

**Endangered Species Act Section 7(a)(2) Consultation
Biological Opinion And Magnuson-Stevens
Fishery Conservation and Management Act Essential
Fish Habitat Consultation**

**Consultation for the Operation and Maintenance of
10 U.S. Bureau of Reclamation Projects and 2 Related Actions in the
Upper Snake River Basin above Brownlee Reservoir**

**(Revised and reissued pursuant to court order,
American Rivers v. NOAA Fisheries, CV 04-0061-RE (D. Oregon))**

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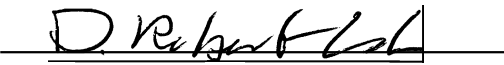
Issued by: 
D. Robert Lohn
Regional Administrator

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Terms and Definitions

Abundance	In the context of salmon recovery, abundance refers to the number of adult fish returning to spawn.
Acre-feet	A common measure of the volume of water in the river system. It is the amount of water it takes to cover one acre (43,560 square feet) to a depth of one foot.
Adaptive Management	The process of adjusting management actions and/or directions based on new information.
Anadromous Fish	Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.
Baseline Monitoring	In the context of recovery planning, baseline monitoring is done before implementation, in order to establish historical and/or current conditions against which progress (or lack of progress) can be measured.
Beverton-Holt Function	This function predicts the number of progeny that will return to spawn from a given number of parental spawners.
Biogeographical Region	An area defined in terms of physical and habitat features, including topography and ecological variations, where groups of organisms have evolved in common.
Broad-Sense Recovery Goals	Goals defined in the recovery planning process, generally by local recovery planning groups, that go beyond the requirements for delisting, to address, for example, other legislative mandates or social, economic, and ecological values.
Compensatory Mortality	Refers to mortality that would have occurred for another reason.
Compliance Monitoring	Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.
Delisting Criteria	Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species.
Demand	The amount of power being used at any given time. Demand in the Northwest is seasonal; with the highest use in the winter for heating and the lowest in the summer.
Density-Independent Survival	A change in survival that is not influenced by the number of fish in the population. Generally speaking, most factors influencing survival after the smolt stage are assumed to be density independent. During the egg-to-smolt stage, the density of adults and juveniles can influence survival as a result of competition for

limited habitat or other factors. For evaluation of survival gaps, estimates of survival changes resulting from actions affecting early life stages of salmon and steelhead are made under the assumption of low density.

Dissolved Gas Level

As falling water hits the river surface, it drags in air as it plunges. With increasing water pressure, the air dissolves into the water and increases the levels of pre-existing dissolved gases.

Distinct population segment (DPS)

A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NOAA Fisheries policy. A population is considered distinct (and hence a “species” for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species’ range.

Diversions

Refers to taking water out of the river channel for municipal, industrial, or agricultural use. Water is diverted by pumping directly from the river or by filling canals.

Diversity

All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

Draft Limit

The lowest level to which a reservoir can be drawn down. The limit is based on rule curves that are calculated on both historic and current streamflow data.

Drafting

The process of releasing water from storage in a reservoir. Operators begin drafting reservoirs—through turbines or over the spillway of a dam—to lower the level for a number of reasons, including flood control or downstream flows for fish or power generation.

Dredging

The act of removing sediment from the river bottom to keep the channel at the proper depth for navigation. The continual moving and shifting of sediment makes dredging an ongoing activity.

Effectiveness Monitoring

Monitoring set up to test cause-and-effect hypotheses about recovery actions: Did the management actions achieve their direct effect or goal? For example, did fencing a riparian area to exclude livestock result in recovery of riparian vegetation?

ESA Recovery Plan

A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1)

objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

Evolutionarily significant unit (ESU)

A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.

Factors For Decline

Five general categories of causes for decline of a species, listed in the Endangered Species Act section 4(a)(1)(b): (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

Fall Chinook Salmon

This salmon stock returns from the ocean in late summer and early fall to head upriver to its spawning grounds, distinguishing it from other stocks which migrate in different seasons.

Fish Guidance Efficiency

Number of fish guided into the bypass system divided by total number passing via the powerhouse (i.e., the combined total for bypass system and turbine passage).

Fish Ladder

A series of stair-step pools that enables salmon to get past the dams. Swimming from pool to pool, salmon work their way up the ladder to the top where they continue upriver.

Fish Passage Efficiency

Number of fish passing the dam via non-turbine routes divided by total number passing the dam by all routes.

Flip Lips

A structural device that redirects water as it comes over the spillway of a dam. Flip lips reduce deep plunging of water into the pool below; keeping the water from becoming supersaturated with nitrogen. Fish are naturally attracted to the rapidly moving water at the base of the dam but can suffer from gas bubble disease when the water is supersaturated with gas.

Flood Control

Streamflows in the Columbia River Basin can be managed to keep water below damaging flood levels in most years. This level of flood control is possible because storage reservoirs on the river can capture and store heavy runoff as it occurs.

Flood Control Rule Curve

The curve is also called the upper rule curve. It establishes the amount of storage space that must be maintained in a reservoir to reduce damaging flood conditions downriver.

Flood Control Storage Space

The space that is provided in a storage reservoir to allow for the capture of runoff that could otherwise cause flood damage.

Flow Augmentation	Water released from system storage at targeted times and places to increase streamflows to benefit migrating salmon and steelhead
Freshet	The heavy runoff that occurs in the river when streams are at their peak flows with spring snowmelt. Before the dams were built, these freshets moved spring juvenile salmon quickly downriver
Functionally Extirpated	Describes a species that has been extirpated from an area; although a few individuals may occasionally be found, they are not thought to constitute a population.
Hyporheic Zone	Area of saturated sediment and gravel beneath and beside streams and rivers where groundwater and surface water mix.
Implementation monitoring	Monitoring to determine whether an activity was performed and/or completed as planned.
Independent population	Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations.
Indicator	A variable used to forecast the value or change in the value of another variable.
Interim regional Recovery plan	A recovery plan that is intended to lead to an ESA recovery plan but that is not yet complete. These plans might address only a portion of an ESU or lack other key components of an ESA recovery plan.
International Joint Commission	Six-person Canada-U.S. board created by the 1909 Boundary Water Treaty to resolve disputes on waters shared by the two nations.
Intrinsic Productivity	The average of adjusted recruits per spawner estimates for only those brood years with the lowest spawner abundance levels.
Kelts	Steelhead that have spawned but may survive to spawn again, unlike most other anadromous fish.
Lambda	Also known as Population growth rate, or the rate at which the number of fish in a population increases or decreases.
Large woody debris (LWD)	A general term for wood naturally occurring or artificially placed in streams, including branches, stumps, logs, and logjams. Streams with adequate LWD tend to have greater habitat diversity, a natural meandering shape, and greater resistance to flooding.
Legacy Effects	Impacts from past activities (usually a land use) that continue to affect a stream or watershed in the present day.

Levees, Flood Walls, & Bank Protection	A levee is a raised embankment built to keep out flood waters. Flood walls, such as the concrete seawall along the Willamette River in downtown Portland, are barriers constructed to hold out high water. The soil on river banks is protected from erosion in a variety of ways. River grasses and trees are cultivated in some areas, and fine mesh screens are laid on banks in other areas to keep soil in place. Rip-rap is also used to protect against fast moving streams or vigorous wave action.
Limiting Factor	Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish at the population, intermediate (e.g., stratum or major population grouping), or ESU levels that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach its desired status.
Locally developed recovery plan	A plan developed by state, tribal, regional, or local planning entities to address recovery of a species. These plans are being developed by a number of entities throughout the region to address ESA as well as state, tribal, and local mandates and recovery needs.
Locks	The key to inland navigation on the Columbia-Snake River Waterway, locks raise and lower ships between pools on the river, i.e., from below a dam to the pool above it. On the trip from the ocean to Lewiston, Idaho, vessels travel from sea level through eight locks to an elevation of over 700 feet.
Major dams	Large hydro-electric projects developed by Federal agencies within the Pacific Northwest. Twenty-nine major dams are in the Columbia River Basin. Two dams are in the Rogue River Basin. A total of 31 dams comprise the Federal Power System.
Management unit	A geographic area defined for recovery planning purposes on the basis of state, tribal or local jurisdictional boundaries that encompass all or a portion of the range of a listed species, ESU, or DPS.
Major population group (MPG)	A group of salmonid populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU.
Megawatts	A measure of electrical power equal to one million watts. Megawatts delivered over an hour are measured in megawatt-hours.
Morphology	The form and structure of an organism, with special emphasis on external features.

Multipurpose Facilities	The Columbia River and the reservoir system are used for many purposes or uses. Projects that were authorized to serve a variety of purposes are referred to as “multipurpose.”
Northern Pikeminnow	A giant member of the minnow family, the Northern Pikeminnow (formerly known as Squawfish) is native to the Columbia River and its tributaries. Studies show a Northern Pikeminnow can eat up to 15 young salmon a day.
Quasi-Extinction Threshold (QET)	This is the point at which a population has become too small to reliably reproduce itself, even though there may be a few fish remaining. Since there is debate about the exact population level at which this condition occurs, several possible levels (50, 30, 10, 1) are considered. Results from short-term quasi-extinction probability modeling are used to help assess near-term (24-year) extinction risk.
Operating Requirements	These are the limits within which a reservoir or dam must be operated. Some requirements are established by Congress when a project is authorized; others evolve with operating experience.
Operating Year	Detailed operations planned over a 12-month period. The operating year begins on August 1 and ends on July 31.
Parr	The stage in anadromous salmonid development between absorption of the yolk sac and transformation to smolt before migration seaward.
Peak Flow	The maximum rate of flow occurring during a specified time period at a particular location on a stream or river.
Phenotype	The external appearance of an organism resulting from the interaction of its genetic makeup and the environment.
Piscivorous	Describes fish that prey on other fish for food.
Population bottlenecks	The most significant limiting factors currently impeding a population from reaching its desired status. Bottlenecks result in the greatest relative reductions in abundance, productivity, spatial distribution, or diversity and are defined by considering viability impairment across limiting life stages and limiting factors.
Productivity	A measure of a population’s ability to sustain itself or its ability to rebound from low numbers. The terms “population growth rate” and “population productivity” are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.
Proposed Action	A proposed action or set of actions
Prospective Actions	Actions from both the FCRPS Biological Assessment and Upper Snake Biological Assessment, August 2007

Reasonable and Prudent Alternative (RPA)	Recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the purposes of the action, that can be implemented consistent with the scope of the Federal agency’s legal authority and jurisdiction, that are economically and technologically feasible, and that the Service believes would avoid the likelihood of jeopardizing the continued existence of the listed species or the destruction or adverse modification of designated critical habitat.
Recovery domain	An administrative unit for recovery planning defined by NOAA Fisheries based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.
Recovery goals	Goals incorporated into a locally developed recovery plan. These goals may go beyond the requirements of ESA de-listing by including other legislative mandates or social values.
Recovery plan supplement	A NOAA Fisheries supplement to a locally developed recovery plan that describes how the plan addresses ESA requirements for recovery plans. The supplement also proposes ESA de-listing criteria for the ESUs addressed by the plan, since a determination of these criteria is a NOAA Fisheries’ decision.
Recovery scenarios	Scenarios that describe a target status for each population within an ESU, generally consistent with TRT recommendations for ESU viability.
Recovery strategy	A statement that identifies the assumptions and logic—the rationale—for the species’ recovery program.
Recruits per spawner	Generally, a population would be deemed to be “trending toward recovery” if average population growth rates (or productivities) are expected to be greater than 1.0.
Redd	A nest constructed by female salmonids in streambed gravels where eggs are deposited and fertilization occurs.
Reservoir Drawdown	The water levels in a reservoir can be lowered, or drawn down, by releases from the dam. These drawdowns have the effect of speeding up the water through a reservoir by decreasing its cross-sectional area.
Resident Fish	Fish that are permanent inhabitants of a water body. Resident fish include trout, bass, and perch.
Riparian area	Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.
River Reach	A general term used to refer to lengths along the river from one point to another, as in the reach from the John Day Dam to the McNary Dam.

Rule Curve	Water levels, represented graphically as curves, that guide reservoir operations.
Runoff	Precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water.
Salmonid	Fish of the family <i>Salmonidae</i> , including salmon, trout, chars, grayling, and whitefish. In general usage, the term usually refers to salmon, trout, and chars.
Smolt	A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt from freshwater to a saltwater environment.
Snowpack	The accumulation of snow in the mountains that occurs during the late fall and winter.
Sound	In order to pass via the spillway of a dam, smolts must dive to locate spillway entrances.
Spatial structure	The geographic distribution of a population or the populations in an ESU.
Spill	Water released from a dam over the spillway instead of being directed through the turbines.
Spill Effectiveness	The proportion of fish passing the spillway divided by the proportion of water spilled.
Spill Efficiency	The total number of fish passing the spillway divided by the total number passing the dam.
Stakeholders	Agencies, groups, or private citizens with an interest in recovery planning, or who will be affected by recovery planning and actions
Stratum/major population group	An aggregate of independent populations within an ESU that share similar genetic and spatial characteristics.
Streamflow	Streamflow refers to the rate and volume of water flowing in various sections of the river. Streamflow records are compiled from measurements taken at particular points on the river, such as The Dalles, Oregon.
Streamflow Records	For over 100 years, water resource managers in the Northwest have maintained records on the seasonal volume and rate of flow in the Columbia River. These historical records are of profound importance to planning system operations each year.
Technical Recovery Team (TRT)	Teams convened by NOAA Fisheries to develop technical products related to recovery planning. TRTs are complemented by planning forums unique to specific states, tribes, or regions, which use TRT and other technical products to identify recovery actions. See SCA Section 7.3 for a discussion of how TRT information is considered in these Biological Opinions.
Temperature Control	By drawing water from different elevations within a reservoir, water temperature can be regulated. This temperature regulation

results in the ability to control the water temperature released from the reservoirs, and the subsequent water temperature downstream.

Threats

Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.

Transmission Grid

The network of high-voltage transmission lines serving the region, carrying power from generating plant to cities.

Turbine

An enclosed rotary type of prime mover that drives an electric generator to produce power.

Viability criteria

Criteria defined by NOAA Fisheries-appointed Technical Recovery Teams based on the biological parameters of abundance, productivity, spatial structure, and diversity, which describe a viable salmonid population (VSP) (an independent population with a negligible risk of extinction over a 100-year time frame) and which describe a general framework for how many and which populations within an ESU should be at a particular status for the ESU to have an acceptably low risk of extinction. See SCA Section 7.3 for a discussion of how TRT information is considered in these Biological Opinions.

Viable salmonid population (VSP)

An independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame. Viability at the independent population scale is evaluated based on the parameters of abundance, productivity, spatial structure, and diversity.

VSP Parameters

Abundance, productivity, spatial structure, and diversity. These describe characteristics of salmonid populations that are useful in evaluating population viability. See NOAA Technical Memorandum NMFS-NWFSC-42, "Viable salmonid populations and the recovery of evolutionarily significant units," McElhany et al., June 2000.

Acronyms and Abbreviations

Action Agencies	U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and the Bonneville Power Administration
AFF	anadromous fish evaluation program
amsl	above mean sea level
B.C.	British Columbia
BIA	Bureau of Indian Affairs
BiOp	Biological Opinion
BLM	Bureau of Land Management
BMPs	Best Management Practices
BON	Bonneville Dam
BPA	Bonneville Power Administration
BRT	Biological Review Team (NOAA Fisheries)
BY	brood years
CBFWA	Columbia Basin Fish and Wildlife Authority
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHARTs	critical habitat analytical review teams
CI	confidence interval
Comanagers	States and Tribes of the Columbia River Basin
COMPASS	Comprehensive Fish Passage
Corps	U.S. Army Corps of Engineers
CR	Columbia River
CRB	Columbia River Basin
CREP	Conservation Reserve Enhancement Program
CRFMP	Columbia River Fishery Management Plan
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CTWSRO	Confederated Tribes of the Warm Springs Reservation of Oregon
CTWS	Confederated Tribes of the Warm Springs
CWA	Clean Water Act
CWMS	Corps Water Management System (database)
CWT	coded-wire tag
D	differential delayed survival of transported fish

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DART	Data Access in Real Time (University of Washington Program)
DDT	dichlorodiphenyltrichloroethane
DIP	demographically independent population
DNR	see WA DNR
DPS	Distinct Population Segment
EDT	ecosystem diagnosis and treatment
EEZ	Exclusive Economic Zone
EF	east fork
EFH	essential fish habitat
EIP	Ecological Improvement Potential
EIS	environmental impact statement
ENSO	El Niño Southern Oscillation
ESA	Endangered Species Act
ESBS	extended-length submersible bar screen
EST	Columbia River estuary
ESU	evolutionary significant unit
FCRPS	Federal Columbia River Power System
FFDRWG	Fish Facility Design Review Work Group
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FGE	fish guidance efficiency
FMEP	Fisheries Management and Evaluation Plan
FPE	fish passage efficiency
FPOM	Fish Passage Operations and Maintenance Coordination Team
FR	Federal Regulation
FRN	Federal Regulation Notice
FS	Forest Service
GBT	gas bubble trauma
GDU	genetic diversity unit
H	High
HCD	Habitat Conservation Diversion
HCP	Habitat Conservation Plan
HCY	Hell's Canyon
HGMP	hatchery and genetic management plan

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HIP	Habitat Improvement Program
HOF	hatchery-origin fish
HSRG	Hatchery Scientific Review Group
HUC	Hydrological Unit Code
HYDROSIM	Hydro Simulation Program
I-205	Interstate Highway 205
I-5	Interstate Highway 5
ICB-TRT	Interior Columbia Basin Technical Recovery Team
ICTRT	Interior Columbia Basin Technical Recovery Team
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IHR	Ice Harbor Dam
IPER	Implementation Plan Evaluation Report
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
ISS	Idaho Supplementation Studies
JDA	John Day Dam
kcfs	thousand cubic feet per second
km²	square kilometers
ksfd	Thousand cubic feet per second days
L	Low
LCFRB	Lower Columbia Fish Recovery Board of the NWPCC
LCR	Lower Columbia River
LGO	Little Goose Dam
LGR	Lower Granite Dam
L-M	Low to Medium
LMN	Lower Monumental Dam
LSRCP	Lower Snake River Compensation Plan
LWD	large woody debris
MAF	million acre-feet
MaSA	major spawning areas
MCN	McNary Dam
MCR	Mid-Columbia River
MFJD	Middle Fork John Day
MHHW	mean higher high water level

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mi/mi²	miles per square mile
MIP	minimum irrigation pool
MiSA	minor spawning areas
MMPA	Marine Mammal Protection Act
MOP	minimum operating pool
MPG	major population group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NF	north fork
NFH	National Fish Hatcheries
NFJDR	North Fork John Day River
ng/g	nanograms per gram
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOF	natural-origin fish
NPMP	Northern Pikeminnow Management Program
NRC	National Research Council
NWF	National Wildlife Federation
NWPCC	Northwest Power and Conservation Council
NWPPC	Northwest Power Planning Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
PA	Proposed Action
PAH	polyaromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	primary constituent element
PCSRF	Pacific Coast Salmon Recovery Fund
PCTS	Public Consultation Tracking System (database)
PDO	Pacific Decadal Oscillation
PECE	“Policy for Evaluation of Conservation Efforts When Making Listing Decisions”
PFMC	Pacific Fishery Management Council
PGE	Portland General Electric

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PIT	passive integrated transponder
POD	point of diversion
ppt	Parts per thousand
PUD	Public Utility District
QET	quasi-extinction threshold
R/S	returns-per-spawner
RFT	reproductive failure threshold
RHCA	riparian habitat conservation area
Rkm	river kilometer
RM	river mile
RM&E	Research, Monitoring, and Evaluation
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RPMs	reasonable and prudent measures
R/S	recruits per spawner
RSW	removable spillway weir
SAR	smolt-to-adult return rate
SASSI	Salmon and Steelhead Stock Inventory
SbyC	separated-by-code
SCA	Supplemental Comprehensive Analysis
SCT	System Configuration Team
SEF	East Fork Salmon River
SF	south fork
SFJD	South Fork John Day
SIMPAS	simulated passage (model)
SR	Snake River
SRPAH	Pahsimeroi River
SRS	sediment retention structure
SRUMA	Salmon River-Upper Mainstem
SRWG	Studies Review Workgroup
SRYFS	Salmon River-Yankee Fork
STS	submersible traveling screen
SWHA	shallow water habitat area
SWCD	Soil and Water Conservation District
SYSTDG	System Total Dissolved Gas (TDG) Model

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T&C	terms and conditions
TDA	The Dalles Dam
TDG	total dissolved gas
TERP	Tower Ecosystem Restoration Projects
TMDL	total maximum daily load
TMT	Technical Management Team
TRT	Technical Recovery Team
TSW	temporary spillway weir
UCM	Unit Characteristic Method
UCR	Upper Columbia River
UCUT	Upper Columbia United Tribes
UNF	Umatilla National Forest
UPA	Updated Proposed Action
URC	upper rule curve
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USRC	Upper Salmon River at Challis Project
USRITAT	Upper Salmon River Interagency Technical Advisory Team
UWR	Upper Willamette River
VARQ	variable (VAR) outflow (Q)
VH	Very High
VL	Very Low
VSP	viable salmonid population
W/LC TRT	Willamette/Lower Columbia TRT
WA DNR	Washington Department of Natural Resources
WCS BRT	West Coast Salmon Biological Review Team
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife
WF	west fork
WNFH	Winthrop National Fish Hatchery
WQT	Water Quality Team

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WRIA water resource inventory area
YN Yakima Nation

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Chapter 1

Background & Consultation History

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Chapter 1

Background & Consultation History

The Endangered Species Act (ESA) (16 U.S.C.A §1531-1544) established a national program for the conservation of threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA (16 U.S.C.A § 1536 (a)(2)) requires Federal agencies to consult with NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of species listed as endangered or threatened, or to adversely modify or destroy their designated critical habitat. This is a Biological Opinion (Opinion) on the likely effects of operating and maintaining 10 U.S. Bureau of Reclamation (Reclamation) irrigation projects and two other actions (Table 1-1) located in the Snake River Basin upstream from Brownlee Reservoir, Idaho (Figure 1-1) on ESA-listed salmon and steelhead.¹ It is the product of an interagency consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations (50 C.F.R § 402).

1.1 Objective

The principal objective of this Biological Opinion is to apply ESA standards to the effects of the U.S. Bureau of Reclamation’s projects in the Snake River basin upstream from Brownlee Reservoir, on thirteen anadromous fish species, that is, salmon and steelhead trout, in the Columbia River Basin. NOAA Fisheries is also considering whether these activities also affect and require consultation for two additional listed species: Southern Resident killer whales and the Southern DPS of green sturgeon.² A secondary objective is to identify, in a written statement, the incidental “take” expected from actions meeting the standards. This includes terms and conditions to minimize such take.

The actions that are evaluated by this Biological Opinion are briefly described in Chapter 2 of this Opinion and fully described in Chapter 2 of the BA (USBR 2007) and its supporting documents. As proposed by Reclamation, this consultation and this Opinion cover Reclamation’s proposed actions from the date this Opinion issues through December 31, 2034. Reclamation’s future actions in the upper Snake are described in its 2007 Upper Snake BA (USBR 2007) and supporting documents. Each proposed action was defined by project facilities that are located within the same drainage and are operationally coordinated as one action. For example, the operations and routine maintenance of the Michaud Flats, Minidoka, Palisades, and Ririe Projects, located above Milner Dam on the Snake

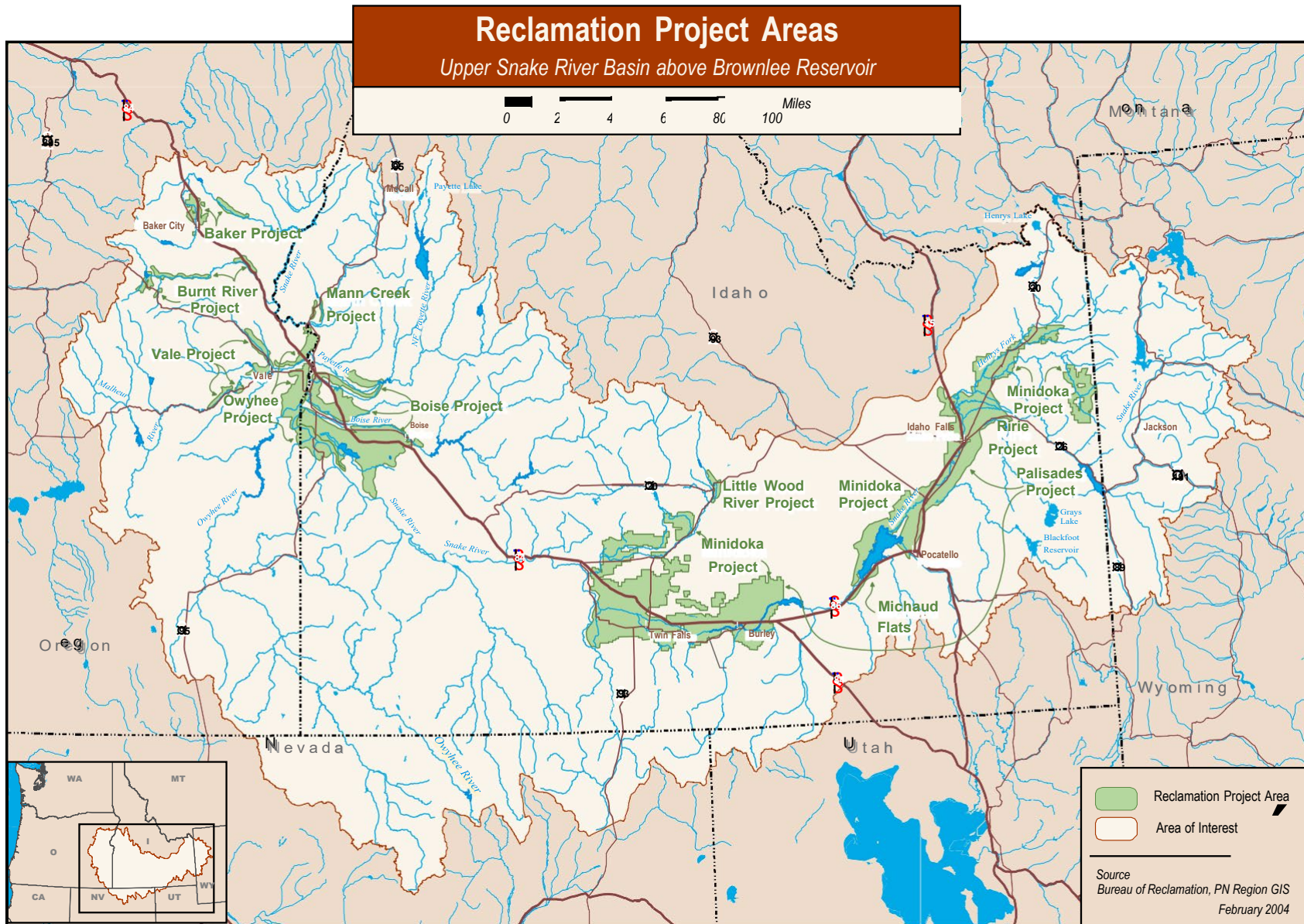
¹For the reasons discussed in Section 3, this Opinion considers the effects of all 12 proposed actions identified in Table 1-1 in the aggregate thereby providing a full and comprehensive evaluation of the significance of those effects on ESA-listed anadromous fish. NOAA Fisheries finds that a delineation of the separate effects of each project is not necessary for this evaluation because the listed species experience the effects of these projects after they combine in the lower Snake River.

² By letter of April 18, 2008 (from Witt Anderson, USACE, to, Robert D. Lohn, NOAA Fisheries), the Action Agencies requested NOAA Fisheries’ concurrence with their determination that killer whale and green sturgeon are not likely to be adversely affected by the Prospective Actions. In support of that determination, the Action Agencies submitted an addendum to their biological assessment (Corps et al. 2008).

River near Twin Falls, Idaho, are defined as one separate action because the operations of these project facilities are coordinated with one another. Similarly, the operations and routine maintenance of the facilities on the Boise drainage (Anderson Ranch, Arrowrock, and Lucky Peak Dams and Reservoirs) are coordinated and are considered a separate action.

Table 1-1. U.S. Bureau of Reclamation's proposed actions. (Source: USBR 2007)

- | |
|---|
| 1. Future operations and routine maintenance (O&M) in the Snake River system above Milner Dam (Michaud Flats, Minidoka, Palisades, and Ririe Projects). |
| 2. Future operations in the Little Wood River system (Little Wood River Project). |
| 3. Future O&M in the Owyhee River system (Owyhee Project). |
| 4. Future O&M in the Boise River system (Arrowrock Division of the Boise Project & the Lucky Peak Project). |
| 5. Future O&M in the Payette River system (Payette Division of the Boise Project). |
| 6. Future O&M in the Malheur River system (Vale Project). |
| 7. Future O&M in the Mann Creek system (Mann Creek Project). |
| 8. Future O&M in the Burnt River system (Burnt River Project). |
| 9. Future O&M in the upper Powder River system (Upper Division of the Baker Project). |
| 10. Future O&M in the lower Powder River system (Lower Division of the Baker Project). |
| 11. Future provision of salmon flow augmentation from the rental or acquisition of natural flow rights. |
| 12. Surveys and studies of ESA-listed aquatic snail species on Snake River above Milner Dam. |



1.2 Previous Consultations

This Opinion is the latest in a series of ESA § 7(a)(2) consultations between NOAA Fisheries and Reclamation on the continued operation and maintenance of its projects in the upper Snake River basin (hereinafter Upper Snake projects) that began with NOAA Fisheries' initial request for consultation in May 1997. That consultation supplemented the 1995 Biological Opinion on the Federal Columbia River Power System (FCRPS) (NMFS 1995a). Under that Opinion, water stored in Reclamation's Upper Snake projects was used to benefit listed anadromous fish by augmenting flows in the Snake and Columbia Rivers. In April 1998 Reclamation submitted a biological assessment for these projects providing greater detail regarding project operations and effects. NOAA Fisheries issued its Opinion in December 1999 supplementing the 1995 Opinion for the Federal Columbia River Power System (NMFS 1999b). This Supplemental Opinion confirmed the 1995 FCRPS Biological Opinion's finding that providing 427 kaf for flow augmentation, when combined with other measures throughout the basin, was adequate to avoid jeopardy to listed Snake River salmon during the interim period (1995 - 1999).

On December 21, 2000 NOAA Fisheries issued a new Biological Opinion on the FCRPS (NMFS 2000b). This Opinion covered operation of the FCRPS for 10 years, and, although it did cover some of Reclamation's irrigation projects in the Columbia Basin, it reserved the Reclamation's operation of its projects in the upper Snake basin for a separate ESA consultation in recognition of then ongoing Idaho water rights negotiations that would affect the operation of those projects.

The Snake River Basin Adjudication (SRBA), a legal proceeding concerning water rights in Idaho State court, included a sub-proceeding for adjudicating the claims of the Nez Perce Indian Tribe for water rights. This, in part, was to support anadromous fish that are the focus of the Tribe's fisheries. In an agreement reached with the Tribe, the United States, the State of Idaho and various other water right holders and users, Reclamation agreed to implement a program of providing water to augment flows in the lower rivers for outmigrating salmon. The provisions of this agreement, the Nez Perce Water Rights Settlement, described in Reclamation's Biological Assessment, §1.4, are to govern Reclamation's operations of its upper Snake projects for a total of thirty years, until December 31, 2034.

In April 2000, Reclamation provided a supplement to its 1998 biological assessment and on May 2, 2001, NOAA Fisheries issued a new Opinion on these projects (NMFS 2001c). The 2001 Biological Opinion was originally issued to cover an interim one-year period, awaiting the SRBA negotiations that were nearing completion. On November 7, 2001, when it was evident that the complex SRBA negotiations would require more time to complete an agreement, Reclamation requested initiation of formal consultation on the continued operation and maintenance of its Upper Snake projects and submitted an amended biological assessment of effects (USBR 2001). The action proposed in the November 7, 2001 consultation was identical to that considered in the 2001 Biological Opinion. After considering the best science available at that time, NOAA Fisheries determined that its previous ESA Section 7(a)(2) determinations continued to be appropriate and, therefore, reissued the 2001

Biological Opinion on January 24, 2002, for an additional three years. Thus, the 2001 Biological Opinion remained in effect through March 31, 2005.

The parties to the SRBA negotiations reached agreement in May, 2004 on the Nez Perce Water Rights Agreement. Consequently, in November 2004 Reclamation issued a new biological assessment for its Upper Snake projects, including the portion of the Nez Perce Water Rights Settlement terms dealing with these projects (Term Sheet of April 20, 2004). NOAA Fisheries issued a new Opinion of the Upper Snake projects on March 31, 2005 covering the 30-year term of the SRBA settlement (NMFS 2005e).

1.3 Court Decision & Remand Instructions

In a suit originally filed to challenge NOAA Fisheries' 2001 Biological Opinion for the Upper Snake projects, the plaintiffs, a coalition of environmental and sportsfishing organizations, submitted an amended complaint on September 29, 2005. This complaint challenged NOAA Fisheries' 2005 Biological Opinion for alleged violations of the Administrative Procedures Act (APA) and ESA (American Rivers v. NOAA Fisheries, CV 04-0061-RE (D. Oregon)). The plaintiffs brought a motion for summary judgment asserting that 1) it was improper to consult on the Upper Snake Projects, for ESA § 7(a)(2), as an action separate from the FCRPS, and 2) NOAA Fisheries' analysis of jeopardy and critical habitat adverse modification was flawed for the same reasons as already found for the ESA consultation for the FCRPS. On May 23, 2006, Judge James Redden ruled that 1) the Upper Snake Projects were a separate action from the FCRPS and could be the subject of its own Biological Opinion, and 2) that NOAA Fisheries' analysis for the ESA § 7(a)(2) standards was arbitrary and capricious for using the same flawed comparative jeopardy analysis used in the FCRPS 2004 Biological Opinion. In particular the Court found that "NOAA's jeopardy analysis in the 2005 upper Snake Biological Opinion did not consider the combined effects of the proposed action and the existing environmental baseline, and thus did not provide the comprehensive review that was required under the ESA" (Opinion and Order, May 23, 2006). In addition, the court concluded that "NOAA must examine whether the effects of the proposed action, together with any cumulative effects, will jeopardize the continued existence of the listed species when added to the environmental baseline. NOAA Fisheries may include the FCRPS in the environmental baseline of Reclamation's proposed action in the upper Snake River, or vice versa. However, only if NOAA Fisheries examines the effects of a Federal action on the listed species and any cumulative effects and the environmental baseline in the aggregate, can the agency insure that a proposed action will not jeopardize the continued existence of the species," *Id.* Pg. 23-24 (emphasis in original).

On September 26, 2006, Judge Redden issued an Opinion and Order of Remand providing details on how Federal defendants must revise the consultation to correct these deficiencies. The Court remanded NOAA Fisheries' 2005 Biological Opinion for the Upper Snake Projects for NOAA Fisheries to apply the standards of ESA § 7 to Reclamation's proposed action and to correct the deficiencies identified in the Court's May 23, 2006 Opinion and Order. The Court also ordered quarterly status reports coinciding with similar reports for the remand for the FCRPS Biological Opinion ordered in *NWF v. NMFS*, CV01-640-RE (D. Oregon). For the first status report the Court

directed NOAA Fisheries to explain how it would “ensure the kind of comprehensive analysis required by the ESA – i.e., a comprehensive analysis consistent with [the Court’s] May 23, 2006 Opinion and Order, which considers the combined effects of the Reclamation Projects and the FCRPS operations on ESA-listed salmon and steelhead” (Opinion and Order of Remand).

1.4 Comprehensive Analysis

The remand consultation on Reclamation’s upper Snake actions coincided with the FCRPS remand. Reclamation based its upper Snake biological assessment on analysis presented in the Comprehensive Analysis of the Federal Columbia River Power System and Mainstem Effects of Upper Snake and Other Tributary Actions (Comprehensive Analysis) (Corps et al. 2007a). Reclamation explains that the Comprehensive Analysis considers “the combined effects of: (a) the operation and maintenance of the FCRPS; and, (b) the operation and maintenance of the Reclamation’s Upper Snake River Projects.” The Comprehensive Analysis also included the mainstem effects of Reclamation’s tributary projects described in Attachment B.1-7 of the FCRPS Biological Assessment in their Comprehensive Analysis, see Appendix B.

The Comprehensive Analysis and Reclamation’s Biological Assessment serve as the starting point for NOAA Fisheries’ consideration of the effects of the Reclamation’s Upper Snake projects. While the Action Agencies’ Comprehensive Analysis evaluates the aggregate effects of (1) the proposed FCRPS actions, (2) the proposed upper Snake actions, (3) the environmental baseline, and (4) cumulative effects, NOAA’s Supplemental Comprehensive Analysis (SCA) further considers additional proposed actions; given the timing and interrelated nature of Columbia River salmon harvest actions with the FCRPS RPA actions, the analysis also encompasses the 2008-2017 *United States v. Oregon* Management Agreement (hereafter 2008 *U.S. v. Oregon* Agreement).

The effects of all of these actions, which NOAA Fisheries refers to in the SCA collectively as the Prospective Actions, are evaluated for the purpose of understanding the effects of these actions when applying the jeopardy and critical habitat standards of ESA § 7(a)(2).

The actions for the FCRPS and the mainstem effects of Reclamation’s tributary projects, comprising a reasonable and prudent alternative (RPA), as well as the effects of the 2008 *U.S. v. Oregon* Agreement, are the subject of a separate Biological Opinions that NOAA Fisheries is issuing at the same time as this Opinion. The effects of the future operation of FCRPS and the mainstem effects of Reclamation’s tributary projects included in the FCRPS actions and as modified by NOAA Fisheries’ RPA, as well as the effects of the 2008 *U.S. v. Oregon* Agreement, are considered part of the environmental baseline in this Biological Opinion. Since the future operations of those projects and that Agreement are future Federal actions they can only be included in the environmental baseline, in accordance with ESA Consultation Regulations (50 C.F.R. § 402.02 “effects of the action”), if they “have already undergone formal or early Section 7 consultation.” The Comprehensive Analysis prepared by the FCRPS Action Agencies, and as supplemented by NOAA Fisheries in the SCA, serves as the formal Section 7 analysis that satisfies the intent of the consultation regulations. The clear intent of those regulations is that NOAA Fisheries not speculate about future Federal actions

when their effects on listed species have not been fully evaluated.³ NOAA Fisheries is reaching its conclusions regarding the effects of Reclamation's projects in the Upper Snake with the benefit of a full evaluation of the effects of the FCRPS and Reclamation's other tributary projects in the Comprehensive Analysis and SCA, as well as with the effects of the 2008 *U.S. v. Oregon* Agreement in the SCA. Similarly, the effects of the future operation and maintenance of Reclamation's upper Snake projects are considered in the environmental baseline for NOAA Fisheries' separate Biological Opinion for the FCRPS and the mainstem effects of Reclamation's other tributary projects, and its separate biological opinion for the 2008 *U.S. v. Oregon* Agreement, again with a full, current understanding of their effects on listed species.

In this Opinion, NOAA Fisheries cites the Comprehensive Analysis where it agrees with the FCRPS Action Agencies' data and analysis. Where NOAA Fisheries has a different judgment or additional data or analysis NOAA Fisheries supplements the Comprehensive Analysis with its Supplemental Comprehensive Analysis. In the event there are inconsistencies between the CA and the SCA, NOAA Fisheries intends for the SCA to control.

1.5 Application of ESA Section 7(a)(2) Standards – Jeopardy & Critical Habitat Analysis Framework

To achieve the objectives of this Biological Opinion, NOAA Fisheries generally uses the five-step approach for applying the ESA Section 7(a)(2) standards to Pacific salmon (originally developed for the 1995 and 2000 FCRPS Biological Opinions). The steps are adapted to conform to current legal authorities as follows:

1. Define the biological requirements and current status of each affected listed species and the conservation role and current function for affected designated critical habitat.
2. Evaluate the relevance of the environmental baseline and activities with cumulative effects, occurring in the action area, to the current status of affected listed species and designated critical habitat.
3. Determine the likely effects of the Prospective Actions on listed species and designated critical habitat.
4. Determine
 - (a) whether the species can be expected to survive with an adequate potential for recovery (e.g. trending toward recovery) under the effects of the action, the effects of the environmental baseline, and any cumulative effects, and

³ See: 51 Federal Register 19926 at 19932 (June 3, 1986).

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(b) whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term under the effects of the action, environmental baseline and any cumulative effects.

(c) If necessary, identify reasonable and prudent alternatives (RPAs) to a proposed or continuing action when that action is likely to jeopardize the continued existence of a listed species or destroy or adversely modify its critical habitat.

Step 1: Define the biological requirements & current status of each listed species & designated critical habitat affected.

With this first step in the analysis, NOAA Fisheries accounts for the principle life history characteristics of each affected listed species. This includes attention to their geographic distribution and population structure as well as their habitat requirements for spawning, rearing and migration to and from the ocean. In particular it is important to understand which attributes are likely to be required to move each species to the point at which ESA measures are no longer necessary, i.e. to recovery. It is equally important to understand the species' requirements for continued survival while maintaining an adequate potential for eventually achieving recovery. As the time required to achieve recovery is significant, the time period for taking the action being evaluated in the consultation is always shorter, typically substantially shorter. For this reason, NOAA Fisheries must evaluate the effects of the action on the process of moving the species toward recovery and the potential for achieving recovery, recognizing that recovery itself is beyond the time frame of the typical consultation under ESA Section 7(a)(2).

Step 2: Evaluate the relevance of the environmental baseline & activities with cumulative effects, occurring in the action area, to the current status of affected listed species & designated critical habitat.

The next step in the analysis concerns the factors for the decline of the species and the ongoing effects on the species and critical habitat from past and present activities plus the expected future effects of actions that are "reasonably certain to occur." Future federal actions are only considered in this analysis if they have been fully evaluated for an ESA Section 7(a)(2) consultation. The relevant scope for this step is the "action area" which is defined to include all areas that are directly or indirectly affected by the action (50 C.F.R. § 402.02). The ongoing effects of activities in the environmental baseline, or those with cumulative effects, may be adverse or beneficial to the species and critical habitat. Understanding the collective effect of these activities on the species will be essential when considering the additional effects of the action in Step 4, below.

This step informs the development of an RPA, if one is necessary. Understanding the threats to the species can focus the efforts to design an action, and any needed mitigation, upon sufficiently reducing risk to the species and to protect or improve the function of critical habitat such that the action can avoid jeopardy and adverse modification of critical habitat. Similarly, the RPA can supplement existing mitigation efforts of others in the environmental baseline and activities with cumulative effects so the RPA can protect and possibly augment those efforts.

Step 3: Determine the likely effects of the Prospective Actions on listed species & designated critical habitat.

In this step NOAA Fisheries evaluates the likely effects of the action, both adverse and beneficial. It determines the nature and extent of those effects and their relevance for the biological requirements and status of the listed species and the conservation role of critical habitat likely to be affected. The timing of the expected effects is an important attribute for the analysis, especially for any mitigation actions where benefits may accrue for the species immediately or, on the other hand, not for some time following implementation. Actions with immediate benefits may be important for species survival while actions with later accruing benefits are important for their recovery potential.

NOAA Fisheries also looks for the certainty that planned actions can and will be implemented by the Action Agency and result in the expected effects. The Action Agency's experience and past success with similar actions will be indicative of certainty. This is particularly true of the Action Agency's ability to obtain annual funding appropriations necessary for the action, especially for actions requiring implementation over multiple years. Where actions are dependent on feasibility investigations or on the decisions of third parties, certainty will be less likely. If mitigation action includes adaptive management, then NOAA Fisheries will evaluate the availability of alternative actions with equivalent benefits in the event the planned mitigation cannot be implemented. Similarly, NOAA Fisheries looks at the interdependence or independence of adverse elements of the action with proposed mitigation. For example, if the adverse effects will not be incurred until after mitigation is in place, the certainty of the mitigation will be less critical.

Step 4: Determine (a) whether the species can be expected to survive with an adequate potential for recovery, e.g. trending toward recovery, under the effects of the proposed or continuing action, the effects of the environmental baseline, & any cumulative effects, & (b) whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near & long term under the effects of the action, environmental baseline & any cumulative effects.

Step 4 calls for a forward looking evaluation of the listed species and critical habitat once the action is implemented and thus added to the ongoing and future effects of the environmental baseline and activities with cumulative effects. It looks at the aggregate of all such effects going forward. The focus of the analysis is on the resulting survival and recovery potential. In particular, NOAA Fisheries identifies the factors limiting improvement in the species' status toward a recovered status and assess whether such limiting factors (considering both biological and listing factor criteria)⁴ will be lessened or eliminated. The listed species must have a high probability of continued survival. NOAA Fisheries considers a short-term extinction risk of less than 5% as constituting a high likelihood of short term survival.

⁴ See "Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance", May 1, 2007, found at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf.

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An adequate potential for recovery is evident when the listed species is on a trend toward eventual recovery. The adequacy of the recovery potential is sensitive to the present obstacles for planning or achieving recovery, as well as to the extent of influence the agency's actions can have on recovery potential considering the action's duration and magnitude of adverse effects on the listed species. Thus, in some clearly articulated circumstances, a resulting recovery potential will be adequate where limiting factors are reduced or protective mechanisms are implemented, as with safety net hatcheries, to position the species for eventual progress to recovery.

NOAA Fisheries' evaluation of the conservation role for affected critical habitat considers, in particular, the support that the habitat provides to the species survival and potential for recovery given the aggregate effects of the environmental baseline, cumulative effects and the action.

The technical methodologies and metrics NOAA Fisheries is using to apply these standards are detailed in Chapter 7.

Step 5: If necessary, identify reasonable & prudent alternatives (RPAs) to a proposed or continuing action when that action is likely to jeopardize the continued existence of a listed species or destroy or adversely modify its critical habitat.

The RPA will have to both reduce or offset the adverse effects associated with the proposed action to a level that does not likely jeopardize the species, and maintain (or restore) essential habitat features so as to not be likely to result in the adverse modification of designated critical habitat. An analysis to determine the sufficiency of the reasonable and prudent alternative will be based on the same considerations described above.

An RPA is defined by the ESA consultation regulations (50 C.F.R. §402.02). An action or program of actions is considered an RPA if it:

1. Can be implemented in a manner consistent with the intended purpose of the action,
2. can be implemented consistent with the scope of the FCRPS Action Agencies' legal authority and jurisdiction,
3. is economically feasible,
4. is technologically feasible,
5. avoids jeopardizing the continued existence of the listed species, and
6. does not result in the destruction or adverse modification of critical habitat.

1.6 Nez Perce Water Rights Settlement

Reclamation's actions in the upper Snake include the provision of flow augmentation to benefit migrating salmon and steelhead. Reclamation has provided flow augmentation to benefit fish since 1991. Longstanding disputes over water allocation were addressed by the 2004 Nez Perce Water Rights Settlement (Settlement) and the Snake River Water Rights Act of 2004 (P.L. 108-447), which includes provisions to allow Reclamation's continued delivery of flow augmentation water for a 30-year period (through 2034).

The Nez Perce Water Rights Settlement was negotiated through adjudication proceedings for the Snake River basin in Idaho, which began in 1987. The Snake River Basin Adjudication (SRBA) is a general adjudication of water rights in Idaho's Snake River basin. During general adjudication, the McCarren Amendment (43 USC 666) requires the Federal government to assert its water right claims for adjudication in State court. In 1993, the United States, as Trustee for the Nez Perce Tribe, and the Tribe in its own behalf, filed water right claims in the SRBA for fish habitat and habitat protection, with a "time immemorial" priority date. The claims involved substantial volumes of water.

After the initial rounds of negotiations failed to produce a settlement, the Court began proceedings on the Federal and Tribal claims in the fall of 1997. In 1998, private objectors to the Tribal claims suggested mediated negotiations, which later resulted in the Nez Perce Water Rights Settlement in May 2004. The United States approved the Settlement as the Snake River Water Rights Act of 2004. Idaho and the Tribe approved the Settlement on March 24, 2005, and March 29, 2005, respectively.

All actions required for full implementation of the Settlement were recently completed and, in accordance with the 2004 Act, the Secretary of the Interior executed a final Statement of Findings: Snake River Water Rights Act in the Federal Register (USDOJ 2007) on May 15, 2007, certifying that all conditions for effectiveness of the agreement have been satisfied including:

- Execution of all necessary documents
- Approval and ratification by Congress and authorization of Federal expenditures
- Approval and ratification by the Idaho State Legislature and enactment of required State legislation
- Ratification by the Nez Perce Tribe
- Issuance of a final judgment and decrees by the SRBA District Court
- Issuance of Biological Opinions for the Snake River Flow component

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The Settlement consists of three components: the Nez Perce Tribal, the Salmon/Clearwater, and the Snake River Flow components. The following summarizes key elements of each component. Appendix A provides more information about the Settlement.

The Nez Perce Tribal component addresses the Tribe's consumptive water rights claims on-reservation, provides funds for water development, and resolves other on and near reservation issues. This component gave the Nez Perce Tribe, in conjunction with an intergovernmental board comprised of the Tribe, U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA), NOAA Fisheries, and the State, use of 200,000 acre-feet of water stored in Dworshak Reservoir, located on the North Fork Clearwater River on the Reservation. This water can be used for flow augmentation and temperature control (cooling) in the lower Snake River in August and September. This measure is intended to benefit juvenile and adult fall Chinook and adult steelhead by shaping cool flows into September.

The Salmon/Clearwater component addresses fish habitat protection throughout the Salmon and Clearwater River basins through a cooperative agreement under Section 6 of the ESA that includes adoption of minimum instream flows by the State and establishment of a habitat trust fund. Consequently, the Idaho Water Resource Board now holds in trust for the public, minimum streamflow rights on over 200 rivers, streams, and creeks in the Salmon and Clearwater River basins that the Tribe identified as Tribal Priority Streams for critical spawning and rearing habitat for ESA-listed spring Chinook salmon, steelhead ("A" and "B" run), and fall Chinook salmon. The objective of establishing minimum streamflows is to ensure these streams are not dewatered to a level that impairs spawning and rearing or other ecological functions that support salmon, steelhead, and the aquatic environment.

Another element is the contribution by the United States of \$38 million (in 2004 dollars) over the course of 5 years, beginning in 2007, for a habitat trust fund to implement fish and habitat protection projects. The purpose of the fund is to supplement monies otherwise available for habitat protection and restoration in the Salmon and Clearwater River basins. Congress has appropriated the 2007 dollars. The out-year funding is anticipated to be appropriated on an annual basis.

The Snake River Flow component addresses flows from the Snake River upstream of Brownlee Reservoir and the conditions for use of water for flow augmentation. The proposed actions described in Reclamation's 2004 Upper Snake BA and its 2007 Upper Snake BA are consistent with the terms of the Snake River Flow component of the Settlement. Of significance to Reclamation's upper Snake flow augmentation activities, the Settlement increases the probability of delivering 427,000 acre-feet of flow augmentation water. Prior to the SRBA and the Nez Perce Water Rights Settlement, Idaho law limited the volume of water that could be protected for flow augmentation to 427,000 acre-feet from all sources. In addition, the laws addressing flow augmentation were short-term and were typically renegotiated every few years or annually. Under the Settlement, Idaho Code § 42-1763B was reenacted to authorize the rental and protection to the state line of up to 427,000 acre-feet of water annually for flow augmentation from traditional sources for the 30-year term of the agreement (through 2034). It also provided that Reclamation could rent or acquire for protection to the state line

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60,000 acre-feet of water from natural water right holders along the Snake River. Also authorized was the release and protection of water stored in reservoir powerhead space to firm up the ability to provide 427,000 acre-feet. These provisions improve Reclamation's ability to provide water for flow augmentation by increasing the long-term probability of obtaining 427,000 acre-feet, and in some years providing as much as 487,000 acre-feet, and by minimizing the uncertainties related to the ability to protect the water in accordance with State law.

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Chapter 2

Proposed Actions

2.1 Term of this Biological Opinion

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Chapter 2

Proposed Actions

The U.S. Bureau of Reclamation proposes to undertake 12 separate Federal actions in the Snake River basin upstream from Brownlee Reservoir and has chosen, as a matter of administrative convenience, to address all 12 proposed actions in a single consultation process. In turn, Reclamation has requested that NOAA Fisheries, as permitted by 50 C.F.R §402.14(c) issue a single Biological Opinion regarding all 12 proposed actions to the extent formal consultation is required by law. The 12 proposed actions are:

- Future operations and routine maintenance (O&M) in the Snake River system above Milner Dam (Michaud Flats, Minidoka, Palisades, and Ririe Projects).
- Future operations in the Little Wood River system (Little Wood River Project).
- Future O&M in the Owyhee River system (Owyhee Project).
- Future O&M in the Boise River system (Arrowrock Division of the Boise Project and the Lucky Peak Project).
- Future O&M in the Payette River system (Payette Division of the Boise Project).
- Future O&M in the Malheur River system (Vale Project).
- Future O&M in the Mann Creek system (Mann Creek Project).
- Future O&M in the Burnt River system (Burnt River Project).
- Future O&M in the upper Powder River system (Upper Division of the Baker Project).
- Future O&M in the lower Powder River system (Lower Division of the Baker Project).
- Future provision of salmon flow augmentation from the rental or acquisition of natural flow rights.
- Surveys and studies of ESA-listed aquatic snail species on Snake River above Milner Dam.

Each proposed action is defined by project facilities (Figure 2-1 and Tables 2-1, 2-2, and 2-3) that are located within the same drainage and are operationally coordinated as one action. For example, the operations and routine maintenance of the Michaud Flats, Minidoka, Palisades, and Ririe Projects, located above Milner Dam on the Snake River near Twin Falls, Idaho, are defined as one separate action because the operations of these project facilities are coordinated with one another. Similarly,

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the operations and routine maintenance of the facilities on the Boise drainage (Anderson Ranch, Arrowrock, and Lucky Peak Dams and Reservoirs) are coordinated and are considered a separate action.

The upper Snake proposed actions include the following activities:

- Future storage of water in reservoirs and its release from dams that the United States owns (Table 2-1). Storage and releases occur in accordance with authorized project purposes, Reclamation contracts, Federal law, and state water law.
- Future diversion or pumping of water into facilities that Reclamation owns or operates (Table 2-2).
- Future hydropower generation at Reclamation's powerplants (Table 2-3).
- Future routine maintenance activities at dams, reservoirs, on-stream diversion structures and pumping plants, and Reclamation hydropower plants, regardless of whether the operation and maintenance responsibility has been transferred to another entity.
- Future provision of salmon flow augmentation by acquiring water through rental pools and leasing or acquiring natural flow rights consistent with the Nez Perce Water Rights Settlement.
- Surveys of ESA-listed aquatic snails below Minidoka Dam.
- Future O&M in the lower Powder River system (Lower Division of the Baker Project).
- Future provision of salmon flow augmentation from the rental or acquisition of natural flow rights.
- Surveys and studies of ESA-listed aquatic snail species on Snake River above Milner Dam.



Figure 2.1. Features and facilities for Bureau of Reclamation projects in the Snake River basin above Brownlee Reservoir.

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Table 2-1. Federal storage facilities included in the proposed actions.

Storage Facility ¹	Stream and River Mile	Active Capacity ² (acre-feet)	Powerplant Owner	Operating and Maintaining Entity
Minidoka Project				
Jackson Lake Dam	Snake River 988.9	847,000	No powerplant	Reclamation
Grassy Lake Dam	Grassy Creek 0.5	15,200	No powerplant	Fremont-Madison Irrigation District
Island Park Dam	Henry Fork 91.7	135,205	Non-Federal	Fremont-Madison Irrigation District
American Falls Dam	Snake River 714.0	1,672,590	Non-Federal	Reclamation
Minidoka Dam	Snake River 674.5	95,200	Reclamation	Reclamation
Palisades Project				
Palisades Dam	Snake River 901.6	1,200,000	Reclamation	Reclamation
Ririe Project				
Ririe Dam	Willow Creek 20.5	80,541	No powerplant	Reclamation
Little Wood River Project				
Little Wood River Dam	Little Wood River 78.8	30,000	Non-Federal	Little Wood River Irrigation District
Owyhee Project				
Owyhee Dam	Owyhee River 28.5	715,000	Non-Federal	Owyhee Irrigation District
Boise Project				
Anderson Ranch Dam	S F Boise River 43.5	413,074	Reclamation	Reclamation
Arrowrock Dam	Boise River 75.4	272,224	No powerplant	Reclamation
Hubbard Dam	New York Canal	1,177	No powerplant	Boise Project Board of Control
Deer Flat Dams	New York Canal	159,365	No powerplant	Boise Project Board of Control
Deadwood Dam	Deadwood River 18.0	153,992	No powerplant	Reclamation
Cascade Dam	N F Payette River 38.6	646,461	Non-Federal	Reclamation
Lucky Peak Project				
Lucky Peak Dam ⁴	Boise River 64.0	264,371	Non-Federal	Army Corps of Engineers
Vale Project				
Warm Springs Dam ⁵	Malheur River 114.0	169,714	No powerplant	Warm Springs Irrigation District
Agency Valley Dam	N F Malheur River 15.0	59,212	No powerplant	Vale Oregon Irrigation District
Bully Creek Dam	Bully Creek 12.5	23,676	No powerplant	Vale Oregon Irrigation District
Mann Creek Project				
Mann Creek Dam	Mann Creek 13.2	10,900	No powerplant	Mann Creek Irrigation District
Burnt River Project				
Unity Dam	Burnt River 63.6	24,970	No powerplant	Burnt River Irrigation District
Baker Project				
Mason Dam	Powder River 122.0	90,540	No powerplant	Baker Valley Irrigation District
Thief Valley Dam	Powder River 70.0	13,307	No powerplant	Lower Powder River Irrigation District

1 Reclamation owns all facilities unless otherwise indicated

2 Active capacity is the volume of storage space that can be filled and released for specific purposes

3 The Little Wood River Irrigation District owns the Little Wood River Dam

4 The Army Corps of Engineers owns Lucky Peak Dam; Reclamation administers water service and repayment contracts for irrigation

5 Reclamation has a one-half interest in Warm Springs Reservoir and associated storage

Table 2-2. Federal diversion facilities included in the proposed actions.

Diversion Facility	Stream	Owner	Operating and Maintaining Entity
Minidoka Project			
Cascade Creek Diversion Dam	Cascade Creek	United States	Fremont-Madison Irrigation District
Minidoka Northside Headworks	Snake River	United States	Minidoka Irrigation District
Minidoka Southside Headworks	Snake River	United States	Burley Irrigation District
Unit A Pumping Plant	Snake River	United States	A & B Irrigation District
Milner-Gooding Canal Headworks	Snake River	United States	American Falls Reservoir District No. 2
Michaud Flats Project			
Falls Irrigation Pumping Plant	Snake River	United States	Falls Irrigation District
Owyhee Project			
Tunnel No. 1	Owyhee River	United States	Owyhee Irrigation District
Dead Ox Pumping Plant	Snake River	United States	Owyhee Irrigation District
Ontario-Nyssa Pumping Plant	Snake River	United States	Ontario-Nyssa and Owyhee Irrigation Districts
Gem Pumping Plants #1 and #2	Snake River	United States	Gem Irrigation District
Boise Project			
Boise River Diversion Dam	Boise River	United States	Boise Project Board of Control *
Black Canyon Diversion Dam	Payette River	United States	Reclamation
Vale Project			
Harper Diversion Dam	Malheur River	United States	Vale Oregon Irrigation District
Bully Creek Diversion Dam	Bully Creek	United States	Vale Oregon Irrigation District
Mann Creek Project			
Mann Creek Dam Outlet	Mann Creek	United States	Mann Creek Irrigation District
Baker Project			
Savely Dam and Lilley Pumping Plant	Powder River	United States	Lower Powder River Irrigation District

* The Boise Project Board of Control operates and maintains the dam. Reclamation operates and maintains the powerplant.

Table 2-3. Federal powerplants included in the proposed actions.

Powerplant	Stream	Impoundment	Nameplate Rating
Palisades Powerplant	Snake River	Palisades Dam	176,600 kW
Inman and Minidoka Powerplants	Snake River	Minidoka Dam	28,500 kW
Anderson Ranch Powerplant	South Fork Boise River	Anderson Ranch Dam	40,000 kW
Boise River Diversion Powerplant	Boise River	Boise River Diversion Dam	1,500 kW
Black Canyon Powerplant	Payette River	Black Canyon Diversion Dam	8,000 kW

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Detailed descriptions of each of these proposed actions are included in Reclamation's 2007 BA and its supporting documents (USBR 2007, USBR 2004a, USBR 2004b, and Schmidt 2005), which NOAA Fisheries hereby incorporates by reference.

2.1 Term of this Biological Opinion

In accordance with Nez Perce Water Rights Settlement Agreement, this consultation covers the period from the date of issuance through December 31, 2034.

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Chapter 3

Species & Critical Habitat Affected

- 3.1 Salmonid Species Affected by the Proposed Action & their Rangewide Status**
- 3.2 Other Species Affected by the Proposed Action & their Rangewide Status**
- 3.3 Rangewide Status of Designated Critical Habitat**
- 3.4 Designated Critical Habitat for Southern Resident Killer Whales**
- 3.5 Designated Critical Habitat for Green Surgeon**

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Chapter 3 Species & Critical Habitat Affected

3.1 Salmonid Species Affected by the Proposed Action & their Rangewide Status

This consultation considers whether the anticipated effects of Reclamation's proposed action are likely to jeopardize the continued existence of 13 listed species of Columbia basin salmonids or cause the destruction or adverse modification of their designated critical habitats. The 13 species are:

Chinook Salmon (*Oncorhynchus tshawytscha*)

ESU	ESA Listing Status	ESA Critical Habitat
Snake River (SR) spring/summer Chinook salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Critical habitat designated on October 25, 1999 [NMFS 1999a]
Snake River (SR) fall Chinook salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Critical habitat designated on December 28, 1993 [NMFS 1993]
Upper Columbia River (UCR) spring Chinook salmon	Listed as endangered on June 28, 2005 [NMFS 2005a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]
Upper Willamette River (UWR) Chinook salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]
Lower Columbia River (LCR) Chinook salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]

Steelhead (*Oncorhynchus mykiss*)

ESU	ESA Listing Status	ESA Critical Habitat
Snake River (SR) steelhead	Listed as threatened on January 5, 2006 [NMFS 2006a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]
Upper Columbia River (UCR) steelhead	Listed as endangered on June 13, 2007 [Court decision]	Critical habitat designated on September 2, 2005 [NMFS 2005b]
Middle Columbia River (MCR) steelhead	Listed as threatened on January 5, 2006 [NMFS 2006a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]

Steelhead (*Oncorhynchus mykiss*) Continued

ESU	ESA Listing Status	ESA Critical Habitat
Upper Willamette River (UWR) steelhead	Listed as threatened on January 5, 2006 [NMFS 2006 a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]
Lower Columbia River (LCR) steelhead	Listed as threatened on January 5, 2006 [NMFS 2006 a]	Critical habitat designated on September 2, 2005 [NMFS 2005b]

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Chum Salmon (*Oncorhynchus keta*)

ESU	ESA Listing Status	ESA Critical Habitat
Columbia River (CR) chum salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Habitat designated on September 2, 2005 [NMFS 2005b]

Sockeye Salmon (*Oncorhynchus nerka*)

ESU	ESA Listing Status	ESA Critical Habitat
Snake River (SR) sockeye salmon	Listed as endangered on June 28, 2005 [NMFS 2005a]	Critical habitat designated on December 28, 1993 [NMFS 1993]

Coho Salmon (*Oncorhynchus kisutch*)

ESU	ESA Listing Status	ESA Critical Habitat
Lower Columbia River coho salmon	Listed as threatened on June 28, 2005 [NMFS 2005a]	Critical habitat designation under development

3.2 Other Species Affected by the Proposed Action & their Rangewide Status

Reclamation has requested NOAA Fisheries' concurrence that its proposed action may affect but is not likely to adversely affect killer whale (*Orcinus orca*) and green sturgeon (*Acipenser medirostris*).

Killer Whales (*Orcinus orca*)

ESU	ESA Listing Status	ESA Critical Habitat
Southern Resident DPS Killer Whales	Listed as endangered on November 18, 2005 [NMFS 2005d]	Critical habitat designation on November 29, 2006 [NMFS 2006c]

Green Sturgeon (*A. medirostris*)

ESU	ESA Listing Status	ESA Critical Habitat
Southern DPS of Green Sturgeon	Listed as endangered on April 7, 2006 [NMFS 2006d]	Critical habitat designation under development

3.3 Rangewide Status of Designated Critical Habitat for Salmonids

NOAA Fisheries has designated critical habitat for 12 of the 13 salmon and steelhead species that would be affected by the FCRPS and Upper Snake prospective actions.¹ Critical habitat includes the stream channel within each designated stream reach with the lateral extent defined by the ordinary

¹ NOAA Fisheries has not yet developed a critical habitat designation for LCR coho salmon.

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high-water line. Within these areas, the primary constituent elements (PCEs) essential for the conservation of the listed species are those sites and habitat components that support one or more life stages. The PCEs for three species of SR salmon are shown in Table 3.2-1, below. The PCEs for nine other species of Columbia basin salmon and steelhead are described in the paragraphs following Table 3.2-1

Table 3.2-1. PCEs identified for SR Sockeye, spring/summer Chinook, and fall Chinook Salmon (NMFS 1993).

Habitat Component	Sockeye	Spring/Summer Chinook	Fall Chinook
Spawning & juvenile rearing areas	1) spawning gravel 2) water quality 3) water quantity 4) water temp. 5) food 6) riparian veg. 7) access	1) spawning gravel 2) water quality 3) water quantity 4) cover/shelter 5) food 6) riparian veg. 7) space	Same as spr/sum Chinook
Juvenile migration corridors	1) substrate 2) water quality 3) water quantity 4) water temp. 5) water velocity 6) cover/shelter 7) food 8) riparian veg. 9) space 10) safe passage	Same as sockeye	Same as sockeye
Areas for growth & development to adulthood	Ocean areas – not identified	Same as sockeye	Same as sockeye
Adult migration corridors	1) substrate 2) water quality 3) water quantity 4) water temp. 5) water velocity 6) cover/shelter 7) riparian veg. 8) space 9) safe passage	Same as sockeye	Same as sockeye

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NMFS (2005b) has identified the following PCEs for the nine other species of Columbia basin salmonids.²

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.
2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival.
3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.

At the time of the critical habitat designations that became final in September of 2005, NOAA Fisheries' Critical Habitat Analytical Review Teams (CHARTs) rated 525 occupied watersheds in the

² A fifth category in NMFS (2005b), "nearshore marine areas," refers to areas designated in Puget Sound (i.e., is not applicable to Columbia basin salmonids).

Columbia River basin. The CHARTs gave each of these occupied watersheds a high, medium, or low rating. High-value watersheds are those with a high likelihood of promoting conservation, while low value watersheds are expected to contribute relatively little. Conservation value was determined by considering the factors listed in Table 3.2-2 below.

Table 3.2-2. Factors considered by Columbia Basin CHARTs to determine the conservation value of occupied HUC-5s.

Factors	Considerations
PCE quantity	Total stream area or number of reaches in the HUC-5 where PCEs are found; compares to both distribution in other HUC-5s and to probable historical quantity within the HUC-5
PCE quality – current condition	Existing condition of the quality of PCEs in the HUC-5
PCE quality - potential condition	Likelihood of achieving PCE potential in the HUC-5, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility
PCE quality - support of rarity/importance	Support of rare genetic or life history characteristics or rare/important types in the HUC-5
PCE quantity - support of abundant populations	Support of variable-sized populations relative to other HUC-5s and the probably historical levels in the HUC-5
PCE quality - support of spawning/rearing	Support of spawning or rearing of varying numbers of populations (i.e., different run-timing or life history types within a single ESU and or different ESUs)

Of the 525 watersheds evaluated, 382 were assigned a high rating, 93 a medium rating, and 50 a low rating. The CHART ratings do not address SR spring/summer Chinook salmon, SR fall Chinook salmon, or SR sockeye salmon because critical habitat was designated for these ESUs in 1993. Ratings for the LCR coho salmon ESU are under development.

Many factors, both human-caused and natural, have contributed to the decline of salmon over the past century. Salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. Thus, critical habitat is not able to serve its conservation role in its current condition in many of the designated watersheds. Factors limiting the functioning of PCEs and thus the conservation value of critical habitat are discussed for each species in Chapter 8 of the Supplemental Comprehensive Analysis.

3.4 Designated Critical Habitat for Southern Resident Killer Whales

NOAA Fisheries published the final designation of critical habitat November 29, 2006 (NMFS 2006l). Critical habitat consists of three specific areas (1) the Summer Core Area in Haro Strait and waters

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around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprise approximately 2,560 square miles of marine habitat. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified the following physical or biological features (i.e., PCEs) essential to conservation: (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging.

Factors limiting the functioning of PCEs and thus the conservation value of critical habitat are water quality (Puget Sound); prey quantity, quality, and availability (throughout portions of the designated area used for foraging); and impediments to passage between areas used for foraging and other activities (e.g., the presence of vessels).

3.5 Designated Critical Habitat for Green Sturgeon

NOAA Fisheries has not yet designated critical habitat for this species.

Chapter 4

Action Area

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Chapter 4

Action Area

The action area defines the geographic scope of the environmental baseline and cumulative effects that are relevant to a particular consultation. It includes all areas affected directly or indirectly by the Federal action, not merely the immediate area involved in the action (50 C.F.R §402.02). The action area is not delineated by the migratory range of the species affected by the project. Thus the action area would not include areas to which affected fish migrate but which are otherwise unaffected by the action. NOAA Fisheries defines the action area for this Opinion as:

- Henrys Lake and the Henrys Fork from Henrys Lake downstream to its confluence with the Snake River (Henrys Lake is not part of the proposed action, but its operations are coordinated with Reclamation's facilities).
- Cascade Creek downstream from Cascade Creek Diversion Dam to its confluence with Grassy Creek.
- Grassy Lake and Grassy Creek from Grassy Lake Dam downstream to its confluence with the Falls River, and the Falls River downstream to its confluence with the Henrys Fork.
- Ririe Reservoir and Willow Creek from Ririe Dam to its confluence with the Snake River.
- Jackson Lake.
- Little Wood River Reservoir and the Little Wood River from the Little Wood River Dam downstream to its confluence with the Snake River.
- Owyhee Reservoir and the Owyhee River from Owyhee Dam downstream to its confluence with the Snake River.
- Anderson Ranch Reservoir and the South Fork Boise River from Anderson Ranch Dam downstream to its confluence with the Arrowrock Reservoir.
- Arrowrock Reservoir and the Boise River from Arrowrock Reservoir downstream to its confluence with the Snake River.
- Lake Lowell.
- Payette Lake and the North Fork Payette River from Payette Lake downstream to its confluence with the Payette River, including Lake Cascade (Payette Lake is not a part of the proposed action, but its operations are coordinated with Reclamation's facilities).
- Deadwood Reservoir and the Deadwood River from Deadwood Dam downstream to its confluence with the South Fork Payette River.

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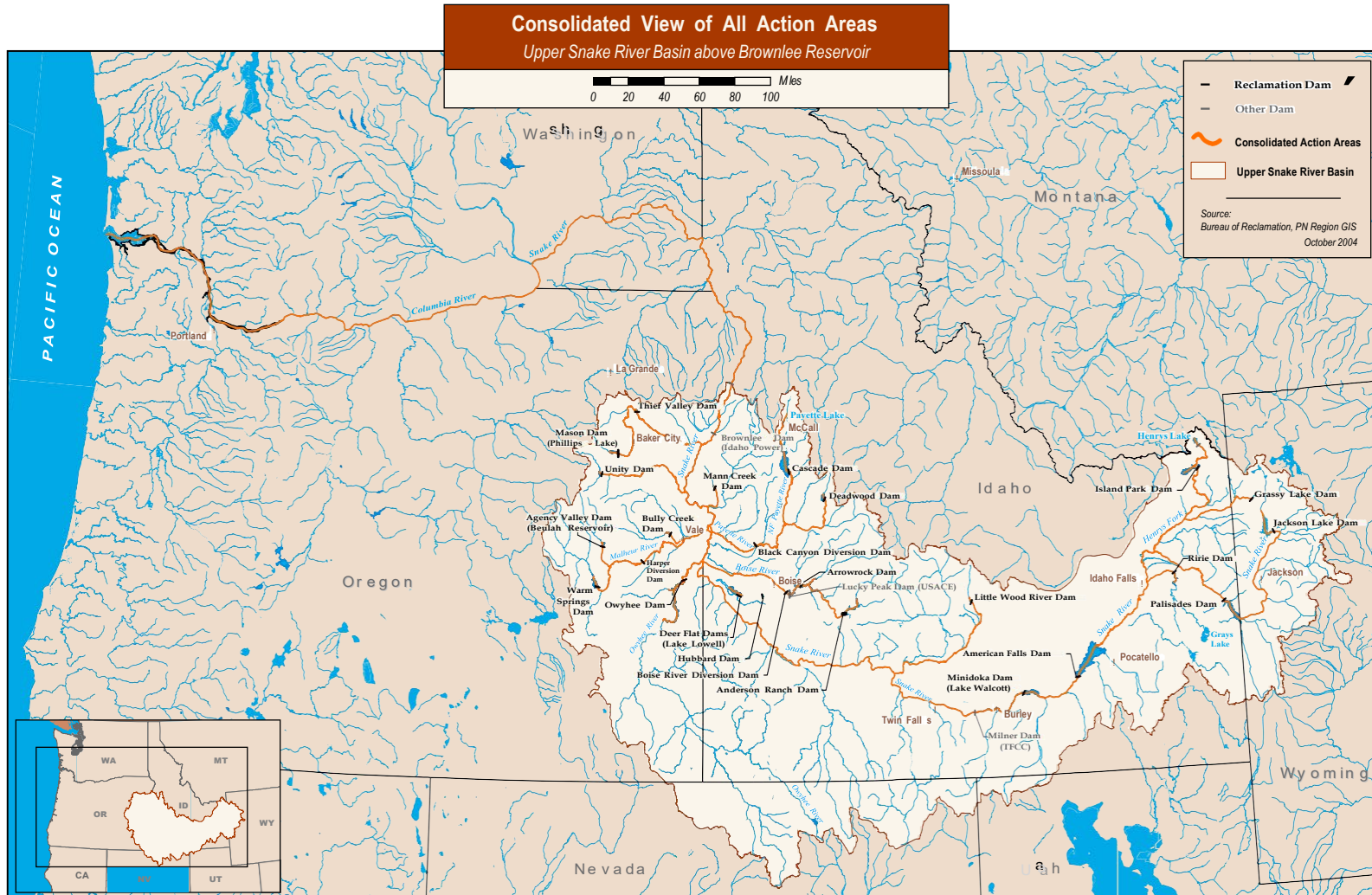
- The South Fork Payette River from its confluence with the Deadwood River downstream to its confluence with the North Fork Payette River.
- The Payette River from its confluence with the North Fork Payette River and South Fork Payette River downstream to its confluence with the Snake River.
- Beulah Reservoir and the North Fork Malheur River downstream from Agency Valley Dam to its confluence with the Malheur River.
- Bully Creek Reservoir and Bully Creek downstream from Bully Creek Diversion Dam to its confluence with the Malheur River.
- Warm Springs Reservoir and the Malheur River downstream from Warm Springs Dam to its confluence with the Snake River.
- Mann Creek Reservoir and Mann Creek downstream from Mann Creek Dam to its confluence with the Weiser River.
- The Weiser River from its confluence with Mann Creek downstream to its confluence with the Snake River.
- Unity Reservoir and the Burnt River from Unity Dam downstream to its confluence with the Snake River.
- Phillips Lake and the Powder River downstream from Mason Dam to its confluence with the Snake River.
- Thief Valley Reservoir and the Powder River downstream from Thief Valley Dam to its confluence with the Snake River.
- All land over which Reclamation project water flows until it is consumed or returned to the mainstem Snake River.
- The mainstem Snake River from Jackson Lake downstream to its confluence with the Columbia River.
- The mainstem Columbia River from its confluence with the Snake River to the Columbia River estuary and plume (i.e., nearshore ocean).
- Areas off the Pacific Coast where salmonid species from the Columbia River, which are affected by the USBR projects and programs in the Upper Snake, are available as prey for listed Southern Resident Killer Whales; generally within 50 km of the coast from the river's mouth and plume south to southern Oregon and north to the Queen Charlotte Islands.
- The estuary and nearshore environment affected by water management operations, including the area between the upstream limit of tidal influence at Bonneville Dam (about RM 146), the mouth

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of the Columbia River, and the ocean plume. ESA-listed anadromous fish species currently only occur within the last three designations of these action area elements. It is the effects within these four elements that is the focus of this Opinion.

The action area for this consultation is shown in Figure 4-1.

Figure 4-1. Consolidated View of All Action Areas



Chapter 5

Environmental Baseline

- 5.1 Hydrologic Effect of Upper Snake Projects in the Environmental Baseline**
- 5.2 Biological Effects of Upper Snake Projects in the Environmental Baseline**

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Chapter 5

Environmental Baseline

The environmental baseline includes the effects of past and ongoing human and natural factors, within the action area, leading to the current status of the species, their habitats and ecosystems. In addition, this analysis evaluates the effects on designated critical habitat. The environmental baseline includes: “the past and present impacts of all Federal, state, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of state and private actions that are contemporaneous with the consultation in progress” (50 C.F.R §402.02, “effects of the action”). Thus, the environmental baseline for this Opinion includes the anticipated future effects of the actions included in the concomitant consultation on the FCRPS.

In keeping with the effort to explicitly aggregate the effects of the FCRPS , harvest actions under the *U.S. v. Oregon* Agreement, and Reclamation’s upper Snake River basin projects in rendering its Biological Opinions on these actions, NOAA Fisheries included an extensive discussion of the environmental baseline applicable to all three consultations in the Supplemental Comprehensive Analysis (SCA) for these consultations (NMFS 2008f), which NOAA Fisheries hereby incorporates by reference. Chapter 5 of the SCA briefly identifies and characterizes man-caused effects on listed ESUs throughout the Action Area in the environmental baseline. Below, we briefly describe the effects of Reclamation’s upper Snake projects in the environmental baseline.

5.1 Hydrologic Effect of Upper Snake Projects in the Environmental Baseline

Past operation of Reclamation’s series of storage, diversion, and conveyance facilities in the upper Snake River basin has changed the shape and magnitude of the Snake River hydrograph. Due to tributary inflows and systematic FCRPS operations designed to maintain good survival conditions for migrating fish throughout the migratory corridor, these effects and their influence on fish survival are largest immediately below Hells Canyon Dam and diminish in the downstream direction.

To quantify these effects, Reclamation updated its MODSIM hydrologic simulation model to incorporate currently available data (USBR 2007). MODSIM was then used to simulate mean monthly inflows to Brownlee Reservoir for the 70-year period of record (1929-1998) currently used for regional planning purposes, under current conditions (environmental baseline) and for the theoretical conditions that would exist absent Reclamation’s operations (no Reclamation). This effort demonstrates that under current operations, Reclamation’s operations reduce total Snake River flows at Brownlee by about 2.2 Maf annually, decreasing flows from November through June and increasing flows from July through September (Figure 5-1). Including non-Federal water use, flows in the Snake River at Brownlee reservoir are reduced by about 6.1 Maf annually, primarily for irrigated agriculture (USBR 2007).

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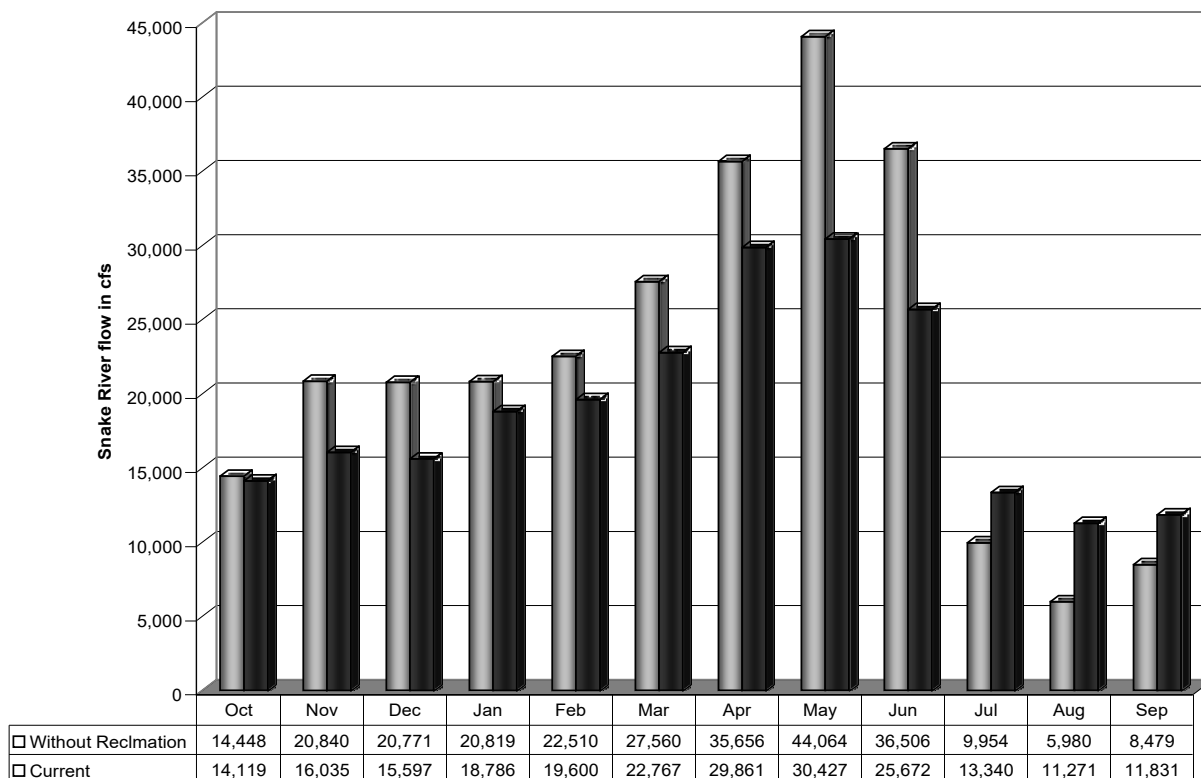


Figure 5-1. Mean monthly Snake River inflow to Brownlee Reservoir (cfs) under the current operation (baseline) and without Reclamation's operations. Sources: USBR 2007, Modsim model runs: Current, Brownlee inflow 2004; Without Reclamation, Brownlee inflow without upper Snake.

BPA's HYDSIM model was used to estimate how these hydrologic effects propagate downstream, assuming that the Hells Canyon Complex (Brownlee, Oxbow, and Hells Canyon dams) was in place and operating under current operating criteria. To illustrate these effects, period average mean monthly flows (1929 – 1998) under current conditions with and without the effects of Reclamation's current operations are presented below for: the Snake River immediately downstream from Hells Canyon Dam (Figure 5-2) and at Lower Granite Dam (Figure 5-3); and the Columbia River at McNary Dam (Figure 5-4) and at Bonneville Dam (Figure 5-5).

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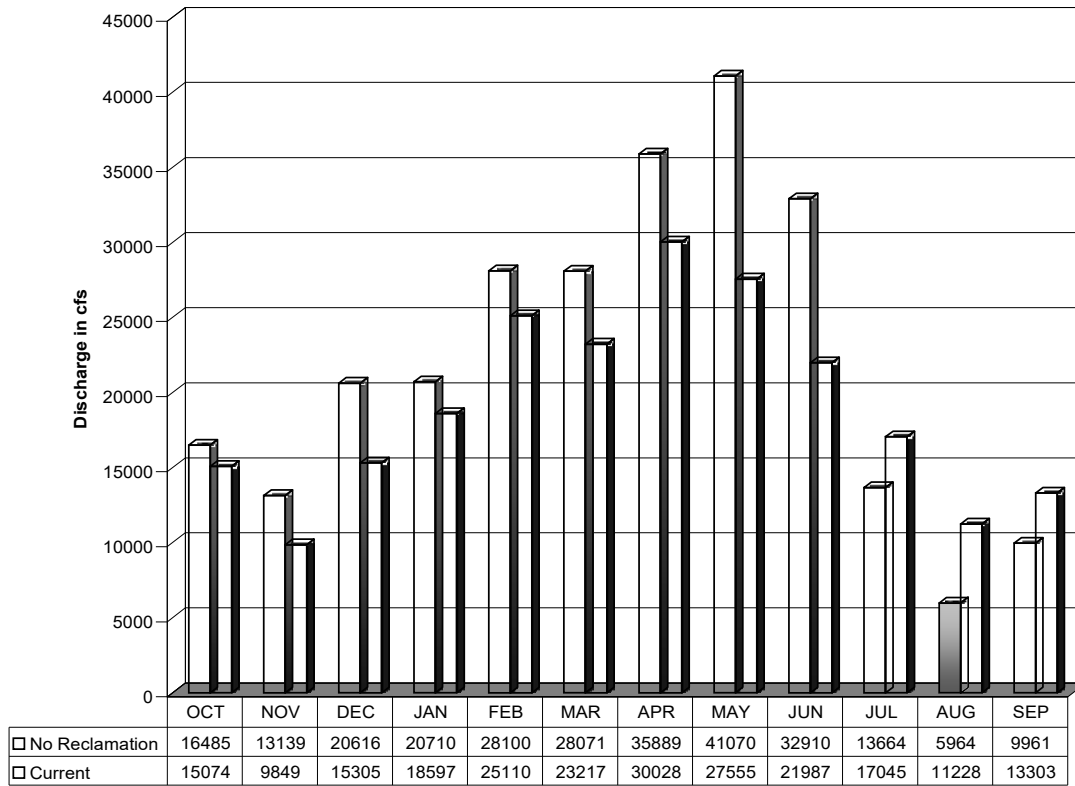


Figure 5-2. Mean monthly Snake River discharge (cfs) below Hells Canyon Dam under the current operation (baseline) and without Reclamation's operations. Sources: Current, BPA HYDSIM model run FRIII_07RemandBase04; No Reclamation, BPA HYDSIM model run FRIII_07DRAFT2007BIOPWITHOUTUPSNAKE.

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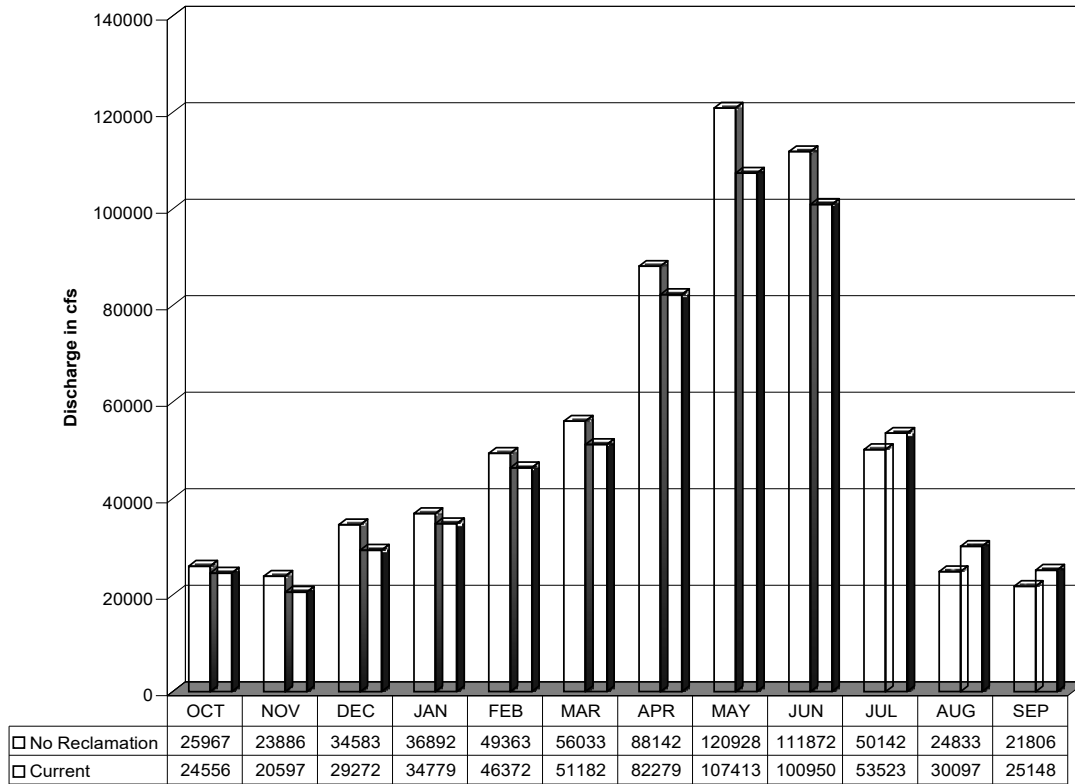


Figure 5-3. Mean monthly Snake River discharge (cfs) at Lower Granite Dam under the current operation (baseline) and without Reclamation's operations. Sources: Current, BPA HYDSIM model run FRIII_07RemandBase04; No Reclamation, BPA HYDSIM model run FRIII_07DRAFT2007BIOPWITHOUTUPSNAKE.

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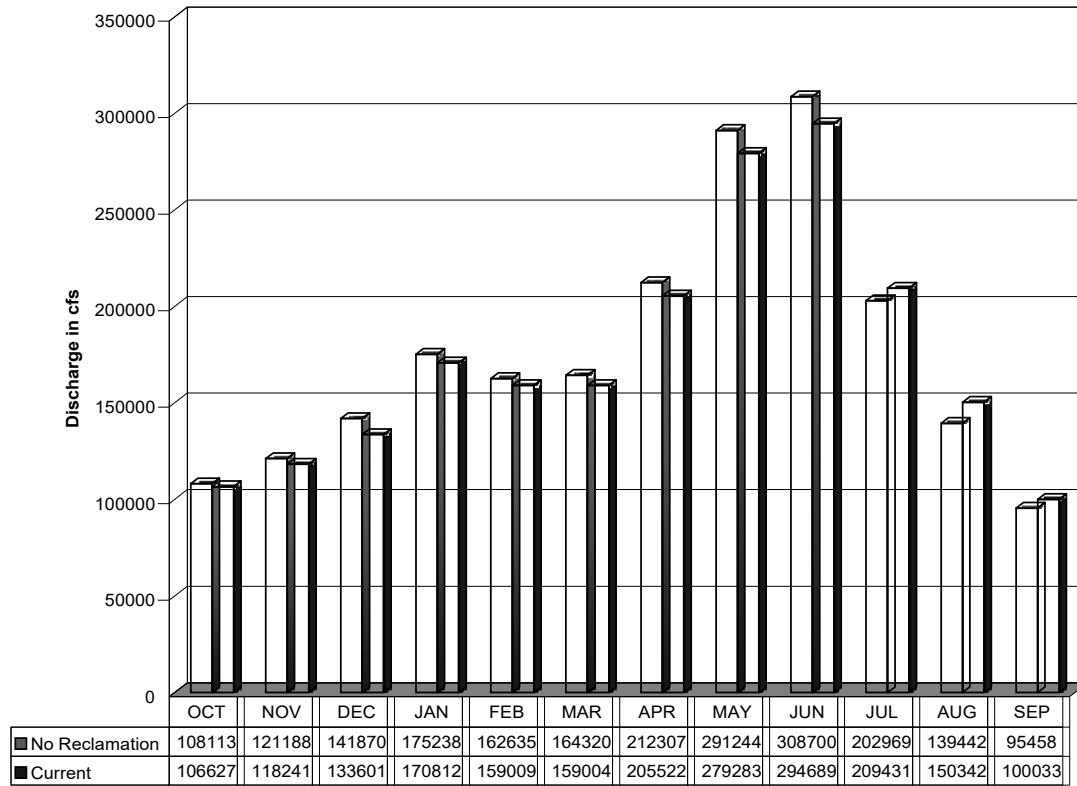


Figure 5-4. Mean monthly Columbia River discharge (cfs) at McNary Dam under the current operation (baseline) and without Reclamation's operations. Sources: Current, BPA HYDSIM model run FRIII_07RemandBase04; No Reclamation, BPA HYDSIM model run FRIII_07DRAFT2007BIOPWITHOUTUPSNAKE.

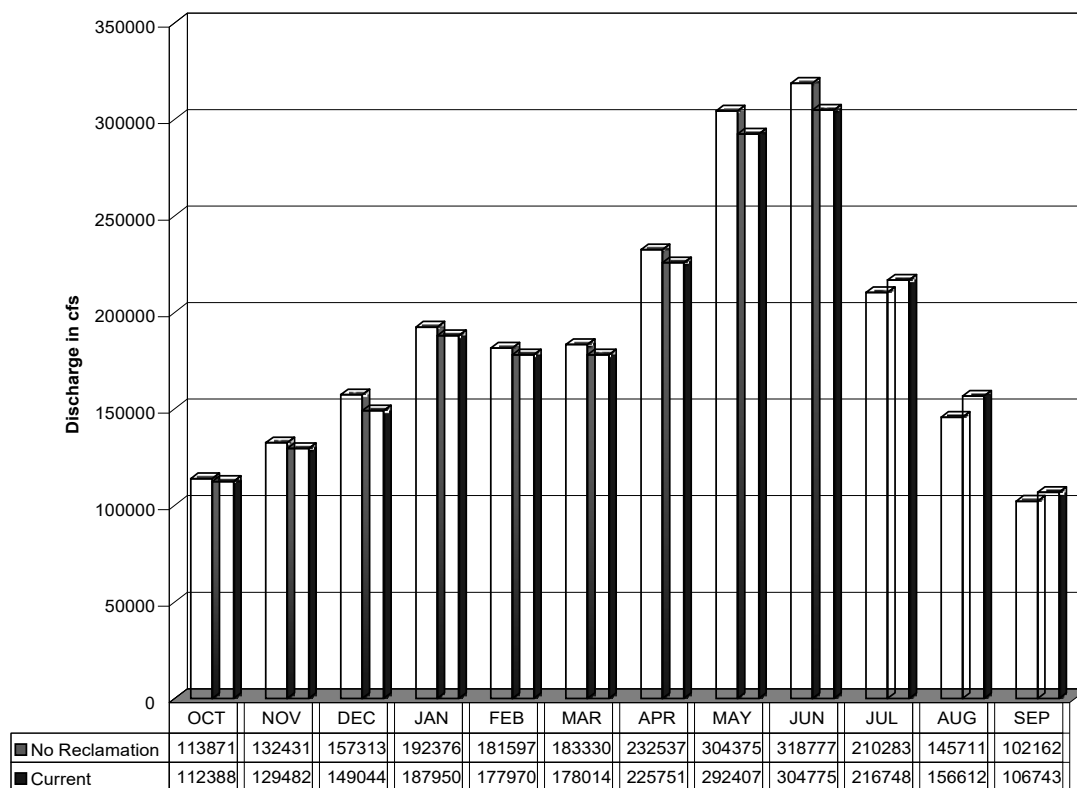


Figure 5-5. Mean monthly Columbia River discharge (cfs) at Bonneville Dam under the current operation (baseline) and without Reclamation's operations. Sources: Current, BPA HYDSIM model run FRIII_07RemandBase04; No Reclamation, BPA HYDSIM model run FRIII_07DRAFT2007BIOPWITHOUTUPSNAKE.

5.2 Biological Effects of Upper Snake Projects in the Environmental Baseline

The hydrologic effects described above affect fish directly by changing conditions in the migratory corridor and can affect fish indirectly by altering flow-dependent dam operations (e.g. spill rates and durations). As can be seen in Figures 5-1 through 5-5, the relative streamflow effects of Reclamation's upper Snake projects decline as one progresses downstream.

To estimate the scale of these effects on fish survival, we used the COMPASS model (NMFS 2008f), In-River Juvenile Survival Appendix) to compare juvenile passage survival and smolt-to-adult return ratios (SARs) for spring migrating juveniles with and without Reclamation's current operations (Table 5-1. Comparison of these two analyses provides estimates of the effects of Reclamation's upper Snake projects on ESA-listed spring-migrants (SR spring-summer Chinook, UCR Chinook, SR steelhead, UCR steelhead, and MCR steelhead) in the environmental baseline. For this analysis, the FCRPS was operated under the Prospective Actions developed for the 2008 FCRPS Opinion for both cases. Results include, in-river survival which estimates the survival rates of fish which migrate through the FCRPS, System Survival, including both in-river

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migrants and fish which are transported by barge, and LGR-LGR SAR which estimates the survival of the population from the time when they pass Lower Granite dam moving downstream as smolts through when they return as adults. The results of the analyses are presented in tables 5-1 and 5-2.

The estimated effects of current operation of Reclamation’s upper Snakes projects on Chinook stocks, both Snake River and Upper Columbia are relatively small both in terms of in-river survival and SAR. There is a larger effect on steelhead survival. Although the hydrologic effects diminish in a downstream direction, impacts on UCR steelhead are larger than the impacts on SR steelhead due to the high proportion of SR steelhead which are collected at Lower Granite Dam and transported through the FCRPS and released downstream from Bonneville Dam, thereby avoiding mortality vectors affecting in-river migrants. Even though Snake River steelhead have a greater decrease in in-river survival than Columbia River Steelhead, the large numbers of transported fish from this stock result in the effect on system survival being small. However, Columbia River Steelhead have no barge transport and suffer between 3.8% and 0.31% reductions in survival due to the effects of the upper Snake projects.

Thus, operation of Reclamation’s upper Snake projects in the environmental baseline has a relatively small adverse effect on fish survival. These effects are included in the aggregate analysis presented in Chapter 8 of the SCA, Greater detail of these analyses are provided in the SCA’s Hydro Modeling Appendix.

Table 5-1. Comparison of survival estimates for juvenile Snake River and Columbia River Chinook passing through the FCRPS with and without the effects of Reclamation’s Upper Snake Projects. System survival includes both in-river migrants and fish which are transported by barge (no barge transport for Columbia River fish).

		In-River Migrant Survival	System Survival	Whole population LGR-LGR Smolt to Adult Returns
Snake River Spring/Summer Chinook				
With Upper Snake Project	70 year water record 1929-1999 Average	0.608	0.868	0.00914
No Upper Snake Project		0.611	0.860	0.00926
absolute change		-0.003	0.008	0.000
Relative change from No Upper Snake Project		-0.5%	0.9%	-1.3%
Upper Columbia Chinook				
With Upper Snake Project	70 year water record	0.726	0.726	0.00767

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		In-River Migrant Survival	System Survival	Whole population LGR-LGR Smolt to Adult Returns
No Upper Snake Project	1929-1999 Average	0.730	0.730	0.00777
absolute change		-0.004	-0.004	0.000
Relative change from No Upper Snake Project		-0.53%	-0.53%	-1.31%

Table 5.2 Comparison of survival estimates for juvenile Snake River and Columbia River Steelhead passing through the FCRPS with and without the effects of the Upper Snake Projects. System survival includes both in-river migrants and fish which are transported by barge (no barge transport for Columbia River fish).

Snake River Steelhead				
With Upper Snake Project	70 year water record 1929-1999 Average	0.385	0.857	0.01801
No Upper Snake Project		0.411	0.858	0.01816
absolute change		-0.026	-0.001	0.000
Relative change from No Upper Snake Project		-6.2%	-0.1%	-0.8%
Upper Columbia Steelhead				
With Upper Snake Project	70	0.528		0.00715
No Upper Snake Project	Average	0.545		0.00746
absolute change		-0.0170		-0.0003
Relative change from No Upper Snake Project		-3.12%		-4.08%
Mid Columbia Steelhead				
<i>Yakima /Walla Walla Stocks</i>				
With Upper Snake Project	70 year water record 1929-1999 Average	0.524		
No Upper Snake Project		0.545		
absolute change		-0.021		

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		In-River Migrant Survival	System Survival	Whole population LGR-LGR Smolt to Adult Returns
Relative change from No Upper Snake Project		-3.82%		
<i>Umatilla/John Day Stocks</i>				
With Upper Snake Project	70 year water record 1929-1999 Average	0.579		
No Upper Snake Project		0.599		
absolute change		-0.020		
Relative change from No Upper Snake Project		-3.28%		
<i>Deschutes Stocks</i>				
With Upper Snake Project	70 year water record 1929-1999 Average	0.768		
No Upper Snake Project		0.773		
absolute change		-0.005		
Relative change from No Upper Snake Project		-0.69%		
<i>Bonneville Pool Stocks</i>				
With Upper Snake Project	70 year water record 1929-1999 Average	0.903		
No Upper Snake Project		0.905		
absolute change		-0.003		
Relative change from No Upper Snake Project		-0.31%		

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Chapter 6

Cumulative Effects

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Chapter 6 Cumulative Effects

During the collaborative effort to develop the 2008 FCRPS Opinion, the states of Oregon, Washington, and Idaho provided information on various ongoing and future or expected projects that are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin (Chapter 17 in Corps et al. 2007a). A number of these projects were described as having a positive effect on the status of Columbia Basin salmonids. All of these actions are either completed, ongoing, or planned with a high likelihood of implementation. They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies.

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Chapter 7

Analytical Methods for Salmonids

- 7.1 Life-cycle analyses to evaluate whether populations are likely to have a sufficiently low short-term extinction risk and are likely to trend toward recovery**
- 7.2 Life-stage and action-specific analyses to support the life-cycle analysis and to estimate incidental take**
- 7.3 Methods for considering population level analysis at ESU/DPS level**
- 7.4 Critical habitat analysis methods**

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Chapter 7

Analytical Methods for Salmonids

These are the methods NOAA Fisheries used to detail how the Prospective Actions identified in Chapter 2 are likely to affect the thirteen listed species of salmon and steelhead of the Columbia River and the critical habitat designated for twelve of those species (please see Chapter 4 for further detail).

Ultimately the purpose of this analysis is to apply the jeopardy and critical habitat degradation standards of ESA § 7(a)(2) as discussed in § 1.7 of the FCRPS Biological Opinion, § 1.5 of the USBR Upper Snake Biological Opinion, and § 1.1 of the 2008-2017 *United States v. Oregon* Management Agreement Biological Opinion. The analysis in this SCA serves the application of those standards in the associated biological opinions. The results of the analysis described in this chapter are presented in Chapter 8 for each listed species of salmon or steelhead.

These species of anadromous fish have similar biological requirements and a hierarchical structure of populations and major population groups (MPGs) that make up the ESA-listed unit (either ESUs or, for steelhead, DPS') as detailed in Chapter 4 (See Figure 4.3-1 for example, and in Chapter 8 for each species). There are also important differences among these listed species that requires that NOAA Fisheries' analytical methods be tailored for the application of the ESA standards. The status of each species varies, the amount of relevant quantitative information available for each varies, and the extent to which the Prospective Actions are likely to affect them also varies. For this reason, NOAA Fisheries divides the thirteen species and their critical habitat into the following groups:

Interior Columbia River species with sufficient data to evaluate relevant quantitative metrics:

- Snake River Spring/Summer Chinook
- Snake River Fall Chinook
- Snake River Steelhead
- Upper Columbia River spring Chinook
- Upper Columbia River steelhead
- Middle Columbia River steelhead

Interior Columbia River species without data sufficient to evaluate relevant quantitative metrics:

- Snake River Sockeye

Lower Columbia River species which are less affected by most Prospective Actions than interior populations:

- Lower Columbia River Chinook

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- Lower Columbia River steelhead
- Lower Columbia River Coho
- Lower Columbia River Chum
- Upper Willamette River Chinook
- Upper Willamette River steelhead

NOAA Fisheries performed a quantitative analysis of the status of the six Interior Columbia River ESUs or DPS' for which there is sufficient empirical data available to support such an analysis. Generally, that analysis evaluated the most relevant empirical data which serves as its base or starting point. Since productivity, trend and extinction risk estimates require multiple years of recent observations, portions of these "base period" observations are influenced by management actions that have been superseded by current management actions and therefore are no longer relevant. The next step in the analysis, therefore, was to adjust the base information to account for changes made to activities affecting the listed fish, such as operations at the dams, since the base period empirical data was gathered. In this way, NOAA Fisheries reaches its judgment about the current status of the listed species derived from what it calls the "base-to-current adjustment." The final phase of the analysis was to further adjust the current status to predict the status of the species that is likely to result from the effects of the Prospective Actions, such as further modifications at the dams, on the current status of these species.

In addition to this quantitative analysis for the six Interior Columbia River listed species, NOAA Fisheries conducted a qualitative analysis further evaluating their status and considering information that cannot be numerically measured or quantified. NOAA Fisheries also conducted a qualitative analysis for the remaining seven listed species.

In particular, this chapter describes:

- Methods for evaluating life-cycle effects at the population level that are applicable to the jeopardy standard (Section 7.1);
- Methods to evaluate action-specific and life-stage-specific effects that contribute to the life-cycle jeopardy analysis (Section 7.2);
- The method for evaluating effects at the MPG and species level (Section 7.3);
- Methods for evaluating effects on critical habitat for the adverse modification analysis (Section 7.4).

Methods for evaluating life-cycle effects at the population level (7.1)

Section 7.1.1 describes quantitative methods applicable to populations of six interior species and Section 7.1.2 describes qualitative methods for the same six species, plus the remaining seven species. The purpose of both the quantitative and the qualitative analyses is to evaluate whether:

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- Short-term extinction risk is sufficiently low to meet the *survival prong* of the jeopardy standard; and whether
- The populations within a species are expected to be on a trend toward recovery, the *potential for recovery prong* of the jeopardy standard.

Within the Section 7.1.1 quantitative analysis, NOAA Fisheries evaluates certain metrics indicative of the survival prong of the jeopardy standard (24-year extinction risk) and indicative of the recovery potential prong (average returns-per-spawner, median population growth rate, and abundance trend). While each metric primarily informs one of the two prongs of the jeopardy standard, each metric contributes to both prongs. For example, a population with high productivity (e.g., average returns per spawner) is less likely to go extinct than one with low productivity.

As described above, this is a three-step process: For each of these metrics, NOAA Fisheries first determines what the values have been over the last two decades (referred to as “base” metrics). Then, because some management actions have changed over this time period, the metrics are adjusted to reflect “current” management practices. Finally, the metrics are further adjusted to reflect new management actions that are included in the Prospective Actions and to represent a range of expectations regarding future climate and other environmental factors.

It is not possible to evaluate the metrics quantitatively for every population of every species, so Section 7.1.2 includes additional qualitative approaches to determine if populations of a species are on a trend to recovery and if they are likely to have a low risk of extinction in the near term. Some qualitative factors include whether safety-net hatcheries protect important populations, if limiting factors are being addressed and threats reduced through management actions, and consideration of recent abundance levels and changes in abundance over time.

Methods to evaluate action-specific and life-stage-specific effects

Section 7.2 describes detailed action-specific methods that are necessary to support the analysis in Section 7.1. Because the analysis in Section 7.1 requires information about changes from the base-to-current management practices and additional changes associated with Prospective Actions, effects of those changes must be calculated. Section 7.2 describes the methods of evaluating changes in survival associated with hydro actions, tributary and estuary habitat actions, harvest, hatchery actions, RM&E actions, and changes in predation resulting from management actions.

Methods for evaluating effects at the MPG and species level

All of the methods described in Sections 7.1 and 7.2 apply to individual populations of listed salmon and steelhead. Section 7.3 describes methods for evaluating these population-level effects at the MPG and ESU level. The approach is qualitative, based largely on information regarding the importance of particular populations to each MPG and other information pertinent to MPG and ESU evaluations from recovery plans and TRT documents.

Methods for evaluating effects on critical habitat for the adverse modification analysis

Sections 7.1 through 7.3 apply to the jeopardy analysis, but an analysis of the effect of Prospective Actions on critical habitat is also necessary. Section 7.4 describes the qualitative methods that are applied to this evaluation. These methods describe the effects of the Prospective Actions on the functioning of primary constituent elements and the resulting effects on the conservation value of critical habitat.

7.1 Life-cycle analyses to evaluate whether populations are likely to have a sufficiently low short-term extinction risk and are likely to trend toward recovery

This analysis must first determine the short-term extinction risk and the expected trend of populations for each listed species. The following section describes the calculations and metrics used to inform the aggregate analysis for the populations of six interior Columbia species.

7.1.1 Population-level quantitative analytical methods for six interior Columbia Basin species

Data Sets

Information is sufficient to conduct quantitative analyses for populations of six interior Columbia River species. These species include:

- SR spring/summer Chinook,
- SR steelhead,
- SR fall Chinook,
- UCR spring Chinook,
- UCR steelhead, and
- MCR steelhead.

All estimates in the Supplemental Comprehensive Analysis (SCA) are derived from data sets produced by the Interior Columbia River Technical Recovery Team (ICTRT). The data sets have been updated since the 2007 Draft SCA, and match data used by the ICTRT in recent analyses submitted to the ISAB (ICTRT 2007c, ICTRT and Zabel 2007). For further information regarding the specific data sources, please see the tables in Chapter 8 and the Aggregate Analysis Appendix of the SCA.

Survival Gaps

The values of metrics that indicate a trend toward recovery are described in Section 7.1.1.2. The “survival gap,” as defined by NOAA Fisheries, refers to the change in density-independent survival¹ that would need to occur in order to change the current value to the desired value of a given metric. Methods for estimating the survival gap differ, depending on whether the metric represents an annual (e.g., median population growth rate, or "lambda") or brood-cycle process (e.g., returns-per-spawner, or R/S). Annual estimates of the survival gap must be raised to the power of the mean generation time. The fundamental principle, common to all metrics, is that the quantitative component of the jeopardy analysis seeks to determine if the survival changes associated with the Prospective Actions, after taking into consideration the environmental baseline and cumulative effects, meet or exceed the remaining survival gap.

It is important to understand that the “survival gap” terminology applies to the needed survival change associated with achieving any goal, based on any survival-based metric. Here, it applies to the goal of being on a trend toward recovery and having a low short-term risk of extinction. The ICTRT (2007c, 2006) also uses the “survival gap” terminology. The ICTRT defines survival gaps associated with the long-term viability of populations. These ICTRT viability survival gaps are based on somewhat different target metrics, and represent the gap between the condition of populations over approximately the last two decades and the condition that the ICTRT considers viable. If a sufficient mixture of populations reaches this level, then the species is considered viable.

In contrast, this analysis is directed at a different question than the ICTRT’s analysis of long-term recovery. This analysis focuses on the survival changes needed to ensure that populations support species (ESU or DPS) that are on a “trend toward recovery;” i.e., moving toward recovery even though full recovery of the species may not be achievable during the period of the Prospective Actions. In general, the needed survival changes for full recovery are higher than the needed survival changes associated with the “trend toward recovery.”

The ICTRT (2007c) noted that some populations, particularly several of the MCR steelhead populations, currently have relatively high productivity but are below minimum abundance thresholds. For these populations, the ICTRT states that gaps are expressed as proportional increases in productivity, but could also be filled by increasing the "effective capacity" of the population. The effective capacity can be increased either by making new habitat available for spawning and rearing or by increasing the productivity (e.g., smolts per adult) of existing habitat.

NOAA Fisheries has not identified quantitative values of metrics that would indicate a sufficiently low short-term risk of extinction because the estimation of extinction risk is dependent on specific

¹ “Density-independent” refers to a change in survival that is not influenced by the number of fish in the population. Generally speaking, most factors influencing survival after the smolt stage are assumed to be density independent. During the egg-to-smolt stage, the density of adults and juveniles can influence survival as a result of competition for limited habitat or other factors. For evaluation of survival gaps, estimates of survival changes resulting from actions affecting early life stages of salmon and steelhead are made under the assumption of low density.

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model functions and assumptions (such as quasi-extinction abundance threshold, QET, and treatment of listed hatchery fish) about which there is considerable uncertainty. The ability of a particular set of actions to achieve a goal of no more than any assumed percentage risk of extinction may vary considerably among models and assumptions. For convenience, the SCA includes estimates of survival gaps necessary to reduce 24-year extinction risk to no more than 5%, given the range of assumptions considered in the analysis. Ultimately, the acceptable level of short-term extinction risk is a qualitative policy determination made by NOAA Fisheries consistent with the ESA and its implementing regulations.

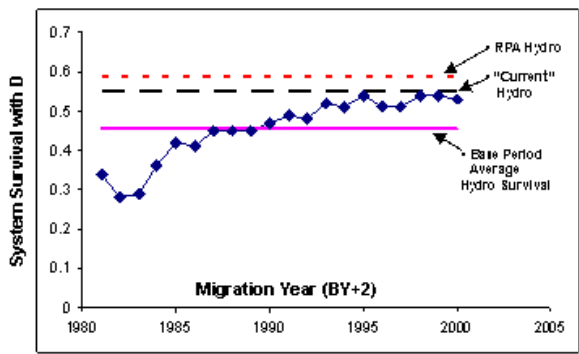
General Approach: Base, Current, and Future (with Prospective Actions) Analyses

Figures 7.1-1 and 7.1-2 demonstrate the approach for evaluating each metric according to the survival and potential for recovery prongs of the jeopardy analysis. Figure 7.1-1 demonstrates the approach for directly assessing the effect of the Prospective Actions on metrics such as average returns-per-spawner (R/S). In doing so, the Marsh Creek population of SR Spring/Summer Chinook is used as an example. Figure 7.1-2 demonstrates an indirect method for assessing the effect of the Prospective Actions on closing the “survival gap” between the base status of a metric, such as extinction risk, and the desired status. Again, the Marsh Creek population of SR Spring/Summer Chinook is used as an example. The sections following Figures 7.1-1 and 7.1-2 describe these general approaches.

Figure 7.1-1. Schematic showing the method of applying survival changes that have occurred during the base period to a “base-to-current” productivity adjustment factor and method of applying expected prospective survival changes to a “current-to-future” productivity adjustment factor. Detailed methodology is described in the accompanying text. This example uses average returns-per spawner (R/S) as the productivity estimate, applied to the Marsh Creek population of SR Spring/ Summer Chinook salmon.

Current Hydro Survival is higher on average than it was during the last 20 years
 The RPA is expected to result in additional hydro survival improvements

Hydro Survival



Productivity

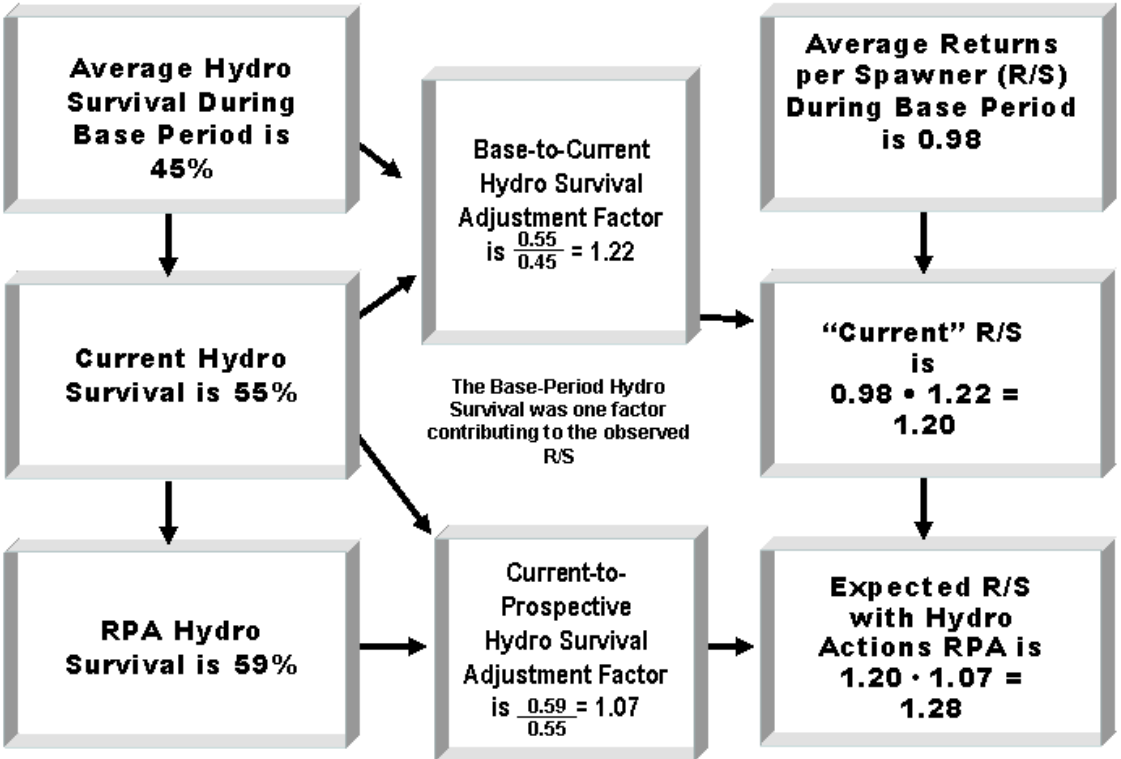
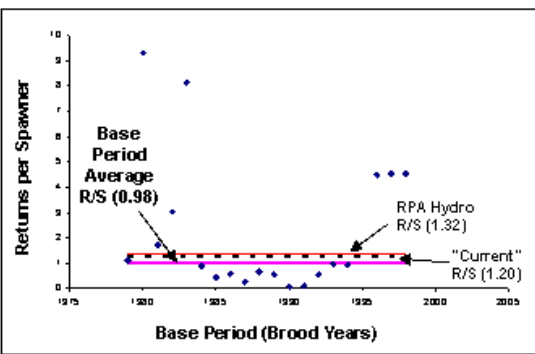
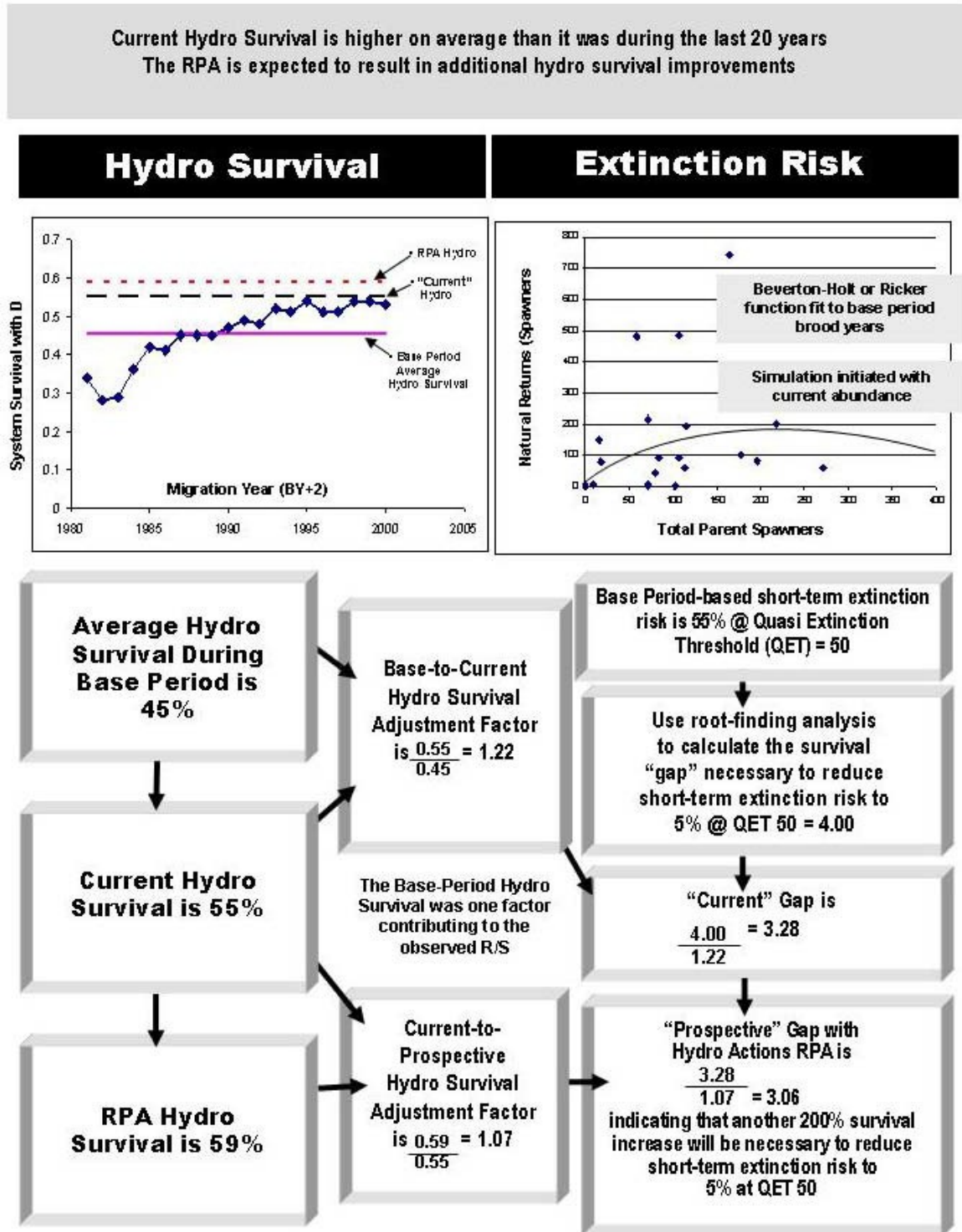


Figure 7.1-2. Schematic showing the method of applying survival changes that have occurred during the base period to a “base-to-current” adjustment factor for an extinction risk survival gap and method of applying expected prospective survival changes to a “current-to-future” adjustment factor. Detailed methodology, including estimation of survival gaps, is described in the accompanying text. This example uses a survival gap based on 24-year extinction risk and QET=50, applied to the Marsh Creek population of SR Spring/Summer Chinook salmon.



Base-to-Current and Current-to-Future Adjustments

Various metrics can inform the analysis of the survival and potential for recovery prongs of the jeopardy analysis. All life-cycle metrics considered here are based on the retrospective performance of populations during a historical time period and an assumption that, unless something affecting the survival or reproduction of the population changes in the future, the future performance can be projected from the pattern of past performance. NOAA Fisheries evaluated alternative historical time periods for these “base” estimates, but focused on the time period used by the ICTRT for recovery planning, which encompasses approximately the 1980 through 1999 brood years (which include spawner returns at age through about 2004 or 2005). Apart from the precedent of the ICTRT’s use of this time period, it also corresponds approximately with that considered in the 2000 FCRPS Biological Opinion. NOAA Fisheries considers this time period a reasonable representation of a long enough time period to encompass variability in climate and biological performance. Additionally, the 1980 through 1999 brood years is considered a sufficiently recent time period to include many of the major changes in management actions that have occurred in recent decades.

As indicated by the ICTRT (2007c), some factors such as hydro operations and configuration have continued to change over that time period, and if the current management actions continue into the future, the projected biological performance will be different from that predicted from base period patterns alone. The ICTRT (2007c) includes an analysis that adjusts productivity estimates to reflect current hydro operations and configuration. The ratio between current hydro survival and the average hydro survival during the base period is calculated as an adjustment factor.

For the jeopardy analysis, adjustment factors are calculated for all ongoing and completed management activities that are likely to continue into the future. The product of these life-stage specific adjustment factors represents the “base-to-current survival adjustment factor.” A similar process is used to estimate the survival changes likely to occur as a result of the Prospective Actions and cumulative effects, and to calculate the product of the changes as the “current-to-prospective survival adjustment factor.”

For some metrics, such as R/S, the prospective R/S can be estimated by multiplying the base period R/S by the survival adjustment factors. To evaluate survival gaps, such as that associated with a particular level of extinction risk, the base survival gap is divided by the survival adjustment factors.

This approach of evaluating proportional changes in mean survival rates is consistent with the methods used during discussions in the *NWF v. NMFS* remand collaboration process resulting from Judge Redden’s Order of October 7, 2005. It is also consistent with the approach used to evaluate recovery actions in the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead (NMFS 2007c). Alternative methods of evaluation using more complex models that incorporate density dependence in estimating future trends following survival rate changes exist but, to date, have only been available for a limited number of populations. These more complex models also rely on a broader set of assumptions and parameter estimates that have not been thoroughly evaluated at the time this document was prepared. Therefore, they are not used in this analysis.

It is important to understand that the proportional change approach applied in this analysis (and the others described above) has a single time step. This means that the analysis assumes that all survival changes occur instantaneously and that average life-cycle survival is immediately affected. For the extinction risk analysis, two alternatives for considering implementation of Prospective Actions were considered, as described below in Section 7.1.1.1. However, for productivity estimates, the time period associated with the estimates begins with full implementation of the expected survival changes. The best way to think of the productivity estimates is that they represent the initial productivity following achievement of the expected survival rate changes resulting from the Prospective Actions. As described in Section 7.1.1.2, there is a relationship between abundance and productivity, such that abundance will increase following a change in survival and productivity. However, as abundance increases, density-dependent interactions will also increase, which will reduce average productivity over time. Therefore, the estimates of average prospective productivity calculated in this analysis are not expected to be maintained indefinitely and over time will be reduced to a lower rate.

Weather and Climate Assumptions

Qualitative considerations of weather and climate, as it affects salmon and steelhead survival, are described in Section 5.7 (Environmental Baseline). That section also summarizes recent literature on potential climate change, such as the Independent Scientific Advisory Board's comprehensive review (ISAB 2007c). This section describes how weather and climate information is applied in quantitative analyses to both the ocean and freshwater life-stages of salmon and steelhead. Qualitative analyses are described in Section 7.1.2.

Mechanically, the quantitative analyses, unless otherwise specified, apply the same climate conditions that influenced survival throughout the life cycle during the "base period" to projections regarding the future. That is, the analysis can be thought of as the base period repeating itself, except for the specific survival changes (e.g., resulting from management actions) that are applied. As described above, the "base period" from which productivity and extinction risk are derived is that used by the ICTRT: completed brood returns generally between 1980 and approximately 2001 (influenced by adult returns through approximately 2005). The exact tie period differs by population and by the particular metric being evaluated. Use of the 1980-2001 time period represents a conservative assumption for climate effects on salmon, compared to a longer historical record. As discussed in Section 5.7, only 4 of the 22 years during this time period had negative (favorable) Pacific Decadal Oscillation (PDO) averages and 18 of the 22 years had positive (unfavorable) PDO averages during the months influencing salmon survival. Similarly, from 1980 through 2001 the El Niño index (MEI) has been dominated by positive deviations from the long-term average (see Figure 5.7.1-1 in Chapter 5) – conditions known to reduce salmon survival. The baseline period therefore represents a regime that is less favorable to salmon than would typically have occurred in the past century.

While climate assumptions in this analysis clearly are conservative relative to climate patterns observed during the past century, many comments on the 2007 Draft Biological Opinion questioned whether NOAA Fisheries was sufficiently cautious in the face of continuing global climate change. As discussed in Section 5.7, Pacific Northwest air temperatures have increased by approximately 1 degree C since 1900 and are expected to increase 0.1-0.6 degrees C per decade over the next century.

The ISAB (2007c) described various mechanisms by which this increase in temperature could reduce survival of salmon and steelhead in freshwater and marine life stages.

Ocean Climate Assumptions

In response, NOAA Fisheries explicitly modeled a climate scenario that addresses potentially worsening survival of salmon and steelhead in the ocean. The ISAB (2007c) stated that global climate change in the Pacific Northwest is predicted to result in changes in coastal ecosystems and salmon production that “may be similar to or potentially even more severe than those experienced during past periods of strong El Niño events and warm phases of the PDO.” The choice of a 1980-2001 base period largely addresses this concern because it is dominated by El Niño and warm PDO events, representing climatic conditions expected to increase in the future. However, because of the uncertainty in future climate effects, a sensitivity analysis of alternative weather and climate scenarios is included in the Aggregate Analysis Appendix of the Supplemental Comprehensive Analysis. This sensitivity analysis includes an alternative weather-related early-ocean survival multiplier from ICTRT (2007 c) and ICTRT and Zabel (2007) that represents a future climate regime associated with poorer survival of salmon than was experienced during the base period (warm PDO climate scenario of ICTRT 2007c). This scenario is based on the survival experienced by the 1975-1997 brood years, all of which were associated with warm phases of the PDO. Survival under the warm PDO climate scenario is 12% lower than the “base” period survival for SR spring summer Chinook, 3% lower for Upper Columbia River spring Chinook, and 2% lower for listed interior Columbia River steelhead species (ICTRT 2007a).

The ISAB (2008) commented that future climate change may result in ocean conditions even worse than those captured in the warm PDO ocean climate scenario. While that may be true over a longer time period, it is unlikely to apply to the period of the Prospective Actions and the metrics considered in this opinion. The ISAB (2008) also commented that “there has been quite a bit of modeling of what to expect, and there are a range of scenarios available to the NOAA team.” NOAA Fisheries requested clarification of which models the ISAB was referring to and if they were specific to ocean conditions. Huntly and Percy (2008) replied that “We are referring to general circulation models (GCMs) as provided in the IPCC-2007 report and others, which clearly predict increased global warming in the future. Others predict increased ocean stratification. We are not referring to regional models for ocean conditions in the Northeast Pacific that predict future conditions (5-10 years from now) such as the frequency and intensity of PDOs and ENSOs and coastal upwelling that will affect the ocean survival of Columbia River salmonids. We are not aware of any such models.”

A second, more optimistic, alternative climate scenario affecting early ocean survival is also included as a sensitivity analysis. This scenario is included because the ICTRT (2007c) stated that, while at this time it is not technically possible to identify likely specific future conditions, the alternative future scenarios discussed in this section “bound a likely plausible range of future scenarios.” It also responds to a comment on the 2007 Draft Biological Opinion that the 1980-present base period is biased toward poor ocean conditions because it is too short to include periods of more favorable climate. The second alternative climate scenario represents a longer historical period of 50 or more years that encompasses both good and bad ocean conditions (“Historical Climate Scenario” of ICTRT

2007c). Survival under the historical climate scenario is 37% higher than the “base” period survival for SR spring summer Chinook, 44% higher for Upper Columbia spring Chinook, and 11-19% higher for listed interior Columbia steelhead species (ICTRT 2007c).

Freshwater Climate Assumptions

Expected changes in climate can also affect survival during freshwater life stages, as described in Section 5.7 and ISAB (2007c). NOAA Fisheries did not attempt to explicitly model quantitative effects of climate change on survival during freshwater life stages; rather, Section 7.1.2 describes use of a qualitative approach. The primary reason for not attempting quantitative modeling is lack of available information regarding effects of climate change on survival of anadromous salmonids of the Columbia basin. The sole quantitative approach that we are aware of is that of Crozier et al. (2008), which is based on instantaneous attainment of expected 2040 climate conditions and its affect on life-stage survival, abundance, and population growth rate (λ). Crozier et al.’s (2008) estimated reduction in life-stage survival, compared to survival estimated under current climate conditions, is significant (18-34% decline in parr-smolt survival with combination of 10 climate prediction models) but the applicability of this estimate to the base period survival estimates used in the SCA analysis is unclear (i.e., it is not clear whether the 18-34% decline is relative to the SCA base period survival or relative to another survival rate). Additionally, the instantaneous implementation of 2040 climate is of questionable relevance to the time period under consideration in the SCA, especially without a modeled ramp-up to the 2040 condition. Finally, Crozier et al. (2008) note that density-dependent processes compensated for declines in parr-smolt survival to some extent. This is an important study and analytical approach to evaluating effects of climate change on anadromous salmonids of the Columbia basin, but at this point additional information is needed before attempting to quantify effects of climate change on freshwater survival over the course of the SCA actions. The method of qualitative evaluation, based on ISAB recommendations for pro-active actions, is described in Section 7.1.2.1.

7.1.1.1 Quantitative Methods Applied to Interior Columbia Species for Assessing the Survival Prong of the Jeopardy Analysis

Extinction Risk Methods

As described in Hinrichsen (2008), which is Attachment I to the “Aggregate Analysis Appendix,” quantitative assessment of short-term (24-year) extinction risk is calculated in a manner that is similar to that used by the ICTRT for calculating long-term (100-year) extinction risk. This analysis encompasses the entire lifecycle and, therefore, applies to the entire action area of all associated biological opinions. Briefly, observed abundance and productivity estimates during the base period are used to define a stock-recruitment function that predicts the number of progeny that will return to spawn from a given number of parental spawners. The production functions are the Beverton-Holt (for spring Chinook ESUs) and Ricker (for steelhead DPSs and SR fall Chinook), which are standard in fisheries literature. The Ricker function is used for steelhead because valid parameter estimates could not be found with the Beverton-Holt function for about half the steelhead populations. The hockey stick, which is used by the ICTRT, Beverton-Holt, and Ricker functions all predict high numbers of recruits per parental spawner at low spawner densities and lower recruitment at higher

densities, up to a capacity limit. There is uncertainty in the estimates caused by random error and by the tendency of a series of high-or low-survival years to follow each other (autocorrelation).

Estimates of extinction probability are based on simulations. These start with current abundance and then project a 24-year time series of future spawners. Each projection will have a different outcome due to random error and autocorrelation terms, so the projections are repeated thousands of times to generate a range of outcomes. The proportion of simulation runs that fall below the quasi-extinction threshold within the 24-year time period represents the probability of short-term extinction. That is, of 1000 simulations, if 300 predict salmon abundance that is below QET at the end of the 24-years there is a 30% risk of extinction.

Survival “gaps,” as defined in Section 7.1.1, were calculated for Chinook populations with sufficient data by determining the change in the slope at the origin of the Beverton-Holt production function that corresponded to short-term extinction risk of 5% or less (see Hinrichsen 2008, included as Attachment 1 to the Aggregate Analysis Appendix). The change in survival was estimated strictly from changes in this slope parameter, with no changes in the Beverton-Holt capacity parameter. This conservative approach estimates a larger survival gap for a given data set than will an approach that assumes density-independent survival improvements that would also affect the capacity parameter, such as the approach the ICTRT used to estimate long-term extinction risk gaps (ICTRT 2007a, 2007c). Similar estimates were not possible for steelhead because of mathematical constraints of using this procedure with the Ricker production function.

Determining the Quasi-Extinction Threshold (QET)

Extinction, for the purpose of this analysis, was defined as falling below a quasi-extinction threshold (QET) four years in a row (representing a full brood cycle of mature male and female spawners) per the ICTRT (2007a). Choice of QET level can significantly influence extinction risk estimates. In the 2000 FCRPS Biological Opinion, the QET was set to the absolute extinction level of one fish:

Absolute extinction is used instead of a quasi-extinction level because of the unambiguous interpretation of this criterion, whereas quasi-extinction levels such as 20, 50, or 100 fish have different meanings for populations of different sizes and capacities in different river systems. (NMFS 2000b)

The problem with the use of absolute extinction as a criterion is that it is very difficult to predict the dynamics of populations at extremely low abundance. Various reviews since the 2000 FCRPS Biological Opinion have suggested that it would be more appropriate to evaluate extinction risk relative to a higher quasi-extinction threshold. Such a threshold does not necessarily represent true biological extinction, but it represents an abundance below which there is great concern from a management perspective and high analytical uncertainty regarding persistence. As the Independent Scientific Advisory Board pointed out in their review of the ICTRT’s draft viability criteria (ISAB 2007d):

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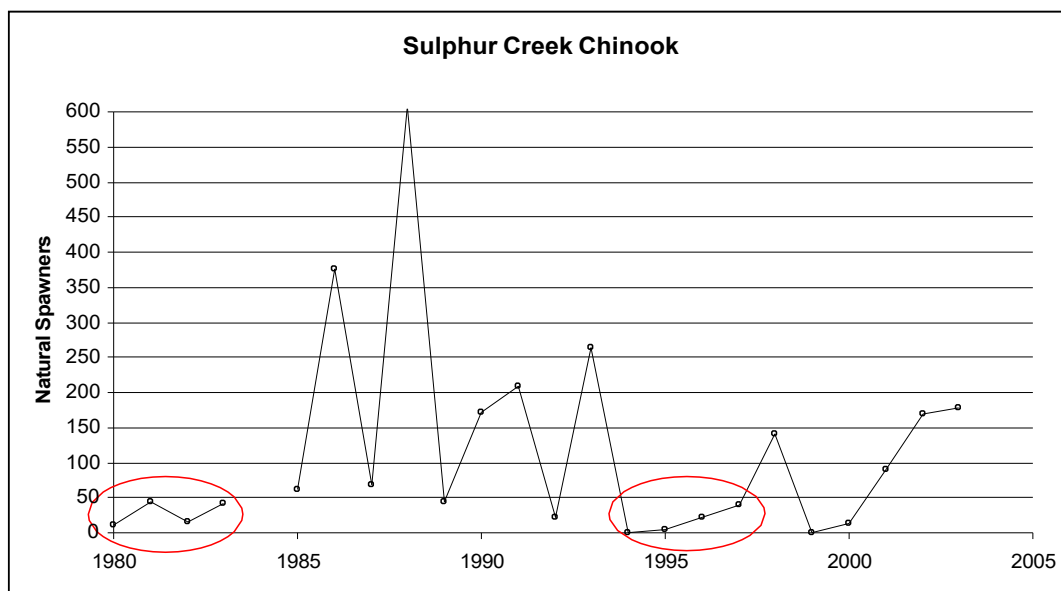
The probabilities of quasi-extinction should not be considered equivalent to the probability of biological extinction. Rather, the former should be interpreted as the probability of entering a state where the risk of extinction cannot be modeled but is considered to be unacceptably high. The true probability of extinction could be bounded by probabilities derived using quasi-extinction thresholds of 1 and 100.

For their 100-year extinction risk analysis, the ICTRT selected a QET of 50 fish. The ICTRT (2007a) selected 50 fish based on four considerations; [1] consistency with theoretical analyses of increasing demographic risks at low abundance; [2] uncertainty regarding low abundance productivity of Interior Columbia ESU populations due to paucity of escapements of less than 50 spawners in the historical record; [3] sensitivity analyses indicating that the probability of multiple very low escapements increases substantially as the QET approaches one spawner per year; and [4] consistency with the Puget Sound and Lower Columbia/Willamette TRTs.

The ICTRT further elaborated on the first point by stating that three factors contributing to highly elevated extinction risk at low density (presumably 50 fish) are demographic stochasticity (the impact of random events and processes that could drive a small population to zero), Allee effects (such as inability to find mates at low densities), and loss of genetic variability. The first two of these factors likely affect short-term as well as long-term risk of extinction. However, the loss of genetic variability may be expressed over a longer time period and may be less likely to influence short-term extinction risk.

While the ICTRT's observation of a paucity of observations of less than 50 spawners is true across a broad range of populations in the Columbia basin, there are certain populations that have dropped below 50 fish over four years (in some cases more than once) and that have not gone extinct. An example is displayed in Figure 7.1-3.

Figure 7.1-3. Adult spawners in the Sulphur Creek population of SR spring/summer Chinook salmon. Circles indicate four consecutive return years that are below 50 spawners. ICTRT abundance estimates are from Cooney (2007).



The ICTRT does not address nor recommend a reasonable QET for shorter-term extinction risk. The analysis in this SCA includes the 50-fish QET recommended for evaluating 100-year extinction risk by the ICTRT, but it includes also a sensitivity analyses to alternative choices of QET. These may also be appropriate for assessment of short-term extinction risk since many populations in the Columbia Basin have dropped below 50 fish and returned to higher abundance levels during the past 20 years.

The ICTRT determined that for single years in which spawner numbers are as low as 10 fish, successful reproduction is highly uncertain (referred to as the “reproductive failure threshold,” RFT). The analysis in this SCA also is based on RFT = 10 and assumes, as did the ICTRT, that successful reproduction occurs when abundance is greater than 10 fish. A sensitivity analysis of QET=1 assumed a RFT of two spawners, as described in the Aggregate Analysis Appendix. This assumption was also applied by the ICTRT for a sensitivity analysis to QET=1 (ICTRT 2007a).

Assessing Short-Term Extinction Risk

Short-term extinction risk with the Prospective Actions in place is estimated with a range of adjustment factors. While many of these actions will occur in the near future and have near-term biological effects, others will take longer to implement and have a biological impact. Because the analysis is based on a single time step and because the exact timing of Prospective Actions and attainment of biological effects is unknown, two adjustment factors are considered: A conservative approach assumes that extinction risk will not be influenced by any improvements associated with Prospective Actions. Only actions that are implemented already and that are captured in the base-to-current adjustment factor, as described in Section 7.1.1, are included in this calculation. A more

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optimistic assumption is that all Prospective Actions and all effects of those actions expected to occur within the next 10 years will affect the short-term risk of extinction. This approach includes Prospective Actions that will be implemented quickly, but is also optimistic because it includes actions that may not result in biological improvements for up to 10 years. The true extinction risk associated with the Prospective Actions is expected to be somewhere between these two extremes.

Uncertainty about the extinction risk estimates in the form of 95% confidence intervals is calculated using statistical bootstrapping methods, as described in the Aggregate Analysis Appendix. The confidence intervals are one method of indicating the statistical uncertainty of the quantitative extinction risk estimates and the degree to which they should be relied upon for decisions.

NOAA Fisheries received several comments on the 2007 Draft Biological Opinion regarding this approach to analyzing the survival prong of the jeopardy standard.

Some suggested that NOAA Fisheries evaluate a 100-year extinction risk time horizon, rather than a 24-year period, or else set standards for both periods. The rationale was that the 24-year extinction risk is lower than the 100-year extinction risk (i.e., it “inflates” survival probability compared to the 100-year time horizon). It has been well-documented that extinction risk increases with longer time horizons, with the probability of extinction “approaching 100% for all species if the period is long enough” (NRC 1995). For example, Oregon’s comments (page 5) include a Figure 2 that shows a low likelihood of extinction over 24 and 48 years and a high likelihood of extinction over 100 years for Upper John Day spring Chinook. This population is not listed under ESA, and is considered by the state of Oregon to be healthy (ODFW 2006a). While NOAA Fisheries is not familiar with the data or assessment methodology used in Oregon’s 100-year extinction risk estimates for this population, their result suggests that even healthy salmon stocks may appear to have a high likelihood of extinction under this assumption. It has been equally well-documented that the precision of the risk estimate decreases with longer time horizons. For example, Fieberg and Ellner (2000) estimated that reliable estimates of extinction risk may only be possible when the number of base period observations is 5-10 times greater than the number of years in the time horizon.

NOAA Fisheries continues to rely primarily on the 24-year time horizon for this analysis because the main purpose of the metric is to inform our judgment regarding the ability of the species to survive while actions to promote recovery are implemented under the Prospective Actions and through other processes. The 24-year period is more than twice that of most of the Prospective Actions and is identical to the short-term period considered in the 2000 FCRPS Biological Opinion (NMFS 2000b). However, NOAA Fisheries did calculate extinction risk over the 100-year time horizon to allow comparison of the 24-year extinction risk results with the 100-year extinction risk results of interest to some parties in the region. The 100-year extinction risk estimates and associated confidence intervals are reported in the Aggregate Analysis Appendix.

Some comments on the 2007 Draft Biological Opinion (NMFS 2007d) recommended that NOAA Fisheries use only a QET of 50 or higher (up to 100) in assessing extinction risk and disregard the sensitivity analysis of QET=30, 10, and 1. These comments said that NOAA Fisheries did not

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provide adequate explanation for considering results less than QET=50 in reaching conclusions. On the other hand, one comment stated that QET=50 is conservative and recommended displaying and discussing QET=10 more prominently. The same commenter opined that the real ESA standard is absolute extinction (QET=1), not “entering a state where the risk of extinction can’t be modeled” (ISAB 2007c) definition of quasi-extinction threshold).

NOAA Fisheries primarily considered QET=50 in evaluating extinction risk because this is the threshold used by the ICTRT for long-term extinction risk. For the reasons discussed above, this threshold may be overly conservative for smaller populations, particularly those that have demonstrated the ability to return to higher levels after dropping below 50 spawners (e.g., Figure 7.1-3), and it may also be conservative for short-term extinction risk since at least one of the ICTRT’s reasons for QET=50 is related to long-term genetic considerations. Regarding suggestions for higher QET levels, a population of at least 50 spawners clearly has not gone extinct and no evidence was presented in comments to suggest that a population below some higher level (e.g., 100) is more helpful in determining real extinction risk. Regarding emphasizing lower QET levels, NOAA Fisheries agrees that “true extinction” is defined as dropping to 0 or 1 spawner four years in a row. However, the ability of available data and models to accurately predict population behavior at this low level is extremely limited and the risk tolerance in such an analysis would have to be extremely low. It is reasonable to evaluate “quasi-extinction” thresholds above 1 fish, although there is little information favoring use of any particular level.

Two comments on the 2007 Draft Biological Opinion questioned details of the analytical approach used to calculate extinction risk. The first questioned whether variability and autocorrelation were adequately considered in the extinction risk analysis. NOAA Fisheries agrees that variance and autocorrelation are important parameters in any extinction risk analysis, and therefore both were estimated and used in developing the extinction risk estimates. The nonlinear regression method for estimating these parameters was carefully developed and details of methodology are included in the Aggregate Analysis Appendix. That appendix also outlines how these estimates were used in developing estimates of extinction probability. In short, as variance increases and autocorrelation increase, extinction probability estimates increase. Extinction probability curves were not used, although their use was assumed in the comment. Instead NOAA Fisheries used the best estimates of productivity, density dependence, current abundance, variance, and autocorrelation and estimated the resulting extinction probability. The exercise of developing hypothetical extinction probability curves was not needed.

A second technical comment opined that use of the Beverton-Holt function “alpha” parameter (i.e., the slope at the origin) to estimate the extinction risk survival gap under estimates this gap, compared to the methods used by the ICTRT. In fact, this approach generally results in very similar or larger survival gaps than the ICTRT method, as can be seen by comparing the SR spring/summer Chinook base 100-year extinction risk gap at QET=50 in the Aggregate Analysis Appendix with the ICTRT (2007c) 5% risk “observed” survival gap. Most of the estimates differ only slightly between the two approaches, with approximately equal numbers being higher in one or the other model. However, there are five populations with very different survival gap estimates, all of which are much larger (i.e.,

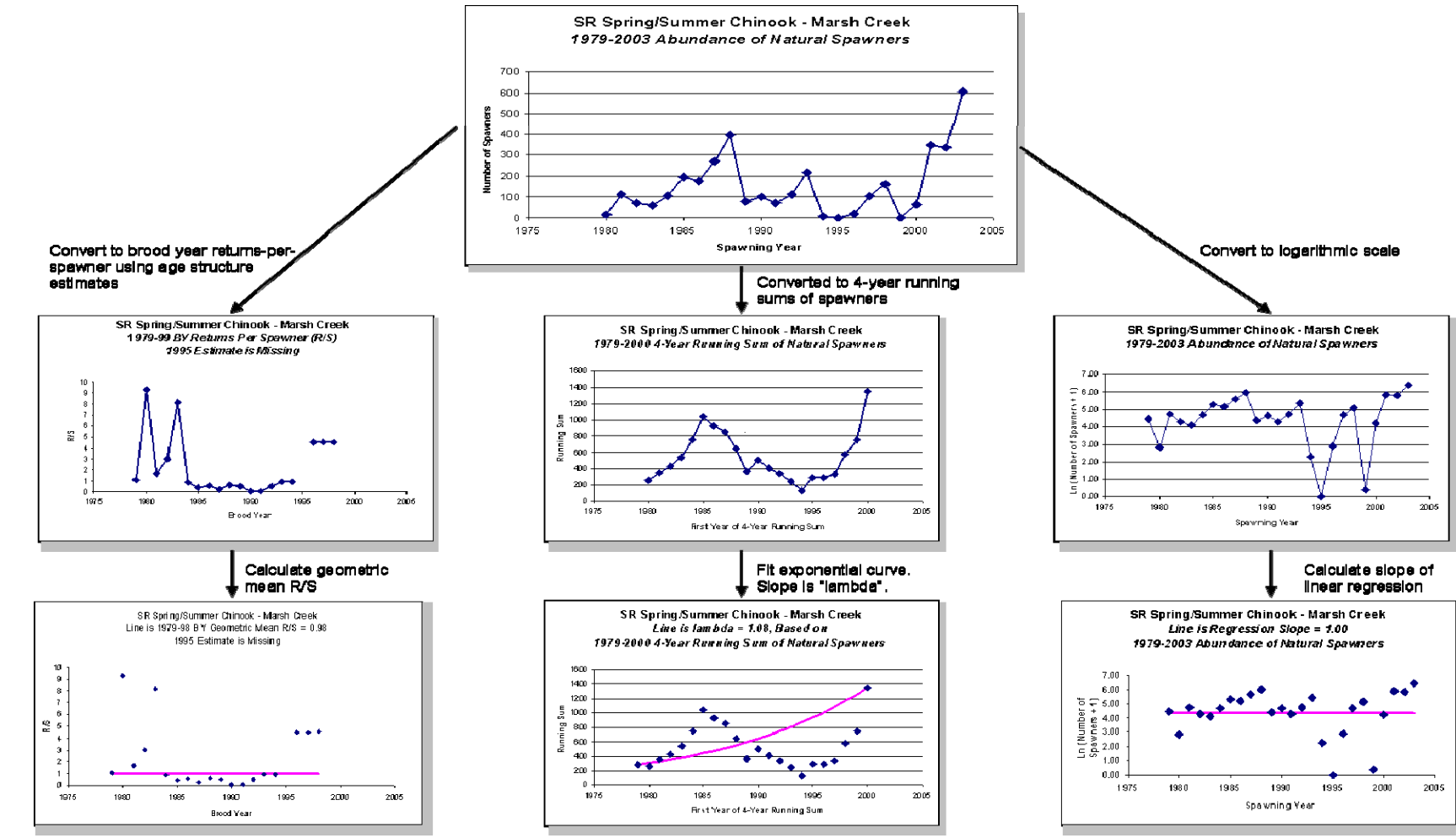
a much greater improvement is needed) using the Beverton-Holt approach. For steelhead, SCA gaps using the Ricker function are nearly always higher than gaps using the ICTRT hockey-stick function.

It is clear from many of the comments and from the results of the analyses that quantitative estimates of extinction risk are subject to considerable uncertainty. In light of this, NOAA Fisheries also considered a variety of qualitative factors, which are described in Section 7.1.2. Included among these factors are important considerations that are not captured in quantitative assessments, such as the relevance of safety-net hatchery programs for reducing or eliminating short-term extinction risk for some populations.

7.1.1.2 Quantitative Methods Applied to Interior Columbia Species for Assessing the Potential for the Recovery Prong of the Jeopardy Standard

Figure 7.1-4 compares the three quantitative metrics indicative of the potential for recovery prong of the jeopardy analysis. All three metrics encompass the entire lifecycle and, therefore, applies to the entire action area of all associated biological opinions. There is great uncertainty in the calculations that characterize the current status of most populations, as well as in estimates of projected performance. The three metrics considered to evaluate the potential for recovery for the jeopardy analysis have different strengths and weaknesses, particularly with respect to the most recent returns included in the analysis, the treatment of hatchery-origin fish, and the level of complexity (number of assumptions) and data requirements. NOAA Fisheries looks at all available tools because the Independent Scientific Advisory Board recommended that policy-makers draw on all available analytical tools (ISAB 2001a).

Figure 7.1-4. Graphic comparison of methods used to calculate average returns-per-spawner (R/S), mean population growth rate (lambda), and the BRT abundance trend (regression of log-transformed abundance). All calculations are based on 1979- 2003 spawner abundance estimates for the Marsh Creek SR spring/summer Chinook population. The estimates in this figure match those in Table 8.2.2-1 for the "base case" Marsh Creek population. The Marsh Creek population has no hatchery-origin spawners; this simplifies the methods compared to populations with both hatchery-origin and natural-origin spawners.



Viable Salmonid Population (VSP) Characteristics

McElhany et al. (2000) define characteristics of viable salmonid populations that are likely to result in persistence for at least 100 years. The VSP characteristics are adequate abundance, productivity (or population growth rate), population spatial structure, and biological diversity. The ICTRT (2007a) apply these general characteristics to interior Columbia River populations in the form of long-term viability criteria. In the context of the SCA, all four VSP characteristics relate to the recovery prong of the jeopardy analysis. This section presents methods for quantitative estimation of abundance and productivity metrics relevant to the jeopardy analysis at the population level. Section 7.1.2 discusses qualitative methods relevant to spatial structure and diversity, as well as qualitative factors relevant to abundance and productivity for those populations with insufficient data for quantitative estimates. Section 7.3 discusses the consideration of these population-level criteria at the MPG and species level.

Average Returns-Per-Spawner (R/S)

Returns-per-spawner (also referred to as recruits-per-spawner) is a measure that determines whether a population is maintaining itself, declining, or growing. If 100 parental spawners produce 100 progeny that survive to maturity and successfully spawn, then $R/S=1.0$ and the population abundance has been maintained over that brood cycle. If, however, only 80 progeny survive to spawn, then $R/S=0.8$ and the population is declining. Since each female produces thousands of eggs, there is also the potential for much higher return rates. So, for example, 200 progeny might survive to spawn, which would result in $R/S=2.0$. In this case, the population abundance has doubled in one generation.

This analysis considers average R/S, with the average calculated as the geometric mean of brood year R/S estimates over the base period. The geometric mean is consistent with the general patterns in variability of annual return rates of anadromous salmon. Use of this metric reduces the influence of the relatively infrequent, extreme high-survival years during the period of interest. The sources of the average R/S estimates used are the ICTRT's Current Status Summaries and a summary of the average R/S metrics generated using the ICTRT data base (Cooney and Matheson 2006), updated to incorporate more recent data from the ICTRT (ICTRT 2007d; Cooney 2007, 2008a)

The estimates of average R/S in Hinrichsen (2008; included as Attachment 1 to the SCA Aggregate Analysis Appendix) applied a slightly different time period and different data sets for some populations. To avoid confusion, only the (ICTRT) estimates of average R/S were used in the SCA calculations for the jeopardy analysis.

It is important to distinguish the average R/S productivity estimates generated from the ICTRT data base from *intrinsic* productivity, which is a critical productivity metric in the ICTRT's long-term risk calculations. Intrinsic productivity, as applied by the ICTRT, is the R/S productivity calculated from the base period years with low spawner abundance (ICTRT 2007a). In other words, average productivity is based on R/S for all brood cycles during the time period of interest. Intrinsic productivity, however, considers a subset of those brood cycles with the lowest parental spawner abundance. The reason the ICTRT places importance on intrinsic productivity is because it represents one method of displaying the resilience of populations to declines in abundance. High intrinsic productivity indicates that populations can increase their abundance after periods of low abundance.

The reason the SCA uses average productivity, rather than intrinsic productivity, as an indicator of a trend toward recovery is because it is a metric that can be calculated and updated over any time period and therefore it is more suitable for a 10-year biological opinion. The relevant brood years in the ICTRT base period for intrinsic productivity are primarily the low abundance years in the late 1980s through mid-1990s for many populations. Intrinsic productivity cannot be recalculated directly until the populations again drop to low levels, and the productivity of the new low-abundance brood years cannot be calculated until their progeny return to spawn in another 4-6 years. Alternative methods of estimating intrinsic productivity based on fitting a stock-recruit function would also be dependent on progeny return data from the same time frame. It may take a decade to update intrinsic productivity estimates, whereas average productivity can be updated and monitored continuously. Average productivity may not be the best indicator of the resiliency of a population, but it is a clear indicator of the current status. When average R/S is greater than 1.0, the population is surviving at a rate that leads to increasing abundance.

R/S, as calculated by the ICTRT (2007a), considers all fish that spawn naturally in the parental generation (i.e., as the S in the R/S calculation). That is, the parents include natural-origin natural spawners and hatchery-origin natural spawners. The returning spawners in the next generation, however, are only the fish produced by those parents (i.e., the recruits are all natural-origin spawners). Therefore, hatchery-origin spawners cannot count in the R part of the R/S calculation. With this approach, one need not attempt to distinguish the productivity of natural-origin natural spawners from that of hatchery-origin natural spawners, at least not for the base period calculations.² However, if changes in either the proportion of hatchery-origin fish or the survival of hatchery-origin fish are relevant to base-to-current or current-to-future adjustments, a more complex approach is required (Section 7.2.4 and Quantitative Hatchery Appendix).

Of the three metrics relevant to the recovery prong of the jeopardy standard, average R/S provides the most realistic assessment of the likelihood that a population will trend toward recovery in the absence of continued hatchery programs. This is because the metric considers only the survival of natural-origin fish. This metric also requires the most data for each population, since brood-year specific estimates of hatchery fraction and age structure are necessary. For a number of populations, this requires assumptions and extrapolations from other populations or time periods. Because R/S evaluates brood cycles, it is only as current as the last completed brood cycle. As discussed previously, the last complete brood year is generally 1999, which makes this metric the least up-to-date of the productivity estimates.

Uncertainty associated with average R/S is calculated using the method of the ICTRT, which assumes a geometric distribution of R/S and calculates standard error and the t-statistic based on this distribution (Cooney and Matheson 2006). Cooney and Matheson (2006) also provide a formula for estimating 95% confidence intervals about the geometric mean from those statistics, which is applied

² Please note that this approach differs from one of the methods of calculating productivity that is described in the SCA Artificial Propagation for Pacific Salmon Appendix. The description of “productivity” in Section 2.1.2 of that appendix refers to the productivity of natural-origin spawners only.

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in the SCA. A second method included in the Aggregate Analysis Appendix is bootstrap estimation techniques to calculate 95% confidence intervals (Hinrichsen 2008). This method generally results in wider confidence intervals than the ICTRT method, in part because it incorporates serial correlation in the estimates. However, to avoid confusion, only the ICTRT approach is applied in the SCA calculations for the jeopardy analysis.

NOAA Fisheries received a comment on the 2007 Draft Biological Opinion that the R/S level associated with the recovery prong of the jeopardy standard should be 1.42, rather than 1.0. This productivity rate would result in doubling population size within two generations, or approximately 10 years. NOAA Fisheries defined the goal for this metric as simply being greater than 1.0 because it is not possible to define a specific level greater than 1.0 that would be relevant to all populations, since they are all of different sizes, with different carrying capacities, and at different levels of current abundance versus carrying capacity. Proponents did not describe why they believed that R/S=1.42 was necessary to avoid jeopardy for every population. However, conclusions in the 2007 Draft Biological Opinion relied in part on estimates of R/S and other productivity measures being higher than 1.0 for many populations, and in some cases the estimates were substantially higher than 1.42. NOAA Fisheries continues to conclude that a goal of R/S greater than 1.0 is reasonable, with consideration of the mix of populations at higher levels an important qualitative consideration for reaching species-level conclusions. NOAA Fisheries does note that results are presented in the Aggregate Analysis Appendix in a manner that allows comparison to 1.42 or any other particular average R/S level of importance to parties in the region.

Median Population Growth Rate (Lambda, λ)

The median population growth rate is the metric primarily relied on in the 2000 FCRPS Biological Opinion. This metric indicates the change in 4-year running sums of population abundance over time. The ICTRT includes lambda estimates in its Current Status Summaries and ICTRT staff provided an updated summary of their average lambda estimates (Cooney 2008b, c). The lambda estimates are calculated using NOAA Fisheries' Salmon Population AnalyZer (SPAZ) model (McElhany and Payne 2006).

The SPAZ model has several options for calculating lambda. The lambda estimates included in the 2007 Draft Biological Opinion did not distinguish between hatchery-origin and natural-origin spawners; however, the ICTRT has changed its approach and now bounds the range of lambda estimates by either assuming that hatchery-origin spawners have success equal to that of natural-origin spawners (HF=1) or that they are entirely unsuccessful (HF=0). Lambda estimates based on HF=1 are similar to R/S estimates, while those based on HF=0 are similar to BRT trend estimates for populations with a significant hatchery influence.

Like R/S, a mean population growth rate of 1.0 indicates a stable population, $\lambda > 1.0$ indicates that the population is growing, and $\lambda < 1.0$ indicates that the abundance is decreasing.

This metric requires less information than R/S, since an average age structure is assumed by the 4-year running sums. But unlike the lambda estimates included in the 2007 Draft Biological Opinion,

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estimates of the fraction of hatchery-origin natural spawners are now required. New lambda estimates are based on the estimates of hatchery fraction that are used to calculate R/S productivity. Lambda can be generated from any index of abundance, such as redd counts, without being converted into numbers of spawners. Lambda, like R/S, involves a time lag such that the most recent 4-year running sum is approximately the 2001-2004 spawning years.

Uncertainty is also calculated by the SPAZ model using standard statistical methods, and results include estimates of the 95% confidence limits and the probability that the estimate is greater than 1.0. The 95% confidence limits are estimated for both the base and the prospective lambda estimates. Based on comments on the 2007 Draft Biological Opinion recommending that NOAA Fisheries display the probability that the productivity is greater than 1.0, this metric is included in the Aggregate Analysis Appendix. It was calculated, using the methods in (McElhany and Payne 2006). Although one commenter recommended that the “potential for recovery” prong of the jeopardy standard required demonstrating with 95% confidence that the estimated productivity is greater than 1.0, NOAA Fisheries did not adopt a particular statistical standard and displays this metric only for comparison with alternative goals recommended by others. This metric was calculated only for lambda estimates, but because of the wide range of hatchery assumptions, the results are similar to those expected from both the R/S and BRT trend estimates.

NOAA Fisheries received a comment on the 2007 Draft Biological Opinion that the population growth rate associated with the recovery prong of the jeopardy standard should be 1.08, rather than 1.0. This productivity rate would result in doubling population size within two generations, or approximately 10 years. NOAA Fisheries defined the goal for this metric as simply being greater than 1.0 because it is not possible to define a specific level greater than 1.0 that would apply to all populations, for reasons described above. However, conclusions in the 2007 Draft Biological Opinion relied in part on estimates of lambda and other productivity measures being higher than 1.0 for many populations, and in some cases the estimates were substantially higher than 1.08. NOAA Fisheries continues to conclude that a goal of lambda greater than 1.0 is reasonable, with consideration of the mix of populations at higher levels an important qualitative consideration for reaching species-level conclusions. However, results are presented in a manner that allows comparison to 1.08 or any other particular lambda value of importance to parties in the region

Biological Review Team (BRT) Trend

NOAA Fisheries' West Coast BRT completed a status review of all listed Pacific Coast salmon and steelhead in 2005 (Good et al. 2005). In addition to estimating lambda and R/S for selected populations, the BRT calculated simple trends in abundance for all available populations. Trend is calculated as the slope of the regression of the number of natural-origin spawners (log-transformed) over the time series (Good et al. 2005). To mediate for zero values, 1 was added to the natural spawners before transforming the data. The BRT calculated the trend for 1990 to the most recently available year and for the longest time period available. The most recent year available was generally 2001 for interior Columbia River populations.

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For this SCA, NOAA Fisheries updated the BRT to include returns through the most recent year available, which was generally 2004 or 2005, using the SPAZ model (Cooney 2008b, c; McElhany and Payne 2006). The methods NOAA Fisheries used are identical to the BRT's methods and the data used is the detailed population data set provided by the ICTRT (Cooney 2007, 2008a). Only the abundance of natural-origin natural spawners was considered in the analysis. To be consistent with the other two productivity metrics and to attempt to be as consistent as possible with recent management actions, the BRT's longer time period was set to 1980 as the earliest year.

Based on the log-transformed data, a slope of 1.0 indicates a stable population (if the data were back-transformed to the original units, this slope would be zero). If the log-transformed slope is greater than 1.0, the population abundance is increasing; if it is less than 1.0, the abundance is decreasing.

The BRT trend does not track the ability of the population to sustain itself and grow in the absence of hatchery production like the R/S estimates. However, it does depict the trend in abundance of natural-origin natural spawners (including F2 progeny of hatchery-origin natural spawners) under current management, which can also be a useful characterization of status. This metric requires less information than R/S, since age structure is not required. Like the estimation of lambda described above, it is necessary to have an estimate of hatchery fraction each year. Also, like lambda, the BRT trend can be generated from any representative index of abundance consistent across a time series, such as redd counts, without being converted into numbers of spawners. The BRT trend reflects the most recent data more strongly than the other indices, since the most recent year's spawner abundance is weighted equally to all other years (i.e., not just a fraction of the last 5-year running sum or the last brood year returns).

In addition to the method of estimating uncertainty using the BRT approach as applied in the SPAZ model, a second method is also applied in the Aggregate Analysis Appendix. The second method uses a statistical bootstrap technique to generate 95% confidence intervals for the slope. This method does not match the BRT method of estimating uncertainty, which assumes that the observations are normally distributed and independent.

Alternative Productivity Metrics & Goals

NOAA Fisheries received comments on the 2007 Draft Biological Opinion suggesting the adoption of alternative productivity metrics and goals indicative of the "potential for recovery" prong of the jeopardy standard. Two have been described in previous sections: a goal of achieving $R/S = 1.42$ and a goal of achieving $\lambda = 1.08$. As described above, NOAA Fisheries does not agree that it is possible to define a specific level greater than 1.0 that would be relevant to all populations, since they are all of different sizes, with different carrying capacities, and at different levels of current abundance relative to carrying capacity. However, the Aggregate Analysis Appendix does provide results that can be directly compared with these alternative goals.

One commenter also suggested an alternative goal of achieving the ICTRT's 5% abundance/productivity goal, which represents a combination of reaching the ICTRT viability abundance threshold and of reducing extinction risk to 5% or less. This goal is associated with

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recovery and delisting in the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead (NMFS 2007c) and in drafts of other Interior recovery plans. It therefore goes beyond the “potential for recovery” prong of the jeopardy standard and would require attainment of abundance and productivity associated with long-term recovery. While NOAA Fisheries does not agree that a jeopardy determination depends on achieving this goal. Nonetheless, NOAA Fisheries finds that it is relevant to compare the survival changes expected from the Prospective Actions with the survival changes needed to attain this recovery goal. NOAA Fisheries provides this information in figures in the Aggregate Analysis Appendix.

Some comments on the 2007 Draft Biological Opinion recommended that NOAA Fisheries pay closer attention to certain steps within the *NWF v. NMFS* remand collaboration process and set goals based on work products of the remand collaboration process. In particular, a collaboration workgroup prepared a report to support “Step 4” of the collaboration’s analytical framework and attempted to apportion the ICTRT’s survival gap among different sources of human-caused mortality, including the existence and operation of the FCRPS, based on the estimated magnitude of each source of mortality (Framework Work Group 2006). NOAA Fisheries does not consider the apportionment of survival gap responsibility of Step 4 of the Collaboration Framework to be relevant to a jeopardy analysis. Nonetheless, NOAA Fisheries presents results of a Step 4 analysis in the Aggregate Analysis Appendix so that they can be compared with this alternative goal. The specific estimates of needed survival change are derived from the relative proportional impacts in Framework Work Group (2006) applied to the ICTRT’s 5% viability gaps in an analysis presented in various chapters of the CA. The CA results are displayed in the Aggregate Analysis Appendix.

Abundance versus Productivity

NOAA Fisheries received comments on the 2007 Draft Biological Opinion suggesting adoption of an explicit abundance metric and abundance “performance standards.” Discussions with some of the commenters clarified that they are primarily interested in tracking abundance during implementation of the Prospective Actions and comparing it to benchmarks such as the ICTRT’s abundance viability thresholds, rather than recommending a prospective analysis of the probability of reaching a particular abundance level under the Prospective Actions. Reporting requirements during implementation of the Prospective Actions are described in Section 2 (Proposed Action) and/or Section 4 (RPA) of the biological opinions associated with each of the Prospective Actions, and it is anticipated that population status, including abundance, will be reported.

These comments do point to a larger issue regarding the relationship between the productivity metrics included in this analysis and population abundance. As described in Section 7.1.1, the estimates in this analysis represent the *initial* productivity that would be expected following an instantaneous survival rate change. That initial change in productivity would lead to greater abundance of spawners, which in turn would lead to density-dependent interactions that would reduce the productivity rate over time. The ICTRT and Zabel (2007) used a matrix simulation model to analyze the expected changes in productivity and abundance over time for a few

populations with sufficient data, following incremental changes in FCRPS hydro survival. Three examples for populations of SR spring/summer Chinook salmon are displayed in Figures 7.1-5 through 7.1-7. These examples compare the initial productivity (R/S) calculated by the proportional change method with average R/S and spawner abundance over time, projected by the simulation model.

Figure 7.1-5. Abundance and productivity (R/S) of the Catherine Creek population of SR spring/summer Chinook salmon predicted in ICTRT and Zabel (2007, their Table 7) using a matrix simulation model. A 6.5% survival improvement is applied to the model at simulation year 1. The matrix model estimates represent means of 100,000 model runs. Matrix model results are compared to an estimate of the initial R/S productivity following instantaneous achievement of a 6.5% survival improvement using the proportional increase method in the SCA.

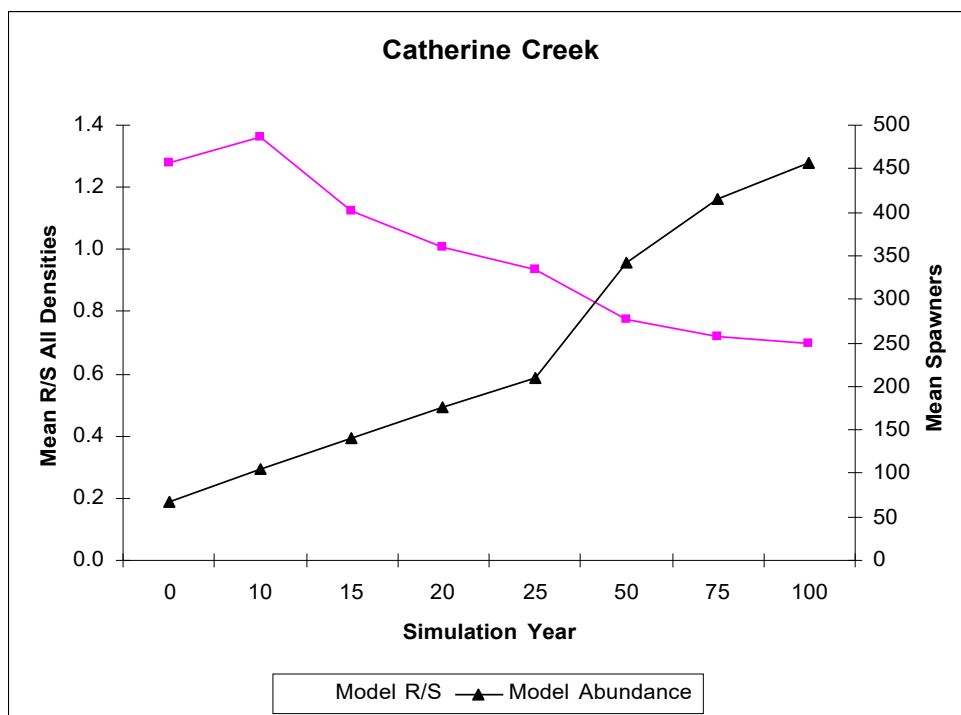


Figure 7.1-6. Same as Figure 7.1-5 for the South Fork Salmon River population of SR spring/summer Chinook salmon

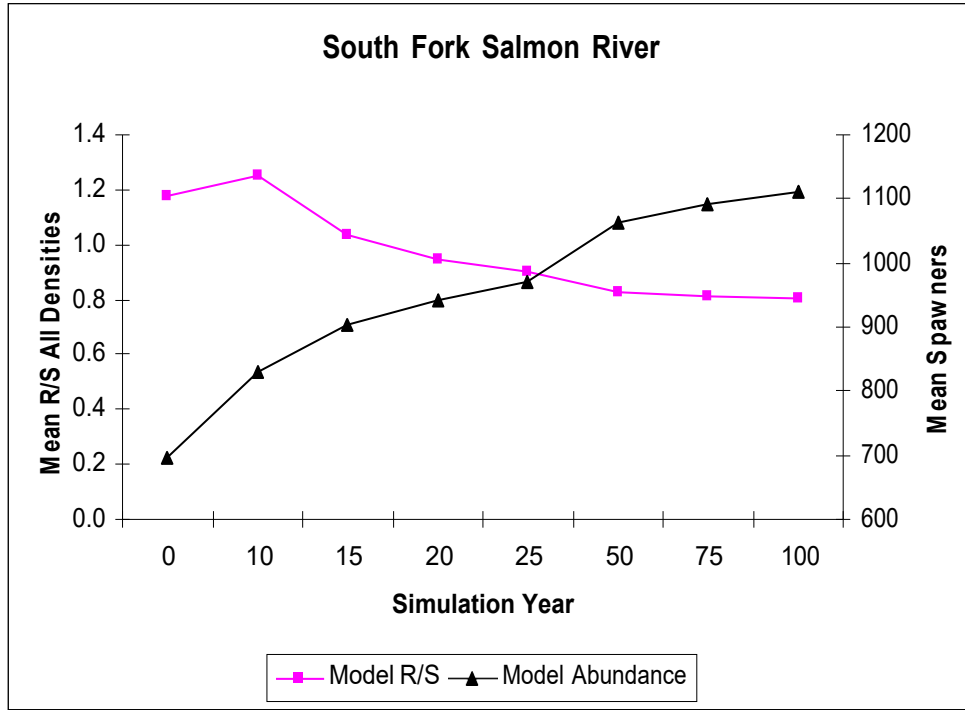
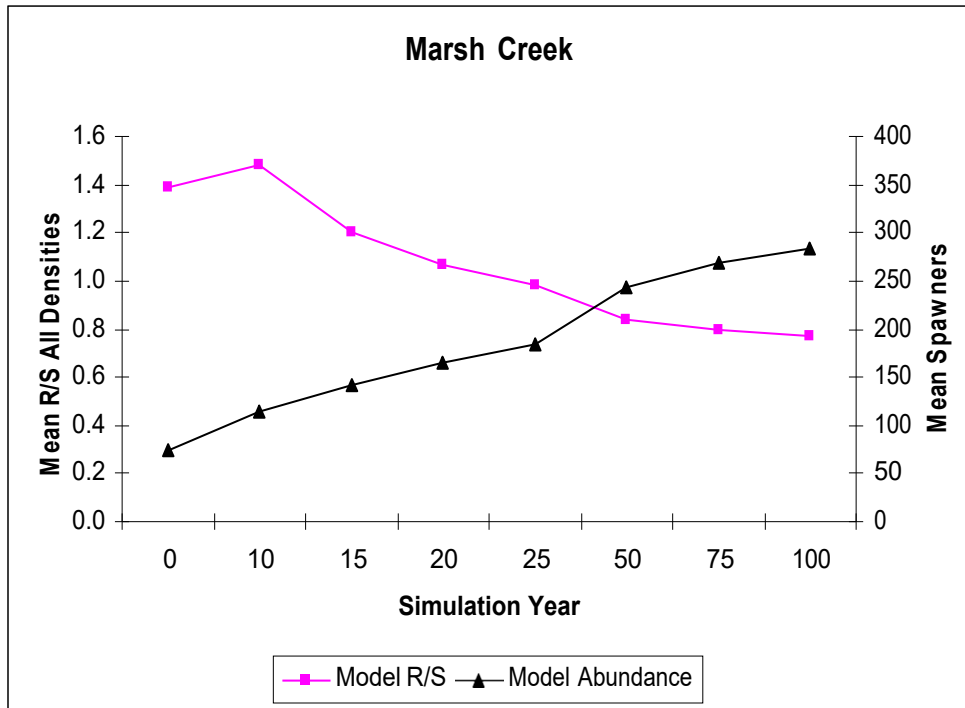


Figure 7.1-7. Same as Figure 7.1-5 for the Marsh Creek population of SR spring/summer Chinook salmon.



7.1.1.3 Summary of Key Assumptions in Analyses

Table 7.4-1 displays key assumptions in the analysis. They are characterized by whether they are somewhat optimistic, pessimistic, or neutral.

Table 7.4-1 Key analytical assumptions for the life-cycle analysis, characterized by their effect on conclusions.

<p>Optimistic Assumptions</p>	<p><i>The response to survival changes in terms of a change in productivity is not affected by density.</i> Moreover, the change in productivity represents the initial change that would occur before abundance increases. It is considered optimistic because, as abundance increases in response to the higher survival rate, productivity will decline over time due to density-dependent effects such as competition for resources. This approach is considered a reasonable way of characterizing the potential for recovery and expected progress toward recovery with the simple productivity ratio method described in this analysis and used in the <i>NWF v. NMFS</i> remand collaboration process. However, more complex modeling approaches incorporating density dependence are currently available only for a limited number of populations.</p> <p><i>All actions are implemented and biological responses occur in a single time step.</i> This assumption will underestimate short-term extinction risk; therefore, risk is bounded by the assumption that no Prospective Actions will help to reduce risk (only continuation of current actions), as well as the more optimistic assumption that all Prospective Actions will be implemented within a time period that will influence the risk of short-term extinction.</p> <p><i>Climate effects are explicitly analyzed only for early ocean survival.</i> Climate change will also affect survival in freshwater life stages but it was not possible to quantify this effect. Therefore, it is treated qualitatively by considering factors described in Section 7.1.21, such as consistency of Prospective Actions with ISAB recommendations for proactive actions in response to climate change.</p>
<p>Neutral Assumptions</p>	<p><i>The base range of uncertainty also applies to current and prospective estimates.</i> This is identical to the ICTRT assumption that the base variance applies to alternative scenarios. In the absence of data suggesting that variability will change, this is the most supportable assumption.</p> <p><i>Processes affecting population dynamics during the base period will continue into the future (i.e., they are stationary) unless modified in the analysis by explicit changes in survival expected from management actions or alternative climate conditions.</i> This assumption is supported primarily by choice of a 1980-present</p>

	<p>time period that is long enough to capture variability in biological processes but short enough to be influenced primarily by the significant management changes that have occurred in recent years.</p> <p><i>The quasi-extinction threshold (QET) is no higher than 50 spawners (ICTRT QET for long-term recovery level), and may be lower for short-term risk, especially for historically small populations that have not gone extinct after dropping below 50 spawners for four years in a row. This analysis also considers results of sensitivity analyses for QET less than 50 spawners.</i></p> <p><i>Reproductive failure in a given year occurs at or below 10 fish, per the analysis in ICTRT (2007a).</i></p> <p>Productivity at different spawner abundance levels can be described by Beverton-Holt and Ricker functions for short-term extinction risk analyses.</p>
<p>Pessimistic Assumptions</p>	<p><i>The climate scenario given the greatest weight is that base period climate will continue. This “Current” ICTRT climate scenario is dominated by poor ocean conditions and does not include a full cycle of favorable ocean conditions. This assumption is much more pessimistic than the historical climate record and is only marginally more optimistic than the worst of the recent years. For further discussion, please see Section 7.1.</i></p> <p><i>Quantitative survival changes expected to result from habitat actions only are those anticipated to accrue within 10 years. It is likely that many habitat actions will result in additional survival improvements after 2018; however, it was not possible to estimate their effects quantitatively.</i></p> <p><i>Expected survival changes as a result of new actions are not affected by density. Only density-independent survival changes are considered. For example, quantitative survival changes related to increasing habitat capacity only represent the effects of increased capacity at low density. The benefit of opening up new habitat would likely be greater at higher densities.</i></p> <p><i>Short-term extinction risk estimates are based on the assumption that supplementation ceases immediately. Sensitivity analyses to demonstrate effects of continuing supplementation on short-term extinction risk are included for selected populations.</i></p> <p><i>Hatchery operations in the basin will continue unchanged, except where specified changes are occurring or will soon occur (e.g., 8.6.5.4). Current hatchery practices</i></p>

have varying effects ranging from positive to adverse. Due to the instances where there are adverse hatchery effects, NOAA Fisheries considers the continuation of current hatchery practices a pessimistic assumption. As described in RPA 39, hatchery reform is a component of the proposed action but will be evaluated in future site-specific consultations.

7.1.2 Population-Level Qualitative Analytical Methods for all Thirteen Columbia Basin Species

In addition to the quantitative methods described above for six interior Columbia species, the jeopardy analysis considers qualitative factors for all species.

7.1.2.1 Climate Change Considerations for Both the Survival & Recovery Prongs of the Jeopardy Analysis

Qualitative considerations of weather and climate, as it affects salmon and steelhead survival, are described in Section 5.7 (Environmental Baseline). That section also summarizes recent literature on potential climate change, such as the Independent Scientific Advisory Board's comprehensive review (ISAB 2007c). Section 7.1.1 describes how weather and climate information is applied in quantitative analyses. This section describes how climate change was considered qualitatively in evaluating the effects of the Prospective Actions on listed species.

The primary qualitative method NOAA Fisheries uses to evaluate the Prospective Actions is to determine the degree to which the Prospective Actions implement recommendations by the ISAB (2007c) to reduce impacts of climate change on anadromous salmonids. The specific recommendations against which the Prospective Actions are evaluated are described in Table 7.1.2.1-1.

NOAA Fisheries also evaluates the Prospective Actions on the basis of the extent to which the Prospective Actions include:

- monitoring climate change effects on listed salmon and steelhead;
- a mechanism for continually updating and synthesizing new information regarding the effects of climate change on listed salmon and steelhead; and
- mechanisms for modifying implementation plans as necessary to respond to new information about climate change.

Table 7.1.2.1-1. Measures recommended by ISAB (2007c) to mitigate the anticipated adverse effects of climate change on Columbia basin salmon and steelhead.

Tributary Habitat
<ol style="list-style-type: none"> 1. Minimize temperature increases in tributaries by implementing measures to retain shade along stream channels and augment summer flow. <ol style="list-style-type: none"> a. Protect or restore riparian buffers, particularly in headwater tributaries that function as thermal refugia. b. Remove barriers to fish passage into thermal refugia
<ol style="list-style-type: none"> 2. Manage water withdrawals to maintain as high a summer flow as possible to help alleviate both elevated temperatures and low stream flows during summer and autumn. <ol style="list-style-type: none"> a. Buy or lease water rights b. Increase efficiency of diversions
<ol style="list-style-type: none"> 3. Protect and restore wetlands, floodplains, or other landscape features that store water to provide some mitigation for declining summer flow. <ol style="list-style-type: none"> a. Identify cool-water refugia (watersheds with extensive groundwater reservoirs) b. Protect these groundwater systems and restore them where possible c. May include tributaries functioning as cool-water refugia along the mainstem Columbia where migrating adults congregate
Mainstem & Estuary Habitat (Non-Hydro)
<p>Remove dikes to open backwater, slough, and other off-channel habitat to increase flow through these areas and encourage increased hyporheic flow to cool temperatures and create thermal refugia.</p>
Mainstem Hydropower
<ol style="list-style-type: none"> 1. Augment flow from cool/cold water storage reservoirs to reduce water temperatures or create cool water refugia in mainstem reservoirs and the estuary. <ul style="list-style-type: none"> - May require increasing storage reservoirs, but must be cautious with this strategy.
<ol style="list-style-type: none"> 2. Use removable spillway weirs (RSW) to move fish quickly through warm forebays and past predators in the forebays. <ul style="list-style-type: none"> - Target to juvenile fall Chinook salmon
<ol style="list-style-type: none"> 3. Reduce water temperatures in adult fish ladders

Mainstem Hydropower

- a. Use water drawn from lower cool strata of forebay
 - b. Cover ladders to provide shade
4. Transportation
- a. Develop temperature criteria for initiating full transportation of juvenile fall Chinook salmon
 - b. Explore the possibility of transporting adults through the lower Snake River when temperatures reach near-lethal limits in late summer
 - c. Control transportation or in-river migration of juveniles so that ocean entry coincides with favorable environmental conditions.
5. Reduce predation by introduced piscivorous species (e.g., smallmouth bass, walleye, and channel catfish) in mainstem reservoirs and the estuary

Harvest

- 1. Harvest managers need to adopt near- and long-term assessments that consider changing climate in setting annual quotas and harvest limits
 - a. Reduce harvest during favorable climate conditions to allow stocks that are consistently below sustainable levels during poor phase ocean conditions to recover their numbers and recolonize areas of freshwater habitat
 - b. Use stock identification to target hatchery stocks or robust wild stocks, especially when ocean conditions are not favorable

7.1.2.2 Qualitative Factors Affecting the Survival Prong of the Jeopardy Analysis

As defined by the ESA regulations, §402.02, "recovery' means improvement in the status of the listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act." This is consistent with ESA §4(c)(2) where a determination to remove a species from the list "shall be made in accordance with the" listing criteria. NOAA has stated that recovery depends on two types of criteria. "[E]valuating a species for potential de-listing requires both an explicit analysis of population or demographic parameters (biological recovery criteria) and also of the physical or biological conditions that affect the species' continued existence, categorized under the five ESA listing factors (listing factor criteria). Together these make up the "objective, measurable criteria" required under section 4(f)(1)(B)." See "Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance," May 1, 2007, found at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf. The qualitative factors relevant to evaluation of the potential for recovery prong of the jeopardy standard therefore are biological factors and listing factors, also referred to as "threats." The

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VSP factors (abundance, productivity, spatial structure, and diversity; see Section 7.1.1.2) inform the biological factors evaluation.

Recent abundance

Particularly low abundance levels (especially levels currently below the QET) would indicate relatively high short-term extinction risk due to factors such as demographic stochasticity (tendency for populations at low abundance to bounce around, possibly going to zero) and Allee effects (difficulty finding mates at low abundance). Conversely, relatively high abundance, especially if coupled with an indicator of sufficient productivity, would indicate a reduced likelihood of short-term extinction.

Recent productivity

In some cases productivity can be estimated but extinction risk cannot. In these cases, recent productivity, especially if coupled with information regarding abundance, can be informative. If productivity is low (e.g., the population is not replacing itself each generation or the trend in abundance has been declining), the risk of short-term extinction may be high. Conversely, a growing population can indicate a lower risk of short-term extinction.

The Degree to which Safety-Net and/or Supplementation Programs Meet Program Objectives

Some hatchery programs provide a short-term cushion to prevent extinction while longer-term recovery measures are being implemented. The hatchery programs that would serve this function are described in the individual species sections of this document, Sections 8.2 through 8.14.

The Degree to which Limiting Factors are Addressed

For some populations it is either not possible to quantify the survival changes associated with current actions and the Prospective Action or there is great uncertainty in the estimates. In this situation a qualitative description of the degree to which current and Prospective Actions reduce limiting factors is relevant to the assessment of extinction risk. Previously implemented actions and Prospective Actions with expected near-term biological benefits would likely reduce extinction risk if they substantially reduce limiting factors and threats.

Monitoring and Adaptive Management

Because there is uncertainty associated with quantitative estimates of risk and expected biological effects of current and prospective actions, it is important to have an effective monitoring program and adaptive management contingencies. It is possible to accept higher uncertainty in the ability of the Prospective Actions to avoid short-term extinction risk if a monitoring program will ensure that unexpected reductions in species status are detected in a timely manner so that contingent adaptive management actions can be implemented in response.

7.1.2.3 Qualitative Factors Affecting the Recovery Potential Prong of the Jeopardy Analysis

The qualitative factors relevant to evaluation of the potential for recovery prong of the jeopardy standard are the VSP factors: abundance, productivity, spatial structure, and distribution.

Abundance and Productivity

It is not possible to quantify abundance and/or productivity for many populations. In these cases, qualitative considerations include the similarity of populations without adequate data to populations with adequate data. In some cases, data is available for one time period but not another, so again, a qualitative consideration can substitute for quantitative analysis in those particular time periods.

Snake River steelhead is an example of a species with limited quantitative information. Data supporting abundance and productivity estimates are available for only three of the 24 extant populations. The ICTRT also estimates average abundance of A-run and B-run populations based on dam counts and assumptions about the distribution of steelhead among populations (ICTRT 2007a, c). Here, the average A-run and B-run base period estimates are applied to individual A-run and B-run populations, respectively. Then population-specific survival changes (e.g., resulting from prospective tributary habitat actions) are applied to the individual populations. This approach is taken because of a desire to match population specific actions with individual populations and the need to consider effects at the MPG level as an intermediate step to making species conclusions.

Snake River sockeye salmon are at very low abundance levels with current returns originating from a captive rearing program. As a result of the virtual absence of naturally produced returns in recent years, specific quantitative estimates of trend and productivity of that component of the ESU are not currently feasible. Qualitative characterizations of abundance and productivity are apparent just from inspection of available information.

The analysis of lower Columbia River species relies more on qualitative analysis than that for interior Columbia River species. The BRT (Good et al 2005) and the Willamette/Lower Columbia TRT (WLCTRT 2004, and McElhany et al. 2007) estimated abundance and trends for available populations in the Willamette and lower Columbia Rivers, but little or no information was available for many populations. The available data sets for Washington populations generally ended in 2001 and those for Oregon populations ended in 2005. No attempt was made to quantify changes from base period productivity to current productivity or to productivity resulting from the Prospective Action. Instead, changes were expressed mainly in terms of direction (improvement/reduction) with qualitative descriptions of magnitude.

Action-specific and life stage-specific survival trends are considered quantitatively in analyses if appropriate (e.g., hydro adjustment factors for interior Columbia River species' productivity estimates), but are also considered qualitatively for all species. An important consideration is whether improving trends in abundance and productivity are solely a result of fortuitous climate conditions or if they are also a result of beneficial human activities. Correspondence of changes in human activities, trends in life-stage survival influenced by those management activities, and trends in population abundance and productivity support the qualitative conclusion that changes in management actions are contributing to improved population status.

The qualitative factors described under Section 7.1.2.1 also apply to the recovery potential prong of the jeopardy standard, with the exception of safety-net hatcheries.

Spatial Structure

The ICTRT (2007a) and WLCTRT (2003) describe viability criteria for spatial structure. These include consideration of the number and spatial arrangement of major spawning areas (MaSA) and minor spawning areas (MiSA), the proportion of the historical range that is occupied, and increases or decreases in gaps between occupied MaSAs. The ICTRT Current Population Status Summaries (Cooney 2007) characterize the current status of spatial structure as “very low” through “high” risk for each population. The WLCTRT (2004) viability assessment provides a formalized expert opinion-based characterization and numerical rating of the spatial structure of each Willamette and lower Columbia River population. Although the ratings are presented as numbers, they actually represent qualitative categories scored through a structured expert opinion process.

In this analysis, Prospective Actions are evaluated in the context of whether they are contributing toward improving spatial structure for affected populations.

Diversity

The ICTRT (2007a) and WLCTRT (2003) described viability criteria for diversity. These include retention of major life history expressions (e.g., summer vs. spring runs), maintenance of phenotypic and genetic variability, maintenance of natural patterns of gene flow (including various criteria for assessing impacts of hatchery programs), and reduction of selective changes resulting from human activities (e.g., large fish selection in fisheries). The ICTRT Current Population Status Summaries (2007d) characterize the current status of diversity as “very low” through “high” risk for each population. The WLCTRT (2004) viability assessment provides a formalized expert-opinion-based characterization and numerical rating of the diversity of each Willamette and lower Columbia River population. Although the ratings are presented as numbers, they actually represent qualitative categories scored through a structured expert opinion process.

In the SCA, Prospective Actions are evaluated in the context of whether they are contributing toward improving diversity for affected populations.

7.2 Life-Stage-Specific & Action-Specific Analyses to Support the Life-Cycle Analysis and to Estimate Incidental Take

Section 7.1 describes methods to estimate productivity and extinction risk that incorporate population survival throughout the life cycle. In conducting the analyses described in Section 7.1, information regarding the effects of specific actions that affect survival at different life stages is needed. Section 7.2 describes methods of estimating effects of actions relevant to particular life stages. These methods also apply to the estimation of incidental take associated with Prospective Actions.

7.2.1 Hydro Methods

This section describes NOAA Fisheries’ analytical approaches to estimating how proposed changes in FCRPS system and individual project operations and changes in individual project configurations (e.g. new RSWs, etc.), collectively termed Hydro Actions, will affect fish survival. This involves a

quantitative analysis of the hydrologic effects of the Prospective Actions, detailing how proposed operations affect flows through the system and the distribution of flows through various systems at each project (i.e. spillway, versus turbine flow). These operational effects are then combined with proposed changes in system configuration and known and estimated performance characteristics of those systems to estimate the fish survival effects of the Hydro Actions through quantitative biological modeling (when possible) or through qualitative evaluations. Section 3.2.1 and Appendix B-1 of the CA provide more detailed descriptions of these analytical methods.

Sufficient information is available to quantitatively assess the effects of the hydro actions on SR spring/summer Chinook and steelhead, UCR spring Chinook and steelhead, and MCR steelhead (Section 7.2.1.1). This assessment also provides surrogate information that is pertinent to populations of lower river ESUs that migrate to and from tributaries entering the Columbia River between Bonneville and The Dalles dams. For the remaining ESUs, a more qualitative assessment was required for assessing hydro effects. This approach is described in 7.2.1.2.

7.2.1.1 Quantitative Juvenile Analysis of Hydro Actions on Five Interior ESUs

General Approach

In developing the overall analysis of the effects of the Proposed Hydro Action on listed anadromous fish, this SCA relies on hydrologic, operations, and biological model outputs and previous analyses for assessing the effects of the hydropower system on ESA-listed salmon and steelhead. In general, the analysis consists of an ESU-by-ESU analysis for three primary time periods of hydropower system existence, the Base (corresponding to the general conditions that were experienced by juveniles during the 1980-2001 outmigrations), Current (2004 FCRPS Biological Opinion operations and actions implemented through 2006), and Prospective conditions with results reported as the average across all years (the 70 year water record included the 1929 to 1998 water years).

The SCA's quantitative analysis begins with baseline survival estimates primarily provided by the TRT or other relevant sources, with consideration of estimates for key parameters (i.e., direct in-river survival, percent transported). Next, the effects of operation and configuration changes that have already occurred (Current) were estimated and compared to the Base condition (Base to Current adjustment).³ And finally, the effects of future changes in hydrosystem operations and configurations (Prospective) were estimated and compared to the Current condition (Current to Prospective adjustment). The resultant Hydro adjustments were incorporated into the life-cycle analysis (Section 7.1).

Because juvenile migrant survival is affected by flows and project operations (e.g., spill rates) and because river flows vary due to both natural climate variation and project operations, a series of

³ Note: The Base-to-Current adjustment assumes no changes have occurred in post-Bonneville survival relationships between the Base and Current periods. This is likely a conservative assumption because many actions that were implemented in the latter part of the Base period through the Current condition (increased spill, improved juvenile bypass systems, RSWs, etc.) should have generally improved the fitness (quality) of fish arriving at the Bonneville tailrace compared to the average fitness of fish observed during the entire Base period.

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models were employed to estimate the survival effects of alternative operating strategies. These models were:

- A hydrologic model
- An operations model (HYDSIM)
- A survival model (COMPASS)

Hydrologic Modeling

Historical streamflows, to the extent measured data are available, are inadequate for system regulation studies because through time, differing levels of storage and irrigation development have affected streamflows and reservoir operations. Thus, even if precipitation conditions were similar during a recent year to that experienced decades earlier, total streamflow and the streamflow pattern at a given point could be quite different due to changes in water development. For this reason, the FCRPS Action Agencies have simulated the flow conditions that would have existed throughout a 70-year hydrologic record had the current (circa 2000) level of water development been in existence during the entire period. Termed “Modified Streamflow,” the 70-year time-series used for the hydro system effects analyses conducted for this consultation approximates the expected flow conditions that would occur today over the range of hydrologic conditions experienced over the period (October 1928 through September 1998). BPA 2004 provides details on how this hydrologic simulation was accomplished.

Operations Modeling

Operations modeling refines the output of the hydrologic models, storing and releasing water from reservoirs according to operations defined by the Prospective Actions. Two system operations models were used to route the modified flows described above through the hydro system. Reclamation’s MODSIM model (updated Upper Snake MODSIM - May and June 2007 runs) was used for the upper Snake River above Brownlee Reservoir, and BPA’s HYDSIM model was used for the remainder of the Snake and Columbia River basins.

MODSIM was used to estimate inflows to Brownlee Reservoir resulting from the existence and operation of Reclamation’s upper Snake River projects and all private diversions and depletions. Input hydrology into the model includes 1928 through 2000 historical water supply period of record. The model is then configured to represent the current level of basin development, including diversions and groundwater pumping, as well as Reclamation’s operations. Thus, the model takes into account Reclamation operations (water storage, flood control releases, irrigation deliveries, delivery for flow augmentation), current level of ground water pumping, irrigation return flows, and current private activities (private water surface diversions and subsequent return flows).

The Brownlee Reservoir inflows developed by MODSIM and modified streamflows for the remainder of the Columbia basin were then incorporated into BPA’s HYDSIM model. Hydro Simulator Program (HYDROSIM, also known as HYDSIM) (BPA 1997) simulates operation of all Columbia basin projects, excluding those on the Snake River upstream from Brownlee Reservoir. For this

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analysis we assumed that Idaho Power Company's Brownlee Reservoir would be operated in a manner designed to protect downstream anadromous fish including: refilling by July 1 each year, drafting 237 thousand acre-feet (kaf) during July each year, and operating through the fall and winter to maintain spawning and incubation flows for SR fall Chinook salmon.⁴

The model produces an array of outputs including reservoir elevation, generation, and spill. User supplied constraints allow simulation of a wide array of operations. Such constraints include specified spill schedules for fish protection, reservoir drafting and refill operations for flood control, electrical power demands, reservoir drafts for flow augmentation, and irrigation withdrawals.

System operations are simulated for 14 periods per year, one for each month with April and August each divided into two periods. Based on inflows and user supplied constraints, the model routes inflows through the system creating a set of operational outputs (e.g. generation, total outflow, spill flow, reservoir storage) for each project. HYDSIM's project-specific time-series of total flow and spill flow are principal inputs to the fish survival modeling process.

Using historical flow data for each water year in the 70-year record, MODSIM and HYDROSIM can be used to project how water would pass through the upper Snake, lower Snake, and Columbia River systems, respectively. For example, the models can be used to project how flows would be distributed through any one of the periods (14 for HYDSIM and 12 for MODSIM) for multiple locations in the system for a selected high-, medium-, or low-flow year and the models can estimate the water distribution effects of alternative project operations.

The output of HYDSIM is then modulated into estimated daily flows (NMFS 2008g) for use in the biological modeling – which incorporates flow as a predictive variable for estimating fish survival through the FCRPS. The overall results of the hydroregulation modeling are presented in CA Appendix B.

Biological Modeling

In collaboration with regional parties, NOAA's Northwest Fisheries Science Center developed a Comprehensive Fish Passage (COMPASS) model (see Corps et al. 2007a Appendix B.3) to assess the likely effects of alternative hydrosystem operations on juvenile survival and post-Bonneville dam survival for five interior basin ESUs: SR spring/summer Chinook salmon, SR steelhead, UCR spring Chinook salmon, UCR steelhead, and MCR steelhead. The model was populated with the best empirically derived estimates of route-specific passage and survival rates available for juvenile Chinook or steelhead to reflect the current configuration of the hydrosystem. The FCRPS Action

⁴ In order to provide an analysis of the aggregate effects of both the Upper Snake Reclamation projects and the FCRPS projects on flows in the lower Snake and Columbia Rivers, some assumption of the operation of Idaho Power Company's Hells Complex (which includes Brownlee Reservoir) was required, because of its physical location between these two systems. NOAA Fisheries chose to assume an operation that is generally reflective of recent operations of this project. However, because the relicensing of the Hells Canyon Complex is a future Federal action that has not yet undergone consultation, NOAA Fisheries does not otherwise consider the effects of this project in this Supplemental Comprehensive Analysis.

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Agencies assessed the likely benefits of prospective action configuration actions to assess their overall effect on survival in the prospective analysis. The operations modeling results were modulated into appropriate formats for input into COMPASS (daily flows and spill rates) (NMFS 2008g), and then the model was run to estimate the effects (across the 70 year water record) of Current and Prospective operations of the mainstem Snake and Columbia River dams and reservoirs on fish survival.

A paper describing the COMPASS model has been provisionally accepted for publication in *Hydrobiologia* (Zabel et al. 2007). The COMPASS model is composed of five modules: 1) reservoir survival, 2) dam passage and survival, 3) fish travel time, 4) hydrology, and 5) post-Bonneville survival. The COMPASS model was generally reviewed by the Independent Scientific Advisory Board (ISAB) during its development (ISAB 2006a, b). The ISAB also reviewed post-Bonneville survival hypotheses, including the Scheuerell – Zabel hypothesis used in the COMPASS model for the analysis in this SCA (ISAB 2007b). NOAA Fisheries considers the COMPASS model to represent the best scientific information available for the purposes of assessing the biological effects of alternative hydrosystem operations. A detailed description of the COMPASS model can be found in the COMPASS model documentation (NMFS 2008g).

Key parameters estimated by the COMPASS model provided for both the Current and Prospective operations include:

- direct system survival (combined survival of both in-river and transported fish starting at Lower Granite Dam for Snake River ESUs and McNary Dam for Upper Columbia River ESUs) to the Bonneville Dam tailrace;
- smolt to adult returns (SARs) of both transported and in-river migrating juveniles from the Bonneville dam tailrace, to the ocean, and back to the Lower Granite Dam for Snake River fish, or to Rock Island dam for Upper Columbia River fish (Scheuerell and Zabel 2007);
- total SARs for Snake River (system survival estimates) \times (post-Bonneville smolt to adult returns).

For the Snake and Upper Columbia River ESUs, total SARs were used to inform the hydro adjustment (current-to-base). For upper Columbia River ESUs, the biological effects were aggregated with the observed (base-to-current) or expected (current-to-prospective) survival improvements resulting from actions taken to improve juvenile survival through the mid-Columbia PUD dams. This was a result of settlement agreements and Biological Opinions (NMFS 2006e hydro module for recovery planning) (effects that are in the environmental baseline considered in this SCA). For Mid Columbia River steelhead, which includes populations that migrate through one to four lower Columbia River dams, there was insufficient information to assess a post-Bonneville survival relationship. For this ESU, the CA only utilizes changes in estimates of system survival in the Base, Current, and Prospective adjustments and does not include an assumption that post-Bonneville survival might be affected through the implementation of the Prospective Actions. The Current and Prospective condition estimates are provided in Chapters 5, 7, 8, 9 and 10 of the CA and in Appendices B.3 and B.4. The COMPASS modeling results for the Prospective Actions considered in this SCA are located in the SCA Hydro Modeling Appendix.

It should be specifically noted that the in-river survival estimates reported for the Base, Current, and Prospective analysis, aggregate the three primary sources of mortality (existence, operational, and natural) between Lower Granite dam on the Snake, Rock Island Dam on the middle Columbia, and Bonneville dam tailrace. Natural mortality certainly existed prior to the existence and operation of the FCRPS. However, no attempt is made to distinguish current natural mortality from other sources within the hydro analysis for this document.

7.2.1.2 Analysis for Juvenile Migrants of Other ESUs

For the Lower Columbia and Willamette ESUs and for Snake River Sockeye, for which existing information is not sufficient for quantitative analysis of hydropower system effects, NOAA Fisheries must rely on a more qualitative approach.

The first approach uses information obtained through the quantitative assessment described in 7.2.1.1 for the more data rich ESUs. They provide a surrogate analysis for the effect of the FCRPS hydro actions on ESUs having one or more populations that commonly migrate through Bonneville reservoir and dam (LCR Chinook salmon, Coho salmon, and steelhead). Specifically, the in-river Bonneville reservoir and dam survival estimates (for the most closely related species) produced by COMPASS for the Current and Prospective periods are used as the estimated hydro survival adjustment for those populations spawning upstream of Bonneville Dam. For LCR coho salmon, the expected benefit for spring Chinook salmon would be used. NOAA Fisheries also considers qualitatively, information provided by the FCRPS Action Agencies in the CA's species specific analysis (CA Chapters 12, 13, and 14) in considering the overall effects of the FCRPS and the hydro actions required by the RPA on these ESUs.

The second approach relies on providing professional judgment to qualitatively assess the likely effect of the FCRPS hydro actions on the ESUs for which empirical information is insufficient to provide useful quantitative assessments (SR fall Chinook salmon, SR sockeye, and CR chum). In this case, NOAA Fisheries considers the qualitative assessment made by the FCRPS Action Agencies in the CA and also any other information that would aid in the assessment of how these species are currently affected by the FCRPS and their likely response to the hydro actions required by the FCRPS RPA.

Lastly, no portion of the UWR Chinook salmon and steelhead ESUs migrate upstream of Bonneville Dam, other than as infrequent strays. For this ESU, NOAA Fisheries assumes that the FCRPS effects on the quantity and timing of flows (as described in the Environmental Baseline) will continue to affect these ESUs, but hydro actions required by the Prospective Actions will not benefit these ESUs in any substantial way.

7.2.1.3 Methods for Adult Migrants of All ESUs

Recent survival of adult salmon and steelhead migrating through the FCRPS was assessed to identify ESU specific adult performance standards (and to estimate incidental take). NOAA Fisheries and the FCRPS Action Agencies, in collaboration with the Policy Work Group, adopted a methodology that

removes the influence of several confounding variables (harvest and “natural” or transportation related stray rates)⁵ that obscure the true effect of the mainstem FCRPS dams on the survival of migrating adults. The assessment is based on returning adults⁶ detected at Bonneville Dam and redetected upstream at McNary dam or Lower Granite Dam (depending upon the ESU in question). Only returning adults of known origin, PIT-tagged as juveniles that migrated in-river to below Bonneville were included in the analysis to correct for the confounding variables identified above. See BA Section 2.1.2.2, Appendix B.2.6-2, and SCA Adult Survival Estimate Appendix for a more detailed description of this methodology.

This methodology is also used to develop standards for adult steelhead, recognizing the limitations/uncertainties of the harvest rate information available at this time. Similarly, this methodology is applied to the available information for Lake Wenatchee and Okanogan River sockeye salmon as a surrogate for adult Snake River sockeye survival. In this analysis, NOAA Fisheries qualitatively assesses the likely survival and effects of the Prospective Actions on migrating adults from these ESUs.

7.2.2 Tributary Habitat Analysis Methods

The approach the Action Agencies used to estimate habitat improvement and survival benefits, which NOAA Fisheries adopts for its analysis, is briefly described here and more fully described in Appendix C of the CA. For the reasons that follow, NOAA Fisheries finds that this approach utilizes the best science available for the task of assessing the effects of actions occurring across the basin, affecting a variety of listed salmonid ESUs/DPSs.

The method to identify the status and potential to improve survival and recovery of listed salmon and steelhead through improvement of tributary habitat conditions is based on an approach developed by the Remand Collaboration Habitat Workgroup (CHW). The CHW convened at the request of the Policy Work Group (PWG), formed as part of the court-ordered remand of NOAA Fisheries’ 2004 FCRPS Biological Opinion. The CHW reviewed and updated the method described in Appendix E of the 2004 FCRPS Biological Opinion (NMFS 2004a). The Appendix E method was employed by NOAA Fisheries in 2004 to estimate the potential improvement from habitat mitigation actions. The approach in Appendix E used the best available information at the time to estimate effects of the tributary habitat proposed action for the 2004 FCRPS Biological Opinion. However, additional information has become available from recovery planning and other efforts that have occurred since the 2004 FCRPS Biological Opinion was issued.

The CHW met regularly during the spring and summer of 2006 (See § 2.2.1, Appendix C, Attachment C-1, of Corps et al. 2007a). CHW members included representatives from the sovereign States and

⁵ As will be demonstrated in Chapter 8, for some species, transportation of fish as juveniles results in elevated straying rates of returning adults.

⁶ Chinook salmon jacks (small, male fish returning to freshwater to spawn after spending only one year in the ocean) were excluded because these smaller fish are not as vulnerable to the fisheries upstream of Bonneville Dam as are the larger 2+ ocean “adult” fish.

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Tribes and Federal Agencies involved in the Collaboration process. The CHW consideration of a number of approaches, such as best professional judgment and EDT. Ultimately the CHW developed a process and provided information that could be used to update the Appendix E method from the 2004 FCRPS Biological Opinion. Appendix C of the Action Agencies' CA contains a full description of their approach.

The CHW's approach to estimating habitat benefits relies on the following sequence of steps:

1. Identify the primary factors limiting the recovery of salmon and steelhead populations,
2. Identify the tributary habitat actions (or types of actions) that could be implemented to address those limiting factors,
3. Estimate the current habitat function,
4. Estimate the habitat function that could be obtained by 2018 (within 10 years) by implementing all tributary habitat restoration actions that were identified for implementation by 2018,
5. Estimate the habitat function that could be obtained after 2018 (within 25 years) by implementing all tributary habitat restoration actions that were identified as planned by 2018, and
6. Convert estimated overall habitat functions to survival estimates.

This sequence of steps can produce estimates of the habitat condition and of the potential for salmon survival improvement from habitat actions. Briefly, the logic path began with the identification of individual populations and the population-specific limiting factors. If limiting factors could be further differentiated by subpopulation, the proportional subpopulation area was identified. Then, the degree that actions implemented to address those limiting factors in those areas would improve habitat quality in that subarea was estimated. This logic path provided the basis for estimating changes in habitat function for salmon and steelhead populations as a result of implementing habitat actions. Local biologists provided information for steps 1-5, the products of which the Action Agencies use to complete step 6 based on general habitat/survival relationships developed within the CHW.

This approach is thus based on best available information from local field biologists and recovery planners and general empirical relationships between habitat quality and salmonid survival. Local biologists considered the primary limiting factors identified in recovery planning as well as the tributary habitat actions needed to address those limiting factors. These biologists then estimated the change in habitat function that would accrue if habitat actions were completed as intended. Professional judgment by expert scientists provided a large part of the determination of habitat function in all locations given the limited extent of readily-available empirical data and information. Although NOAA Fisheries recognizes that empirical data and information provides the best insight for determining habitat functioning and salmonid survival, the extent of readily-available empirical data was not adequate to make a precise determination of habitat function and salmonid response uniformly throughout the

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Columbia River Basin. NOAA Fisheries finds that the approach developed, and information gathered, through the CHW and subsequently applied here represents the best available information that consistently can be applied over the larger Columbia Basin to estimate the survival response of salmonids to habitat mitigation actions.

The Action Agencies used this method to estimate survival improvement from specific actions completed from 2000 to 2006 and those to be implemented from 2007 to 2009 (see Table 1-6 in Attachment B.2.2-2 to Appendix B of the FCRPS BA [Corps et al. 2007b]). The FCRPS Action Agencies also identified further survival commitments for specific populations which will guide their development of projects to be implemented from 2010-2018. These population-specific survival commitments are identified in CA Appendix C-1, Tables 1-5 (Corps et al. 2007a). Although these future projects have not yet been identified, the resulting estimated survival will be determined during the project selection process using the same approach as described in Appendix C of the CA. The performance of this habitat mitigation program will be measured against these survival commitments.

NOAA Fisheries finds, from available scientific literature on the subject of salmon habitat restoration, that many habitat restoration projects can improve salmon survival over relatively short periods of time. Examples include increases in instream flow, access improvements to blocked habitat and reducing mortality resulting from entrainment at water diversion screens. However, other habitat improvements, such as sediment reduction in spawning gravels and the restoration of riparian vegetation and stream structure, may take decades to realize their full benefit (Beechie et al. 2003). NOAA Fisheries was able to quantitatively or qualitatively consider the post-2018 effect of identified actions proposed for implementation between 2007 and 2009 (Corps et al. 2007a, Appendix C Attachment C-1). In contrast, because the specific habitat projects that will be funded between 2010 and 2018 have not been identified, the type and magnitude of the long-term benefits emerging beyond 2018 cannot be described. NOAA Fisheries recognizes that there will be qualitative improvements that accrue for some populations beyond 2018 even though the actual benefit cannot be quantified at this time. Nevertheless, NOAA Fisheries expects that future projects will be selected in a similar method as those identified for 2007 through 2009, as the Action Agencies have committed to implement habitat projects that address population-specific limiting factors to achieve identified population survival commitments. The Action Agencies will implement a habitat restoration strategy which will result in both short and longer-term accrual of survival benefits to focus populations. In NOAA Fisheries' analysis it is assumed that for the duration of the Biological Opinion the Action Agencies will continue to implement a mixture of actions which will result in short and long-term accrual of survival benefits to those populations.

NOAA Fisheries' analysis of the effect of the habitat Proposed Actions is based on the assumption that all estimated life-stage and population-specific survival benefits (or ESU/DPS for the estuary) estimated by the Remand Collaboration Habitat Workgroup process will be realized as a result of implementing actions to improve overall habitat quality. NOAA Fisheries' confidence in this assumption is supported by the following observations. First, the application of the general empirically-based relationships between habitat quality and salmonid survival that the CHW method uses to convert improvement in habitat quality into salmonid survival response is a reasonable

approach given the qualitative nature of the information available. Second, the survival improvements estimated to accrue as a result of the Proposed Actions are within the range of potential survival benefits identified in completed or developing recovery plans. NOAA Fisheries' analysis and conclusions are based on those biological survival commitments by the Action Agencies which NOAA Fisheries finds can be achieved through project implementation through 2018.

7.2.3 Estuary Habitat Analysis Methods

Habitat projects in the Columbia River estuary were evaluated for their potential to improve the survival of salmon and steelhead in the estuary, which extends from Bonneville Dam at River Mile 146 to the mouth of the Columbia, including the river's plume. The approach used builds on information in the *Guidance from the Habitat Technical Subgroup of the FCRPS Hydropower BiOp Remand Collaboration for Providing Columbia River Basin Estuary Habitat Action Information*, provided to the Policy Work Group on August 18, 2006 (Habitat Technical Subgroup 2006a). To estimate project-specific survival benefits, each project was linked to a recommended recovery action which addressed significant limiting factors in NOAA Fisheries' draft *Columbia River Estuary Recovery Plan Module* (NMFS 2006b), and then evaluated in terms of the project's relative contribution to complete implementation of the recommended recovery action. The evaluation included baseline projects (those completed between 2000 and 2006), current projects in various stages of development (2007 through 2009), and future anticipated projects not yet identified (years 2010 through 1017). The approach used to estimate habitat improvement and survival benefits is fully described in Appendix D, Attachment D-1 of the CA. The projects are described in the CA, Appendix D, Attachment D pages D-1-7-10.

7.2.4 Hatchery Methods

Qualitative and quantitative assessments for analyzing hatchery effects are used in this Supplemental Comprehensive Analysis.

7.2.4.1 Qualitative Assessments of Hatchery Effects

Available information, including NOAA Fisheries' Salmonid Hatchery Inventory and Effects Evaluation Report (SHIEER [NMFS 2004b]), the Hatchery Effects Appendix, and NOAA Fisheries' Artificial Propagation for Pacific Salmon Appendix were used to provide qualitative assessments of every hatchery program located in the Columbia Basin, including programs in the lower Columbia and Willamette Rivers.

7.2.4.2 Quantitative Assessment of Hatchery Effects

The hatchery benefits estimation methodology is described in Stier and Hinrichsen (2008), which is included as Attachment 1 of Quantitative Analysis of the Hatchery Actions Appendix. This methodology was quantitatively applied to assess hatchery effects on the UCR steelhead DPS and on SR spring/summer Chinook in the Grande Ronde MPG. The following considerations are important for using the Stier and Hinrichsen (2008) methodology and are used by NOAA Fisheries to estimate

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changes in natural productivity from hatchery reform actions for Upper Columbia River steelhead, Upper Columbia River spring Chinook and Snake River spring/summer Chinook salmon.

The Stier and Hinrichsen (2008) methodology:

- is most useful when direct measures of natural productivity are not available,
- estimates changes in productivity for natural-spawning hatchery fish, and not naturally-spawning, natural-origin fish,
- is particularly sensitive to the quality and quantity of spawner composition data (i.e., the number and proportion of natural spawners comprised of hatchery-origin and natural-origin fish) and to natural-origin and hatchery-origin natural spawner spatial and temporal distribution data,
- assumes density-independent population dynamics,
- should not be used to estimate prospective changes in natural productivity when hatchery reforms are not reasonably certain to occur. Reforms included in NOAA Fisheries' approved Tribal Resource Management Plans, Hatchery and Genetic Management Plans, and Endangered Species Act Section 10 permits or Section 7 consultations are considered reasonably certain to occur,
- does not account for genetic and ecological effects on natural productivity from naturally spawning hatchery-origin fish quantitatively, so NOAA Fisheries will describe these factors qualitatively in the effects analysis (Chapter 8) for each species, and
- recognizes and accounts for limiting factors that reduce or preclude the potential for hatchery reform to increase natural productivity (see Artificial Propagation for Pacific Salmon Appendix). For example, hatchery supplementation may offer little potential to increase the number of recruits and establish a trend toward recovery if the quality and or quantity of spawning habitat is limiting natural productivity.

Where natural-origin fish (NOF) and hatchery-origin fish (HOF) spawn naturally, estimating the natural productivity of a population requires estimates of the proportion of natural spawners comprised of HOF, and the relative effectiveness of HOF. Information on historical natural spawner composition is provided by the ICTRT and is used in the Quantitative Analysis of Hatchery Effects Appendix estimates. Berejikian and Ford (2004) provide the basis for hatchery effectiveness estimates and the Quantitative Analysis of Hatchery Effects Appendix also uses results from Araki et al. (2007a).

Four categories, based on broodstock management scenarios, are used for determining HOF effectiveness relative to NOF:

Category 1 includes non-local domesticated broodstock, HOF<30% as effective as NOF,

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Category 2 hatchery broodstock is comprised almost exclusively of local-origin NOF broodstock, HOF 90-100% as effective as NOF,

Category 3 includes local-origin NOF and HOF broodstock, <30% (6-45% based on Araki et al. 2007a) as effective as NOF,

Category 4 includes captive and farmed broodstocks.

7.2.5 Predation Methods

7.2.5.1 Tern Predation Analysis Methods

The estimated benefit of reducing predation on juvenile salmon and steelhead by Caspian terns on East Sand Island was calculated by modeling a reduced prospective tern population level. This prospective population was based on the 'Future 2' population objective, or 3,125 breeding pairs established in the 2005 *Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary FEIS* (USFWS 2005) The effect of reducing tern predation was estimated at the ESU level since insufficient information was available at the level of the individual population. A more detailed treatment of the method used to estimate the benefit of reducing Sand Island tern predation is presented in Chapter 3 and Appendix F, Attachment F-2 of the CA.

Any estimate benefit of reduced tern predation is sensitive to assumptions about the additive or compensatory nature of mortality from tern predation. The projected benefits identified in the CA (Appendix F) assume complete additivity (no compensatory mortality), i.e., every salmonid not consumed by terns survives all other sources of mortality. However, if some portion of the tern's predation consists of salmonids predestined to die as a result of illness, poor condition or other predators, the survival improvements modeled above would need to be reduced accordingly to estimate the actual survival improvements from tern relocation. Since current literature and empirical data do not identify more specific estimates or ranges, NOAA Fisheries assumes that tern predation likely falls between being completely additive or completely compensatory (Roby et al. 2003). Consequently, in estimating the effect of reducing tern predation NOAA Fisheries assumed a hypothetical compensatory mortality of 50% (Roby et al. 2003).

7.2.5.2 Pikeminnow Predation Analysis Methods

To assess the likely effect (current-to-prospective survival adjustments for juvenile salmon and steelhead) of continuing the expanded Northern Pikeminnow Management Program (NPMP) on salmon and steelhead populations, NOAA Fisheries uses the methodology described in CA Appendix F-1.1. This methodology relies on the Oregon Department of Fish and Wildlife's evaluations of the effectiveness of the NPMP to date and on modeling (consistent with the general assumptions and model parameters used in evaluating the cumulative benefits of the NPMP) the juvenile salmon survival benefits associated with implementing an increased incentive program (Prospective Predation Management Action 1 – BA Section 2.6.1). The general approach employed by NPMP analysts involves applying an appropriate northern pikeminnow consumption rate on juvenile salmonids (temporally and spatially) to the number of additional northern pikeminnow removed (temporally and

spatially) to determine “number of smolts” not eaten. This provides an indication of potential incremental benefit of increased removals, assuming no significant inter-or intra-specific compensation.

7.2.5.3 Marine Mammals Predation Analysis Methods

The method NOAA Fisheries uses to assess the likely effect (base-to-current survival adjustment) of marine mammal predation on adult salmon and steelhead in the Bonneville Dam tailrace is described in NMFS 2007e. The analysis generally relies on estimates of annual consumption made by Robert Stansell (Corps) reported in WDFW et al. (2006) updated with 2007 estimates and fishway counts of Chinook salmon and steelhead at Bonneville Dam through May 31. Based on the effectiveness of management actions taken to date, NOAA Fisheries assumes Predation Management Action 7 (Corps et al. 2007 Section 2.6.3) to limit or reduce the potential for sea lion predation in the future will prevent increases above current levels in the future (i.e., the current-to-prospective adjustment is zero).

7.2.6 Methods for Evaluating the Effect of RM&E Actions

The research and monitoring Prospective Actions which will be implemented to ensure hatchery-and habitat-based RM&E actions are comparable (and often identical) to those analyzed in several recently completed scientific research and enhancement biological opinions (NMFS 2004a; NMFS 2005f, 2005g, 2005h, 2005i, 2005j, 2005k, 2005l, 2005m; NMFS 2006f and 2006g). NOAA Fisheries used these analyses within these Biological Opinions as a basis for evaluating the effects of the research and monitoring actions covered in the habitat and hatchery Prospective Actions. Similarly, hydro-related RM&E Prospective Actions are likely to be qualitatively and quantitatively similar to hydro RM&E activities that occurred in 2007 and their effects are likely to be nearly identical to the level of injury and mortality authorized in 2007.

7.3 Methods for Considering Population Level Analysis at ESU/DPS level

The Jeopardy and Metrics memos outline NOAA Fisheries’ expected technical considerations in making its jeopardy determination in biological opinions that reference this Supplemental Comprehensive Analysis and state in part:

In the end, NOAA Fisheries will exercise its best scientific and professional judgment as to whether the mitigation measures are sufficient to reasonably expect that: (1) the ESUs currently on a trend toward recovery will maintain that trend, and (2) ESUs not currently on such a trend will be started on such a trend. [NMFS 2006h]

Additionally, NOAA Fisheries considers that:

[t]he ESA requires the jeopardy determination to be made at the ESU level. NOAA Fisheries will consider metrics and other information relevant to the population and major population group (MPG) in making a jeopardy determination for an ESU. [NMFS 2006h]

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Consistent with this, NOAA Fisheries evaluated all information at the population and MPG level in its ESU level determination, including the TRT products and other relevant scientific information (NMFS 2006h). Both the Willamette/Lower Columbia and Interior Columbia TRTs, when considering long term recovery goals, recommended that for an ESU/DPS to be considered at low risk of extinction (and therefore viable), all MPGs in that ESU/DPS should be at low risk.

Based on these TRT recommendations, other information and the two guidance memos cited above, NOAA Fisheries considered the population level analyses described earlier in this chapter in assessing the trend of each MPG. For this jeopardy analysis, NOAA Fisheries considered an MPG to have a trend toward recovery if a sufficient number of populations within the MPG have a trend toward recovery.

NOAA Fisheries has determined that it may not be necessary for all of the populations to have a trend toward recovery in order for an MPG to have a trend toward recovery, and likewise, it may not be necessary for all of the MPGs to have a trend toward recovery in order for the ESU/DPS as a whole to be on such a trend. In other words, there is more than one combination of populations and MPGs at various risk levels and trends that constitutes an ESU/DPS on a trend toward recovery. In making this determination, NOAA Fisheries considered all factors, including the importance of each population in the ESU/DPS, the strength of each population, and the presence of safety net programs.

In its assessments, NOAA Fisheries considered the aggregated effects of the environmental baseline, cumulative effects and the Prospective Actions, using quantitative analyses at the population level as well as qualitative considerations. NOAA Fisheries also identified any limiting factors (i.e., threats) at the population level likely to be affected by the Prospective Action.

For species with sufficient data, NOAA Fisheries first describes the performance of each population within an MPG with respect to quantitative and qualitative indicators of short-term extinction risk and a trend toward recovery under the Prospective Actions. If there are differences in performance by population, we review the relative importance of each population to the MPG and ESU, based primarily on information from TRTs and recovery planning documents. For example, some populations may be particularly important because of unique life history characteristics, while others may be important because they are relatively large populations that represent the main repositories of fish in a given area.

The degree to which each population and MPG is individually analyzed varies with the species, due to varying amounts of relevant information as described in previous sections. In general, this process has resulted in more detail for most interior Columbia populations than for lower Columbia populations and Snake River sockeye salmon due to available information and degree of the impact of the FCRPS on the populations.

NOAA Fisheries considers additional factors in evaluating whether the Prospective Actions avoid jeopardy for each species:

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- If a particular VSP factor is not expected to be sufficiently addressed by the Prospective Actions, is this because it is affected by a long-term listing factor or threat that will require many years to correct? Correcting some problems may in fact take many generations. In this case, NOAA Fisheries considers whether the Prospective Actions are addressing this factor, and if the level of effort is reasonable in the context of what is feasible to accomplish during the next 10 years.
- If it is unlikely that all important populations in an MPG will have low short-term extinction risk and be on a trend toward recovery under the Prospective Action, is the Prospective Action providing higher benefits for other populations in the MPG to help offset the poorer-performing populations?

In evaluating the likelihood that an ESU will survive and trend toward recovery, NOAA Fisheries has been informed by the descriptions and priorities of the TRTs and other sources. Ultimately, NOAA Fisheries relies on its own judgment to determine if the aggregated effects of the Prospective Actions, environmental baseline, and cumulative effects result in the ESU as a whole, meeting those standards.

One comment on the 2007 Draft Biological Opinion recommended that the jeopardy determination be dependent on achieving MPG viability scenarios recommended by the ICTRT. While NOAA Fisheries considered these scenarios, they were presented by the ICTRT as one possible way of achieving long-term recovery goals and not as the sole method of doing so. They also represent long-term viability scenarios, rather than a product intended to be used in reaching jeopardy determinations.

7.4 Critical habitat analysis methods

The ESA requires, in part, that the Prospective Actions are not likely to result in the destruction or adverse modification of designated critical habitat. ESA § 7(b)(3)(A), see Section 1.7 above.

This section describes how NOAA Fisheries determines that the Prospective Action meets this requirement. The value of the species' habitat for their conservation, resulting in their recovery and delisting, is a guiding factor in the designation of critical habitat and therefore also in assessing any destruction or adverse modification. 16 U.S.C.A § 1532(5)(A).

The factors that directly influence the conservation value of critical habitat, and thus are relevant to NOAA Fisheries' assessment of the status of critical habitat within the action area, are the essential physical and biological features of that habitat. These include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water, velocity, space, and safe passage.

The specific habitat requirements for each species differ by life history type and life stage. These are described in more detail for each species in Sections 8.2 through 8.14. NOAA Fisheries uses the following framework for analyzing the effects of a Prospective Action on designated critical habitat for each species (NMFS 2005n).

Status of Designated Critical Habitat—Rangewide and Under the Environmental Baseline⁷

- Identify and describe the primary constituent elements of designated critical habitat for each species.
- Describe the conservation role that the designated critical habitat provides in terms of its primary constituent elements (PCEs) referring to available recovery plans and recovery planning materials.
- Describe the current pre-Prospective Action condition of designated critical habitat relative to the functionality of its PCEs as needed to support the species' near term survival and long term trend toward recovery.

Cumulative Effects

- Describe beneficial and adverse effects of non-Federal actions that are reasonably certain to occur relative to the functionality of PCEs needed to support the species' near term survival and long term trend toward recovery.

Effects of the Proposed Action

- Describe both the beneficial and adverse effects of the Prospective Action, including its mitigation measures, on PCEs and how they will influence PCE function and the conservation role of the various critical habitat areas affected.
- Describe the nature, distribution, magnitude, duration, timing, intensity, frequency, and proximity of the effects and relate these to the species' life history characteristics and requirements.
- Describe the resulting trend of PCEs, including short-term degradations that are eventually offset by mitigation actions.
- Evaluate the certainty of any Prospective Actions intended to improve PCE function and the consequence for the species of any delay expected in their implementation.
- Consider the effects of the action on the success of future recovery planning, i.e., determine whether the Prospective Action limits options available for future recovery planning.

Synthesis and Conclusion

- Describe the aggregate effects of the environmental baseline, cumulative effects and the Prospective Action on PCE function and the conservation value of critical habitat.
- After implementation of the action, would critical habitat remain functional (or retain the current ability for the PCEs to become functionally established) to serve the intended conservation role for the species in the near and long terms?

⁷ For the interior species, the action area encompasses almost all designated critical habitat of the species. Therefore, the description of the status of critical habitat in the action area is the same as that for all designated critical habitat.

Chapter 8

Effects Analysis for Salmonids

- 8.1 Effects Specific to this Action**
- 8.2 Snake River Fall Chinook**
- 8.3 Snake River Spring/Summer Chinook**
- 8.4 Snake River Sockeye**
- 8.5 Snake River Steelhead**
- 8.6 Upper Columbia River Spring Chinook**
- 8.7 Upper Columbia River Steelhead**
- 8.8 Middle Columbia River Steelhead**
- 8.9 Columbia River Chum**
- 8.10 Lower Columbia River Chinook**
- 8.11 Lower Columbia River Coho**
- 8.12 Lower Columbia River Steelhead**
- 8.13 Upper Willamette River Chinook**
- 8.14 Upper Willamette River Steelhead**

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Chapter 8

Effects Analysis

This Chapter briefly identifies the anticipated effects of Reclamation's proposed actions in the Upper Snake basin. These actions are then combined with the RPA actions from the FCRPS Opinion and other actions that are interrelated or interdependent, and the environmental baseline, to estimate the combined direct and indirect effects on the listed species and their critical habitats. Results of these analyses are presented for each ESU in Sections 8.2 through 8.14.

For this Opinion, NOAA Fisheries conducted a comprehensive analysis of effects that builds upon the description of effects in the Environmental Baseline in Chapter 5, describes and adds the anticipated effects of the Prospective Actions and all identified Cumulative Effects (Chapter 6), and; considering the current status of each ESU and its MPGs (Chapter 3), estimates the likely combined effects on the future status of the species. Wherever possible we present these effects in quantitative terms, including the quantitative survival and recovery metrics described in Chapter 7. This comprehensive analysis is also presented in the Chapter 8 of the Supplemental Comprehensive Analysis which NOAA Fisheries hereby incorporates by reference.

8.1 Effects Specific to this Action

Reclamation's Upper Snake proposed action will affect listed ESUs from the base of Hells Canyon Dam to the Columbia River estuary and that portion of the Pacific Ocean affected by the Columbia River plume. All of the anticipated effects of Reclamation's proposed action are captured in the analysis presented in the Supplemental Comprehensive Analysis, Chapter 8.

8.1.1 Hydrologic Effects of the Action

At NOAA's request, Reclamation proposes to modify the delivery timing for its flow augmentation program (USBR 2007). This proposed change in Reclamation's flow augmentation program would increase flows during May and June and decrease flows during July, August, and September (Figures 8-1 through 8-5) as compared to current operations.¹ NMFS' rationale for requesting this change in Reclamation's flow augmentation program was to increase the benefit to actively migrating fish, including late-migrating SR steelhead and SR spring-summer Chinook as well as SR fall Chinook. This rationale is more fully described in our Response to Comments document that accompanies this Opinion.

By using hydrology that includes the existing program's effects in the Base Case and the proposed program's effects in the Prospective Case to conduct fish survival modeling, the estimated fish

¹ Figures 8-1 and 8-2 depict the effects of Reclamation's proposed shift in augmentation timing. Figures 8-3 through 8-5 depict not only the effects of Reclamation's proposed shift in augmentation but also include the anticipated hydrologic effects of the suite of actions included in the FCRPS/Upper Snake Prospective Action.

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survival effects of these flow changes are captured in the species-specific analyses presented in sections 8.2 to 8.14 below.

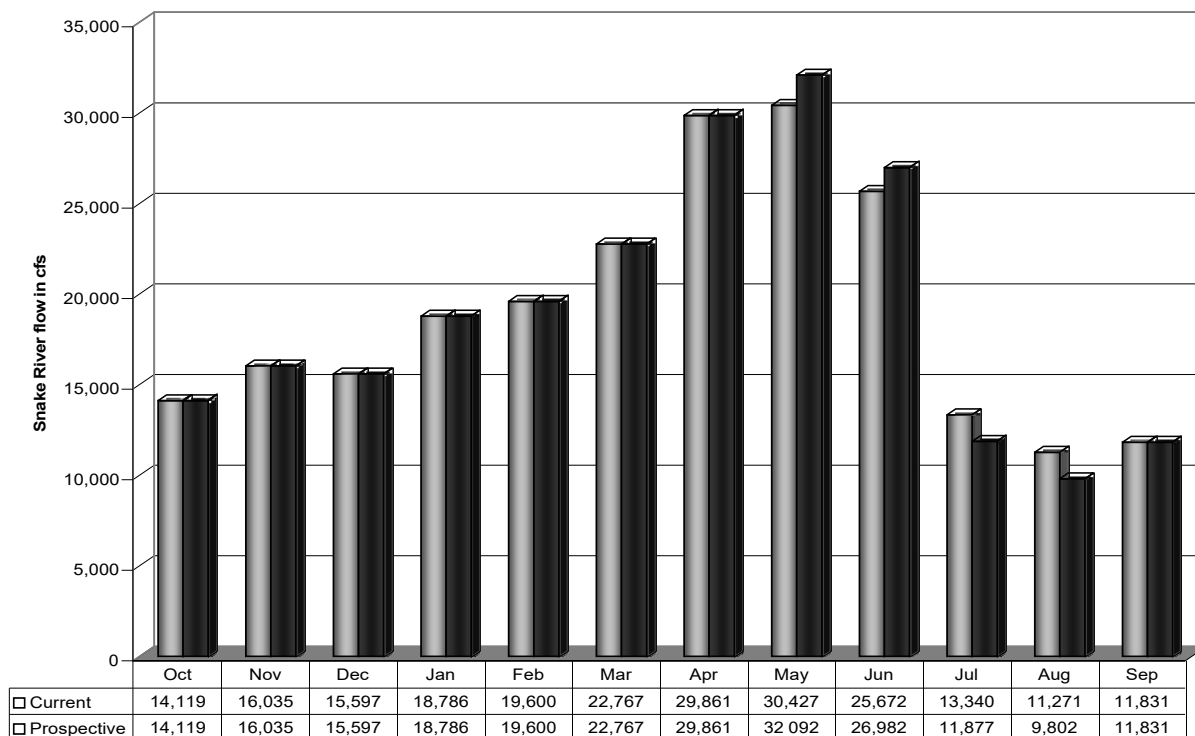


Figure 8-1. Mean monthly Snake River inflows to Brownlee Reservoir under current operations and under Reclamation's proposed action (prospective operations). Source: USBR Modsim model runs (2007): Current, Brownlee Inflow 2004 Up Snake, Prospective, Brownlee Inflow 2007, Up Snake.

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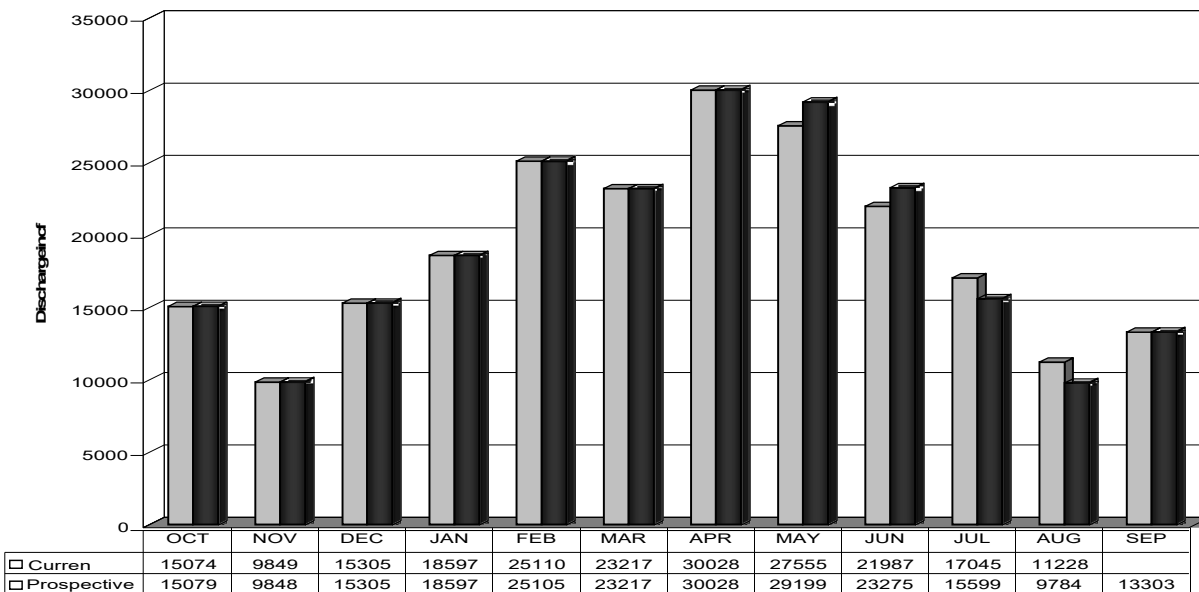


Figure 8-2. Mean monthly Snake River outflow from Hells Canyon Dam under current operations and under Reclamation's proposed action (prospective operations). Source: Current: HYDSIM run FRIII_07Rerun2004BiOp, Prospective: FRIII_Final2008BIOP

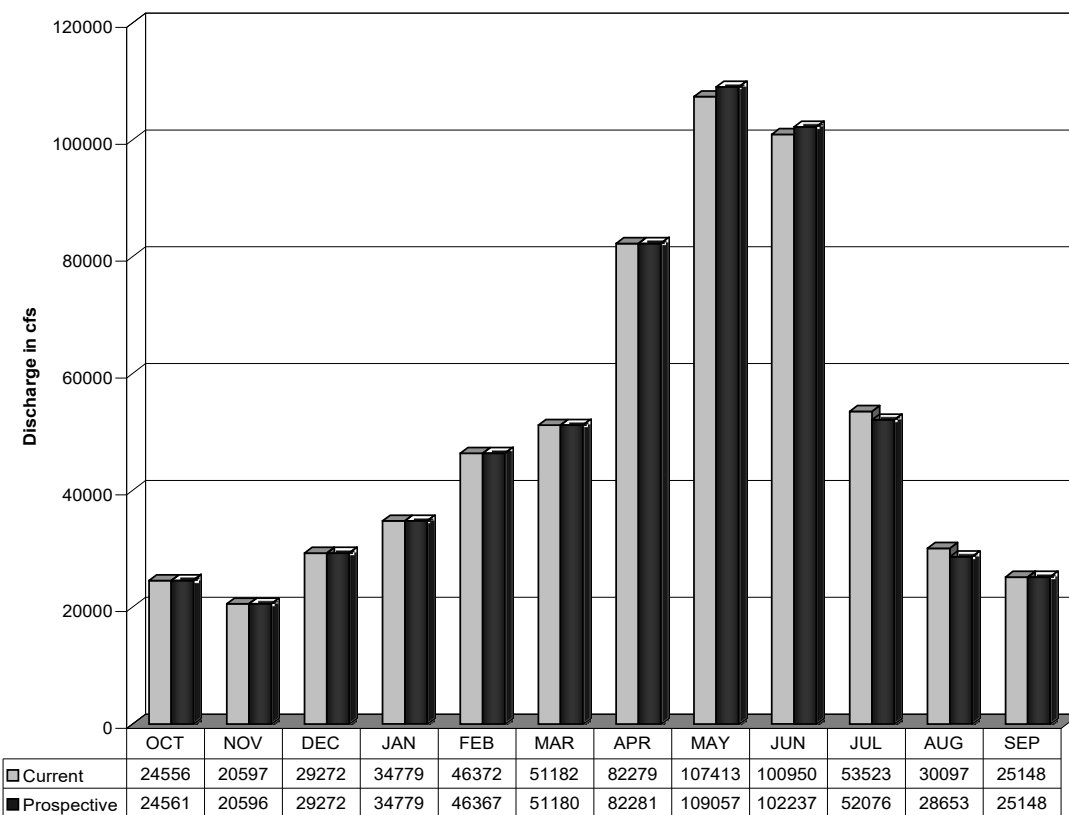


Figure 8-3. Mean monthly Snake River discharge from Lower Granite Dam under current operations and under Reclamation's proposed action (prospective operations). Source: Current: HYDSIM run FRIII_07Rerun2004BiOp, Prospective: FRIII_Final2008BIOP

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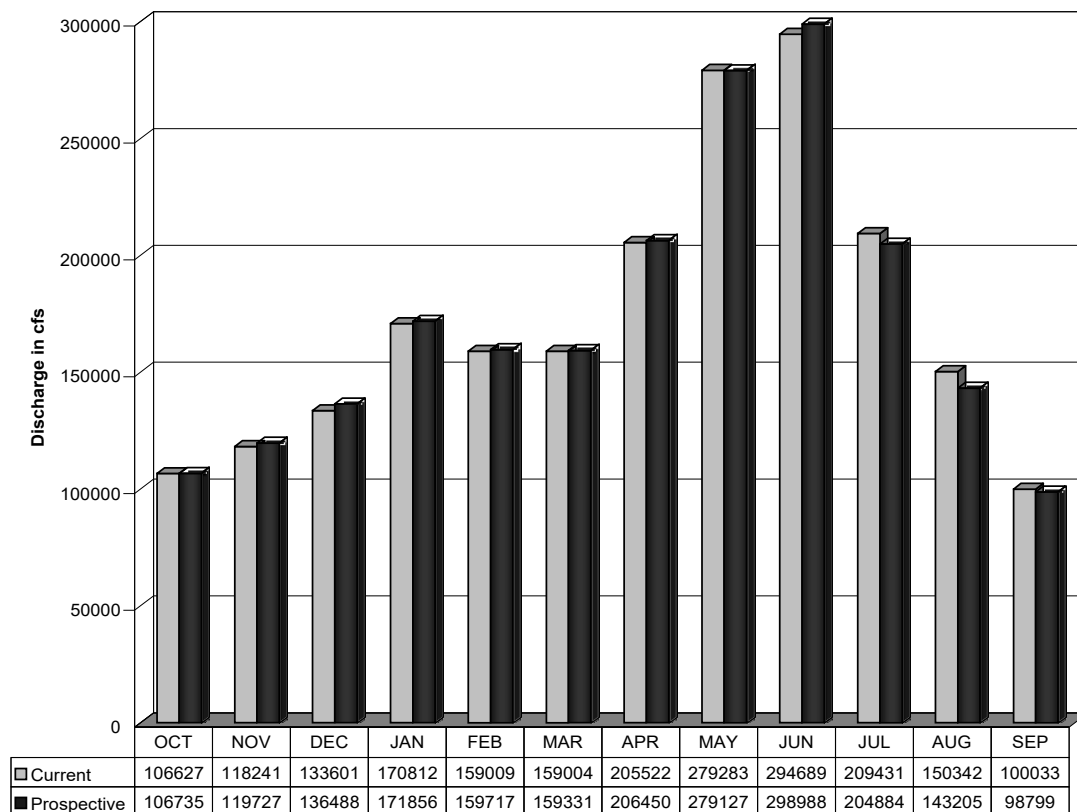


Figure 8-4. Mean monthly Columbia River discharge from McNary Dam under current operations and under Reclamation's proposed action (prospective operations). Source: Source: Current: HYDSIM run FRIII_07Rerun2004BiOp, Prospective: FRIII_Final2008BIOP. NOTE: The Prospective analysis includes changes in proposed FCRPS operations. For example, the increased flows in October under the Prospective operations are primarily due to proposed changes in FCRPS operations, not Reclamation's proposed action.

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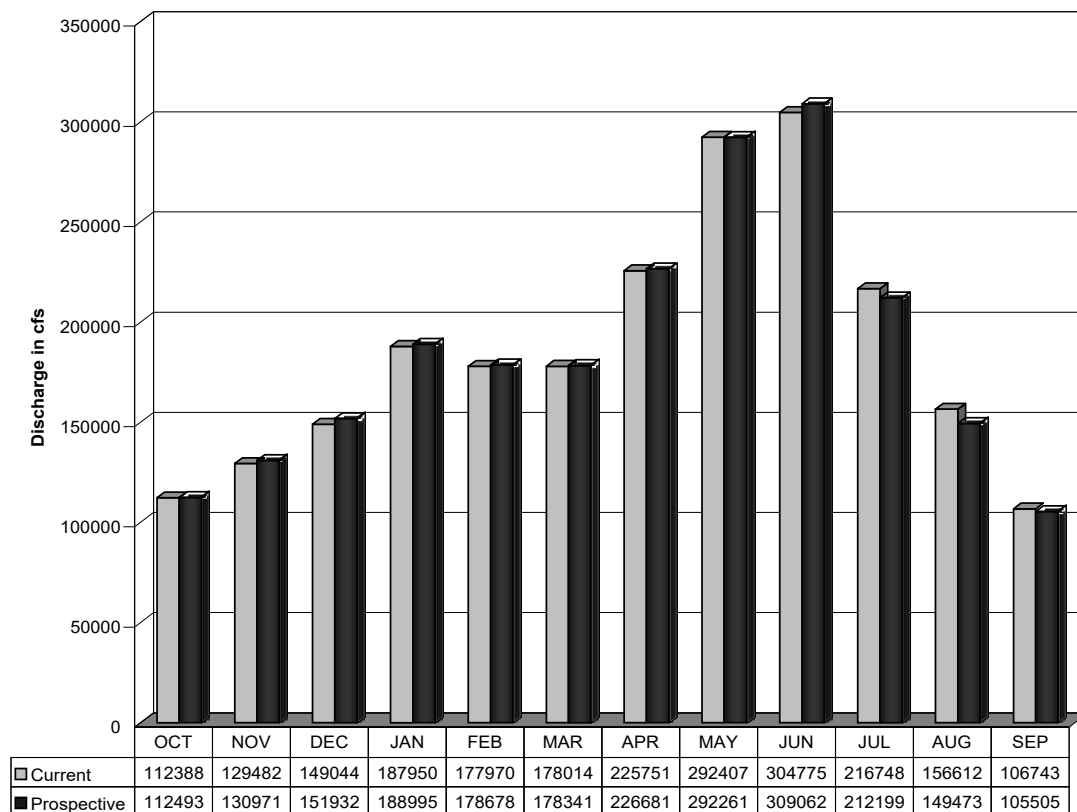


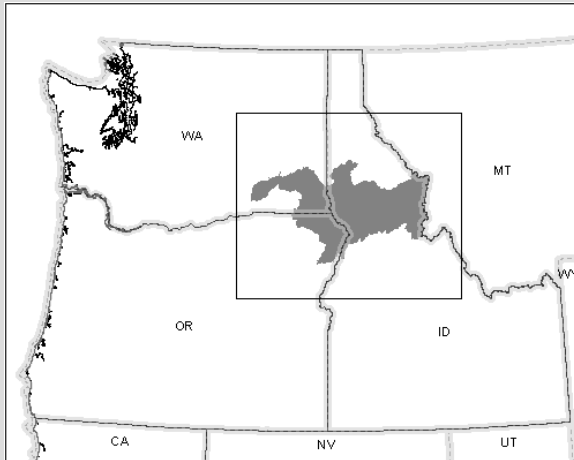
Figure 8-4. Mean monthly Columbia River discharge from Bonneville Dam under current operations and under Reclamation's proposed action (prospective operations). Source: Current: HYDSIM run FRIII_07Rerun2004BiOp, Prospective: FRIII_Final2008BIOP. NOTE: The Prospective analysis includes changes in proposed FCRPS operations. For example, the increased flows in October under the Prospective operations are primarily due to proposed changes in FCRPS operations, not Reclamation's proposed action.

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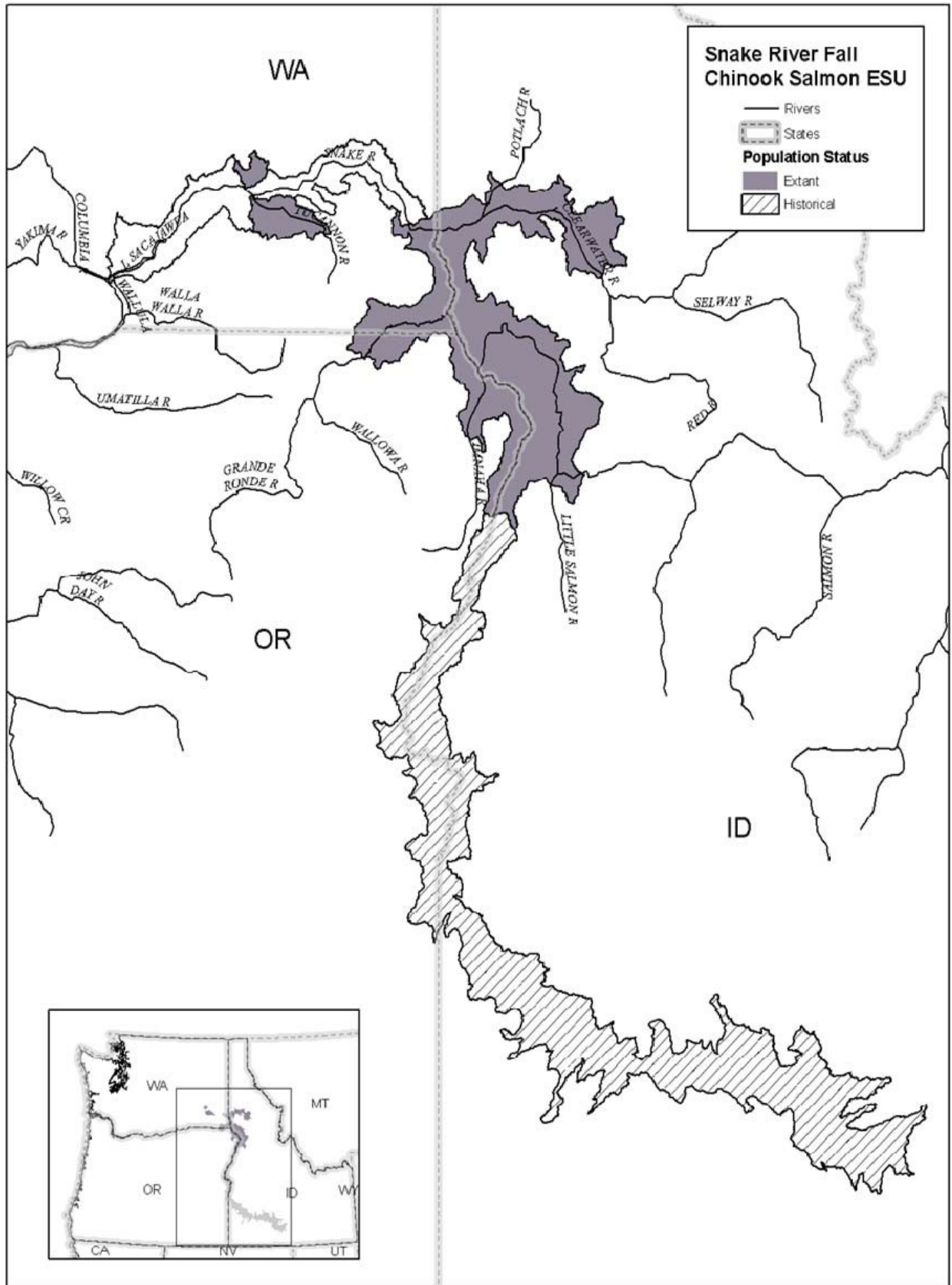
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Section 8.2

Snake River Fall Chinook Salmon



- 8.2.1 Species Overview**
- 8.2.2 Current Rangewide Status**
- 8.2.3 Environmental Baseline**
- 8.2.4 Cumulative Effects**
- 8.2.5 Effects of the Prospective Actions**
- 8.2.6 Aggregate Effects by MPG**
- 8.2.7 Aggregate Effect on ESU**



Section 8.2

Snake River Fall Chinook Salmon

Species Overview

Background

The Snake River (SR) fall Chinook salmon ESU is a single population in one major population group (MPG) that spawns and rears in the mainstem Snake River and its tributaries below Hells Canyon Dam. The decline of this ESU was due to heavy fishing pressure beginning in the 1890s and loss of habitat with the construction of Swan Falls Dam in 1901 and the Hells Canyon Complex from 1958 to 1967, which extirpated two of the historical populations. Only 10 to 15% of the historical range of this ESU remains. Hatcheries have played a major role in the production of Snake River fall Chinook since the 1980s. Snake River fall Chinook were listed under the ESA as threatened in 1992.

Designated critical habitat for Snake River fall Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; the Snake River, upstream to Hells Canyon Dam; the lower reaches of the Palouse; and the North Fork Clearwater River (upstream to Dworshak Dam).

Current Status & Recent Trends

The average abundance (1,273) of SR fall Chinook over the most recent 10-year period is below the 3,000 natural spawner average abundance thresholds that the ICTRT identified as a minimum for recovery. Total returns to Lower Granite Dam increased steadily from the mid-1990s to the present. Natural returns increased at roughly the same rate as hatchery origin returns (through run year 2000), but since then hatchery returns have increased disproportionately to natural-origin returns. On average over the last 23 full brood year returns (1977-1999, which includes adult returns through 2004), the natural origin component of the population has not replaced itself.

Limiting Factors and Threats

Limiting factors for SR fall Chinook include mainstem hydroelectric projects in the Columbia and Snake rivers, predation, harvest, hatcheries, the estuary, and tributary habitat. Ocean conditions have also affected the status of this ESU. Generally, ocean conditions have been poor for this ESU over the past 20 years, improving only recently.

Recent Ocean and Mainstem Harvest

SR fall Chinook are present throughout ocean fisheries from Alaska to California, and in fall season fisheries in the mainstem Columbia River. Incidental catch occurs in fisheries that target harvestable hatchery and natural-origin fish. The total ocean fishery exploitation rate averaged 46% from 1986 to 1991, and 31% from 1992 to 2006. Ocean fisheries have been required since 1996, through ESA consultation, to achieve a 30% reduction in the average exploitation rate observed during the 1988 to 1993 base period. In recent years, about 14% of the incidental take has occurred in the southeast Alaska fishery, about 23% in the Canadian fishery (primarily off the west coast of Vancouver Island), about 20% in the coastal fishery (primarily off Washington, and to a lesser degree off Oregon and Northern California), about 11% in the non-Treaty fishery in the Columbia River, and about 30% in the Columbia River tribal treaty-right fishery. The presence of large numbers of harvestable natural-origin fish in the fishing locations from other sources makes it infeasible to distinguish Snake River fall Chinook through means of mark-selective fishing techniques.

SR fall Chinook are also caught in fall season fisheries in the Columbia River with most impacts occurring in Non-Treaty and treaty Indian fisheries from the river mouth to McNary Dam. Fisheries affecting SR fall Chinook have been subject to ESA constraints since 1992. Since 1996, Columbia River fisheries have been subject to a total harvest rate limit of 31.29%. This represents a 30% reduction in the 1988 to 1993 base period harvest rate.

Total harvest mortality for the combined ocean and inriver fisheries can be expressed in terms of exploitation rates which provide a common currency for comparing ocean and inriver fishery impacts (Fisheries in the Columbia River are generally managed subject to harvest rate limits. Harvest rates are expressed as a proportion of the run returning to the river that is killed in river fisheries). The total exploitation rate has declined significantly since the ESA listing. Total exploitation rate averaged 75% from 1986 to 1991, and 45% from 1992 to 2006.

8.2.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.2.2.1 Current Rangewide Status of the Species

Snake River (SR) fall Chinook is a threatened species composed of one extant population in one major population group (MPG). Two historical populations have been extirpated. This population must be highly viable to achieve the ICTRT's suggested viability scenario (ICTRT 2007a, Attachment 2). Key statistics associated with the current status of SR fall Chinook salmon are summarized in Tables 8.2.2-1 through 8.2.2-4.

Limiting Factors and Threats

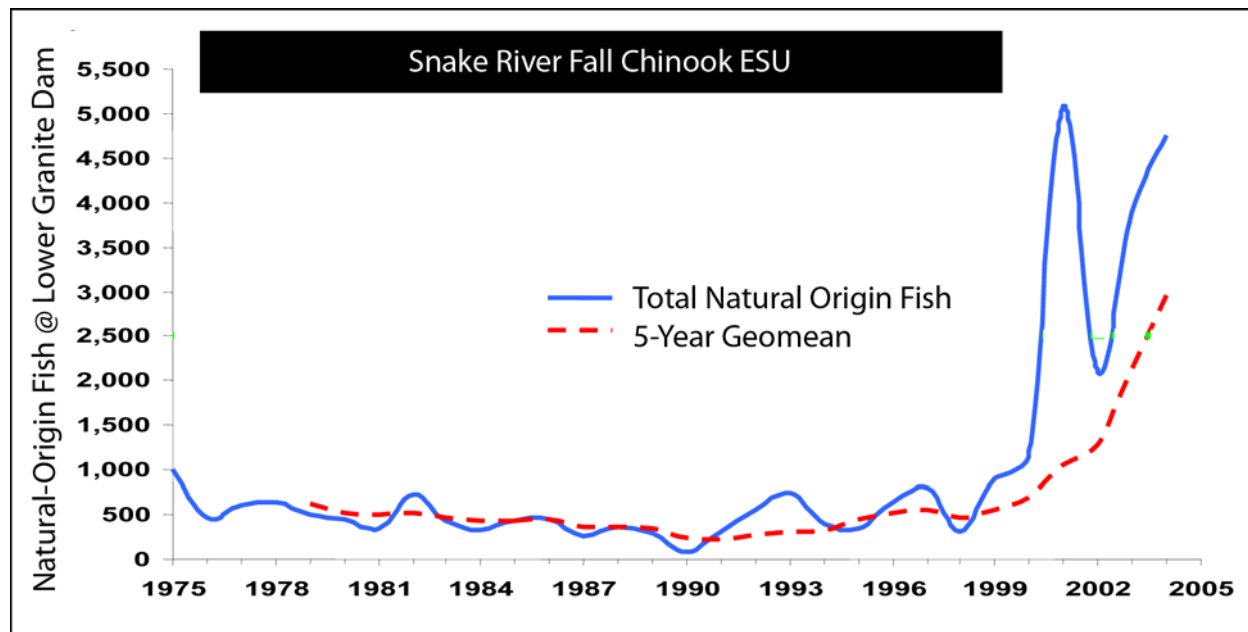
The key limiting factors and threats for the Snake River fall Chinook include hydropower projects, predation, harvest, degraded estuary habitat, and degraded mainstem and tributary habitat. Ocean conditions have also affected the status of this ESU. Ocean conditions affecting the survival of Snake River fall Chinook were generally poor during the early part of the last 20 years.

Abundance

Average abundance (1,273) of SR fall Chinook over the most recent 10-year period is below the 3,000 natural spawner average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.2.2-1).⁴ The ICTRT recommends that no fewer than 2,500 of the 3,000 natural-origin fish be mainstem Snake River spawners. Total returns of fall Chinook over Lower Granite Dam increased steadily from the mid-1990s to the present. Natural returns increased at roughly the same rate as hatchery origin returns (through run year 2000), since then hatchery returns have increased disproportionately to natural-origin returns (Figure 8.2.2.1-1). The median proportion of natural-origin has been approximately 32% over the past two brood cycles (Cooney and Ford 2007).

⁴ BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.2.2.1-1 Snake River Fall Chinook Salmon Abundance Trends (adopted from Fisher and Hinrichsen 2006)



The driving factors for the recent increase may include reduced harvest rates, improved in-river rearing and migration conditions, the development of life history adaptations to current conditions, improved ocean conditions benefiting the relatively northern migration pattern, the supplementation program or other factors. As this time, there is insufficient information to estimate the relative contributions of these factors (Cooney and Ford 2007).

“Base Period” Productivity

On average over the last 23 full brood year returns (1977-1999 brood years [BY], including adult returns through 2004), when only natural production is considered, SR fall Chinook populations have not replaced themselves (i.e., average R/S has been less than 1.0; Table 8.2.2-1). R/S productivity was below 1.0 for all but three brood years prior to 1995, and it was above 1.0 between 1995 and 1999 (Cooney and Ford 2007). Additionally, Cooney and Ford (2007) make preliminary estimates for the 2000-2003 brood years, half of which also indicate R/S > 1.0.

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5% extinction risk (ICTRT 2007c)

The BRT trend in abundance was >1.0 during the 1980-2004 period (Table 8.2.2-1). Median population growth rate (λ), when calculated with an assumption that hatchery-origin natural spawners do not reproduce effectively (HF=0), also was greater than 1.0 (increasing) for SR fall Chinook (Table 8.2.2-1). When calculated with the HF=1 assumption, λ has been less than 1.0.

Spatial Structure

The ICTRT does not yet characterize the spatial structure risk to SR fall Chinook, although generic spatial structure criteria have been described in ICTRT (2007d). However, the Biological Review Team (Good et al. 2005) characterizes the risk for the “distribution” VSP factor as “moderately high” (Table 8.2.2-2) because approximately 85% of historical habitat is inaccessible and the distribution of the extant population makes it relatively vulnerable to variable environmental conditions and large disturbances.

Diversity

The ICTRT has not yet characterized the diversity risk to SR fall Chinook, although generic diversity criteria and the presence of five major spawning areas within currently occupied habitat are described in ICTRT (2007d). However, the Biological Review Team (Good et al. 2005) characterizes the risk for the diversity VSP factor as “moderately high” (Table 8.2.2-2) because of the loss of diversity associated with extinct populations and the significant hatchery influence on the extant population. The median proportion of hatchery-origin has been approximately 68% over the past two brood cycles.

Based on NOAA Fisheries’ SHIEER document (NMFS 2004b), the hatchery and harvest workgroup (under the Policy Work Group), “Hatchery Effects Report,” and Cooney and Ford (2007), there are four primary reasons why the current supplementation program contributes to a diversity risk for Snake River fall Chinook: 1) In order to meet the ICTRT’s (2007a) diversity viability goals, the proportion of hatchery fish spawning naturally must be significantly reduced from current levels; 2) In the current configuration of the program, all components of the ESU are supplemented, limiting the options for evaluating the programs; 3) In the mainstem Snake River major spawning areas, the ESU may be at or near carrying capacity, suggesting the further supplementation is unlikely to be beneficial to the ESU; and 4) The proportion of natural origin fish in the broodstock has been low. These issues are discussed in more detail in Cooney and Ford (2007).

“Base Period” Extinction Risk

A draft ICTRT Current Status Summary (ICTRT 2007d) characterizes the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of SR fall Chinook during the 1977-1999 Brood year “base period” described above for R/S productivity estimates, as “High” (>25% 100-year extinction risk). In these analyses, the ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years (QET=50). The ICTRT also calculated the extinction risk based on the 1990-1999 time period and determined that it was “moderate” (6-25% 100-year extinction risk). The ICTRT indicates that extinction risk is likely between these estimates (“moderate” to “high”).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk, as discussed in Section 7.1.1 of this Supplemental Comprehensive Analysis. Table 8.2.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for SR fall Chinook. This short-term extinction risk analysis is also based on the assumption that

productivity observed during the “base period” will be unchanged in the future. At QET=50, as well as at lower QET levels, there is less than 5% risk of short-term extinction. Confidence limits on this estimate are extremely wide, ranging from 0 to 100% risk of extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1 of the SCA, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current levels for SR fall Chinook, short-term extinction risk is 0% at all QETs (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival that is necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.2.2-4. Mean base period R/S survival gap for the 1977-1999 brood year base period is 34%, while the mean survival gap for lambda (HF=1) is 27%. No additional survival improvements are needed for the R/S gap calculated using the 1990-1999 period, for lambda (HF=0) or for BRT trend estimates. Because base short-term extinction risk is 0-1%, no additional improvements are needed to achieve less than 5% risk at QET=50.

8.2.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR fall Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls and Dworshak and Hells Canyon dams) in the following subbasins: Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. The lower Columbia River corridor is among the areas of high conservation value to the ESU because it connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Designated areas consist of the water, waterway bottom, and the adjacent riparian zone (defined as an area 300 feet from the normal high water line on each side of the river channel) (NMFS 1993). The status of critical habitat is discussed further in Section 8.2.3.3.

8.2.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.2.3.1 “Current” Productivity & Extinction Risk

Because the action area, as defined in Chapter 5, encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year “base period,” ending with the 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity through bank stabilization, shading, etc.).

Quantitative Estimates

Because a number of ongoing human activities have changed in recent years, it is necessary to evaluate changes that have occurred and adjust the “base period” estimates to reflect what would be expected if current management practices continued into the future. For SR fall Chinook, two approaches are used to characterize the current status (Section 7.1.1 of this document).

Base-to-Current Adjustment Approach

The first approach is to adjust the 1977-1999 brood year estimates by estimating a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Section 4.3.1 of the CA. Results are presented in Table 8.2.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 9% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), estuary habitat projects (a less than 1% survival change, based on CA Appendix D), and a reduction in tern mortality (approximately 2%) result in a quantitative survival improvement for SR fall Chinook. The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 12% compared to the 1980-1999 BY average. This also means that the survival “gaps” described in Table 8.2.2-4 would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.12]).

This approach is of limited utility for SR fall Chinook because some of the more important changes from the base period, discussed below, cannot be estimated quantitatively for this species. Therefore, it is only possible to estimate a portion of the survival change that has occurred and the base-to-current survival multiplier represents a very conservative (i.e., negative) estimate of the effect of continuing current hydro operations into the future.

The main change from the base period that cannot be quantified is improvements to hydro configuration and operation for fall Chinook due to uncertainties about the juvenile life history strategies this species employs (Section 8.2.5.1).

Qualitatively, several hydro-related actions have likely contributed to increased productivity of naturally produced SR fall Chinook salmon (base-to-current adjustment). First, Reclamation has provided some level of flow augmentation water (90,000 to 487,000 acre-feet), primarily during July and August, since 1991 (except 1992) to enhance flows (migratory conditions) through the lower Snake and Columbia Rivers (USBR 1998). Second, since 1991, Idaho Power Company has voluntarily provided generally stable outflows (ranging from 8,000 and 13,000 cfs depending on prevailing flow conditions in a given year) at Hells Canyon Dam during the fall Chinook spawning season (primarily late October and November); and maintained these flows as minimums throughout the incubation period (primarily late November through April) to enhance the survival of incubating fall Chinook to emergence (IPC 1991 and FERC 2007). During rearing (March through June) peaking at Hells Canyon Complex is known to cause limited entrapment of fall Chinook fry this effect is currently under investigation by IPC and mitigative measures are being evaluated (Brink and Chandler 2006). Third, since 1993, the Corps of Engineers has drafted Dworshak reservoir (north fork, Clearwater River) to enhance juvenile migratory conditions (reduced summer temperatures and enhanced summer flows) in the lower Snake River (Corps et al. 2007b, Appendix 1). By providing suitable water temperatures for over-summer rearing within the Snake River reservoirs, this action apparently has allowed the expression of a productive “yearling” life-history strategy that was not available to this ESU in the past (Connor et al. 2007). Finally, actions required by the 1995 FCRPS Biological Opinion generally resulted in improved dam configurations, better summer flow conditions, and expanded summer spill programs in the lower Columbia River (BA, Appendix A) beginning in 1996 compared to previous years. This likely resulted in improved passage conditions and increased survival rates for in-river migrating juvenile fall Chinook salmon. Together, these factors likely have increased productivity of this species since the base period depicted in the base-to-current survival adjustments.

Hatchery effects are also considered qualitatively. The discussion of diversity under rangewide status (Section 8.2.2.1) also applies to the status of hatchery programs under the environmental baseline.

1990-Present Approach

An alternative approach to adjusting extinction risk is included here because alternative base periods were evaluated by the ICTRT (2007c). In addition to evaluating the 1977-1999 BY time series, the ICTRT evaluated a 1990-1999 BY series. The more recent time series is representative of recent

harvest rates and hydro effects, as well as other human impacts. In this sense it is a better representation of current conditions under the environmental baseline than is the 1977-1999 time series. However, there are also two potential drawbacks to the shorter time series. First, because it is a shorter time series it captures less of the variability of the population performance and is generally less reliable for making estimates of productivity and extinction risk. As described in Chapter 7, this is the primary reason why the 20-year time series is emphasized in our quantitative analysis. A second factor is that the more recent time period may include a higher percentage of climatic conditions that appear to be favorable to Columbia basin salmon survival. The base-to-current survival adjustment is intended to represent changes in Columbia basin resource management rather than changes in climate.

The ICTRT (2007c) concluded that “at this time, it is reasonable to assume that the A/P [abundance and productivity] gap falls within the range defined by the two recent scenarios.” Therefore, both approaches are used to characterize the current status of SR fall Chinook. The 1990-present productivity estimates are presented in Table 8.2.2-1 and the gaps necessary for productivity >1.0 are included in Table 8.2.2-4. It is not possible to estimate short-term extinction risk for the 1990-present time series (Section 7.1.1). Under this approach, there is no base-to-current adjustment for this metric.

8.2.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.2.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. The following are the major factors limiting the conservation value of critical habitat for SR fall Chinook:

- Mainstem lower Snake and Columbia River hydropower system mortality (juvenile migration corridors with safe passage)
- Altered seasonal temperature regimes
- Reduced spawning/rearing habitat due to mainstem lower Snake River hydropower system (spawning areas with gravel, water quality, cover/shelter, riparian vegetation, and space to support egg incubation and larval growth and development)

The FCRPS Action Agencies have taken a number of actions in recent years to improve the conservation value of PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at FCRPS dams has been improved by the structural improvements and operations described in Section 4.3.1.1 in Corps et al. (Corps et al. 2007a).

Spawning Areas

Dauble et al. (2003) described the sequence of mainstem hydro development that reduced the spawning range of SR fall Chinook salmon in the Snake River. Idaho Power Company (IPC 2003) has estimated that as many as 450,000 fish returned to the Snake River each year before hydropower development. About 270,000 spawned upstream of the current location of the Hells Canyon Complex, a series of three dams that IPC built between 1958 and 1967, blocking access to 210 miles (338 km) of mainstem riverine habitat. Construction of the four federal dams on the lower Snake River (1962 to 1975) converted almost 147 miles (236 km) of riverine to reservoir habitat. The reservoirs reduced average water velocities and habitat complexity and increased water surface elevations. Since then, the 101-mile Hells Canyon Reach (i.e., between the upper end of Lower Granite Reservoir and the tailrace of Hells Canyon Dam) has been the only continuous stretch of free-flowing mainstem habitat available to fall Chinook for spawning. Garcia et al. (2007) reported a peak count of 1,709 redds in this reach in 2004 (and more than 1,000 redds each year from 2002 through 2006; see Appendix 3 in Garcia et al. 2007). Assuming two fish per redd, the Hells Canyon Reach has recently supported at least 3,400 spawners.

SR fall Chinook also spawned historically in the lower mainstems of the Clearwater, Grande Ronde, Salmon, Imnaha, and Tucannon river systems. At least some of these areas probably supported significant production, but at much lower levels than in the mainstem Snake River. Smaller portions of habitat in the Imnaha and Salmon rivers have supported fall Chinook. Some limited spawning currently occurs in all these areas, although returns to the Tucannon are predominately releases and strays from the Lyons Ferry hatchery program. The Clearwater, Grande Ronde, Salmon, and Imnaha collectively supported a maximum of 852 redds in 2004 (averaging at least 500 each year since 2002; see Appendices 3-7 in Garcia et al. 2007). Thus, under current conditions, the available area below Hells Canyon Dam has demonstrated the capacity to support at least 5,000 spawners. The ICTRT has set a recovery abundance threshold of 3,000 spawners (i.e., to meet viability goals for abundance at <5% risk of extinction (ICTRT 2007c).

As discussed in Section 8.2.3.1 (Current Productivity and Extinction Risk), several recent hydro-related activities have improved the functioning of PCEs for spawning and rearing. Since 1991, IPC has voluntarily stabilized outflows from Hells Canyon Dam during late October and November and kept the redds established during that period “watered” through emergence in April. However, if rearing fry move to the shallow river margin, they can become entrapped in several pool complexes. Idaho Power Company is currently investigating this issue and evaluating mitigative measures (Brink and Chandler 2006).

Factors limiting the functioning and thus conservation value of PCEs in the available spawning areas (i.e., affecting water quality, water quantity, space, and/or spawning gravel) are:

- In the Hells Canyon Reach of the mainstem Snake River—changes in river flow [*reductions in flow entrap and strand fry*], temperature regime [*warmer in fall when adults arrive for spawning and cooler during the spring incubation period due to the existence and operation of IPC’s Brownlee reservoir (Hells Canyon complex)*], may delay the emergence of fry production by later

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spawning adults] and dissolved oxygen [episodic low dissolved oxygen conditions can persist into early fall when adult fish arrive and stage for spawning]

- In the Clearwater River below the North Fork—changes in water temperature *[cooler during spring incubation period due to Dworshak operations, slowing development and growth rates in the Clearwater, although cooling the Snake for juvenile fall Chinook migrating from mainstem spawning areas]*
- In the lower Grande Ronde River—sediment in gravel, degraded water quality *[including high temperature and low concentration of dissolved oxygen]*
- In the lower Tucannon River—sediment in gravel *[limits survival in egg to fry stages]*

Rearing Areas & the Juvenile Migration Corridor

Fall Chinook salmon generally begin spawning in the Snake River during the third week of October (Groves and Chandler 1999). Fry emerge from redds during April through June and rear for two months or more in the sandy littoral zone along the river margins (Tiffin et al. 1999). Parr and presmolts move offshore and begin downstream migration and/or extended rearing in the deeper waters of the flowing river and reservoirs. Subyearling smolts are detected passing Lower Granite Dam as early as May and through the late fall when the juvenile fish passage facilities cease operation (Connor et al. 2007). Most of the in-river migrants pass Bonneville Dam by mid-July. Subyearlings that enter the estuary as smolts are thought to reside there for a few weeks before moving into the plume and offshore waters (Fresh et al. 2005). However, recent acoustic tag studies indicate that Snake River fall Chinook subyearling smolts travel from Bonneville Dam to the mouth of the Columbia River in about four days (median value). Survival estimates through this reach (2005-2007) ranged from about 70 to 90% in June, declining to only 20 to 60% in mid-July (McComas et al. 2008).

Several recent hydro-related actions have improved the functioning of PCEs in the juvenile migration corridor. Since 1993, the Corps of Engineers has drafted Dworshak Reservoir to enhance conditions in the juvenile migration corridor by adding cooler water to that in the lower Snake. Reclamation has provided flow augmentation (90,000 to 487,000 acre-feet) from the upper Snake basin to enhance flows in the lower Snake and Columbia rivers during July and August. Actions required by the 1995 FCRPS Biological Opinion have generally resulted in improved dam configurations, better flow conditions, and expanded summer spill programs.

The following are the major factors that limit the functioning and thus the conservation value of rearing areas and the juvenile migration corridor (i.e., affecting water quality, water quantity, cover/shelter, space, food and/or riparian vegetation):

- In the Hells Canyon Reach of the mainstem Snake River, cooler spring temperatures of water released from the Hells Canyon complex *[delays emergence of some fry]*

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- In the juvenile migration corridor—scarcity of cover in the reservoirs (as refuge from fish predators – particularly non-native small mouth bass in the in the Snake River); passage mortality [*FCRPS dams and reservoirs*]; and warm summer temperatures [*juveniles had typically completed their migration from the Snake River basin by the end of June prior to construction of the Hells Canyon complex and Snake River mainstem dams, excluding Ice Harbor dam.*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for subyearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements. For salmon that use an ocean-type life-history strategy, recent restoration projects in the estuary are improving the functioning of the juvenile migration corridor. Projects that are protecting or restoring riparian areas and breach or lower dikes and levees are providing access to the cover/shelter, food, and riparian vegetation required by this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality off-channel habitat (see Section 4.3.1.3 in Corps et al. 2007a).

Adult Migration Corridor

The Action Agencies have increased the likelihood of safe passage in the mainstem FCRPS for adult fall Chinook in recent years by improving the collection channel at The Dalles and the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams.

Areas for Growth & Development to Adulthood

Although Snake River fall Chinook probably spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas are not considered further in this consultation.

8.2.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the ESU and its designated critical habitat.

The Corps completed several consultations on its Clean Water Act section 404 permitting process (maintenance dredging of a barge slip at near the mouth of the Snake River, construction of a new floating dock at the Port of Clarkston, WA, and installing a new boat launch at Wawawai Landing,

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WA). NOAA Fisheries also completed a consultation with BPA on replacing wood pole transmission lines north of Lewiston, ID and with the US Army Corps of Engineers on operations of the fish sampling facility at Lower Granite Dam that will reduce risks to fall Chinook diversity by removing stray hatchery fish and increase the proportion of natural-origin fish in hatchery broodstock.

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies also completed consultation on a large number of projects affecting habitat in the lower Columbia River and estuary including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.3.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and

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conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect the habitat of multiple populations within the ESU. The effects of some on population viability will be positive (habitat restoration; fish sampling at Lower Granite Dam; tar remediation). Other projects, including dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (habitat restoration with stormwater facilities; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone

section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.2.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. However, neither the states nor NOAA Fisheries identified any habitat-related actions and programs by non-federal entities that were expected to benefit Snake River fall Chinook.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.2.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have some continuing adverse effects that are described in this section; however, these will be reduced from past levels. The Prospective Actions also require habitat improvement in the estuary and predator reductions, which are expected to be beneficial. Continuation of flow augmentation from the Upper Snake Projects will continue to provide benefits through 2034. These beneficial effects are described in Sections 8.2.5.2, 8.2.5.3, and 8.2.5.5. Some Prospective Actions, implementing habitat restoration and RM&E, may have short-term minor adverse effects, but these will be balanced by short-and long-term beneficial effects, as described in Section 8.2.5.6.

Continued funding of hatcheries by the FCRPS Action Agencies will have both adverse and beneficial effects, as described in the Hatchery Effects Report (SCA Hatchery Effects Appendix.). The Prospective Actions will ensure continuation of the beneficial effects and will reduce threats to the SR fall Chinook population posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are discussed in Chapter 11 of the FCRPS Biological Opinion. The expected use of transportation under the permit is included in the effects of the FCRPS Prospective Actions, which is described in Section 8.2.5.1.

8.2.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

NOAA Fisheries abandoned efforts to parameterize the COMPASS model to estimate the effect of alternative operations on the survival of SR fall Chinook salmon. This was due to critical uncertainties regarding subyearling juveniles' migration pattern in July and August, and their recently observed "yearling" life-history strategy (see Section 7.2.1). Thus, NOAA Fisheries must use qualitative analysis to assess the likely hydro effects of these Prospective Actions on this ESU.⁵

The Prospective Actions strategies for hydro that are most likely to benefit SR fall Chinook salmon include:

1. Further modification to Columbia and Snake river dams to facilitate safe passage (RPA Actions 4, 5, 14, 18-25, 27, 28, 52, 54);
2. Implement operational improvements at Columbia and Snake river dams (RPA Actions 18-25, 52, 54, 55);
3. Operate and maintain juvenile and adult fish passage facilities (RPA Actions 18-25, 28, 29, 30, 54); and
4. Continue to evaluate the best passage management strategy for fall Chinook salmon (i.e., transport vs. in-river) (RPA Actions 18-25, 31, 52, 53, 54, 55, 58, 59, 60, 61).

Of these Prospective Actions, modifying and implementing operations at the Columbia and Snake River dams to facilitate safe passage – which requires the construction and operation of surface

⁵ NOAA Fisheries assumed – for the purpose of the quantitative analysis – that no benefits would accrue from Hydro related prospective actions (CA Table 4-7).

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passage routes at Little Goose, Lower Monumental, McNary and John Day Dams,⁶ in concert with training spill (amount and pattern) to provide safe egress conditions, are likely to have a large positive effect on juvenile migrants. These structures and operations are expected to reduce travel times within the forebays and tailraces of the individual projects. This is likely to result in survival improvements where predation rates are often the highest, because the juvenile fish will be guided out of the forebay and tailrace faster, reducing their exposure to predators such as the northern pikeminnow (see Section 8.1 of the Supplemental Comprehensive Analysis). Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants if faster migrating juveniles are less stressed than is currently the case. Finally, adaptive management of passage strategies should lead to even further improvements in post-Bonneville survival in the future. That is, the continuous evaluation of fish passage performance metrics (RPA Action 52, 53, 54) should ensure that benefits accrued to date or described above as prospective operations and maintenance of juvenile fish passage facilities do not diminish within the time period relevant to the Prospective Actions.

For adult SR fall Chinook salmon migrating from Bonneville Dam upstream to Lower Granite Dam, the Prospective Actions addressing hydro operation and the RM&E program generally should maintain the relatively high levels of survival currently observed in most years. The current average adult survival is 81.0%⁷ (about 96.9% per project), taking account of reported harvest and “natural” stray rates within this reach, (BA Table 2.1). If currently, adults die outside of the Bonneville Dam to Lower Granite Dam migration corridor (i.e., after passage to the top-most dam but before spawning, known as delayed mortality), this “delayed mortality” is not expected to be affected by the Prospective Actions.

Effects on Critical Habitat

Although one of the effects of the Prospective Actions on critical habitat will be the continued loss of historical spawning areas due to the existence and operation of the lower Snake River dams, the available habitat will have the capacity (space) to support at least 5,000 spawners as described in Section 8.2.3.3. This will be adequate for meeting the ICTRT’s recovery abundance threshold of 3,000 spawners (i.e., to meet viability goals for abundance at <5% risk of extinction). To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. However, this was not identified as a limiting factor for Snake River fall Chinook by the Remand Collaboration Habitat Technical Subgroup.

⁶ Surface bypass facilities are already in place at Lower Granite, Ice Harbor, and Bonneville dams. The RSW at Ice Harbor Dam was first operated in 2005. Therefore, benefits have not yet been reflected in R/S.

⁷ NOTE: 81.0% is an average of the minimum survival estimates for the 2002 to 2007 adult migration years. In 2003 and 2004 adult survival (excluding 1-ocean jacks) was estimated to be 98.6 to 93.7% (average of 96.3%), respectively, falling to 71.2% in 2005, and only 58.8% in 2006, increasing to 83.9% in 2007. While NOAA Fisheries is unable to ascertain the cause of this decline at this time, it is highly unlikely that this effect is due solely, or even primarily, to passage through the FCRPS projects. See SCA Adult Survival Estimates Appendix for calculations and to view assumptions about harvest and stray rates. Future research (RPA 52, 55, 56) should provide additional information to identify the causative factors so that they can be addressed through adaptive management.

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The survival of juvenile SR fall Chinook in the mainstem migration corridor will increase with the construction of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress. In-river migrants will experience reduced travel times past FCRPS dams, reducing predation rates and stress. Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address factors that limit the conservation value of safe passage in rearing areas and the migration corridor. The prospective actions also include passage improvements at The Dalles and John Day dams that will reduce adult delay, which will further improve the conservation value of safe passage in the adult migration corridor.

In addition to increasing flows and reducing travel time in the lower Snake River, releasing cold water from Dworshak Dam will enhance migration conditions by reducing the risk of disease for juvenile migrants. Adult fall Chinook will also continue to benefit from cold water released from Dworshak during summer (improved water quality).

Under the Prospective Actions, flows in the lower Snake River will continue to be reduced during spring compared to an unregulated system (Section 8.1.1.3). However, shifting the delivery of a portion of the Upper Snake flow augmentation water from summer to spring will benefit the subyearling life history type (i.e., ocean-type juveniles) migrating in late spring. This water will be slightly cooler than if delivered during summer, especially in average or dry years, thereby improving water quality in mainstem rearing areas and the migration corridor. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.2.3.3).

8.2.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

Under the RPA (34), the Action Agencies will obtain funding to continue, with the state's Soil and Water Conservation Districts, efforts to reduce soil erosion on the uplands and along the streams of Garfield County. These projects will address the problem of sediment inputs from agricultural lands to gravel in the lower Tucannon River (Section 8.2.3.3), which will support increased productivity of that portion of the population.

Effects on Critical Habitat

Reduced sediment inputs to the lower Tucannon will improve the functioning of spawning gravel.

8.2.5.3 Effects of Prospective Actions in the Estuary

Effects on Species Status

The estimated survival benefit for Snake River fall Chinook (ocean-type life history) associated with the Prospective Actions in the estuary (RPA Actions 36 and 37) is approximately 9.0% (CA Section 4.3.3.3). For ocean-type fish, restoration projects that are placed along the estuary corridor are likely

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to improve abundance, productivity, life history diversity, and spatial structure by providing off-channel rearing habitat and refugia (Fresh et al 2005).

Effects on Critical Habitat

Estuary habitat restoration projects will address the alteration of channel margin habitats, a factor limiting the functioning of PCEs used by subyearling Chinook migrants from the Snake River. Specifically, the Action Agencies will fund conservation protection and rehabilitation for approximately 380 acres of off-channel rearing habitat, or projects similar in nature, under its LCREP project during FY 2007–2009. Thirty acres of riparian areas, including two linear miles of fencing, will be restored during that period. In addition, the Action Agencies will:

- Install tide gates to increase tidal flushing and fish access to approximately 110 acres of wetlands on the Julia Butler Hanson National Wildlife Refuge near Cathlamet, Washington
- Retrofit a tide gate at Vancouver Lake
- Reestablish hydrologic connectivity between Columbia Slough and the Columbia River to improve floodplain wetland function for approximately 5 acres of currently isolated habitat and to increase the amount (by approximately 2.5 acres) and quality of off-channel rearing and refuge habitat (Ramsey Lake)
- Improve hydrologic flushing and fish access to approximately 3,200 acres of habitat in Sturgeon Lake on Sauvie Island, Oregon (Dairy Creek)
- Breach dike and reestablish flow to a portion of the Sandy River channel in the delta reach; plant native vegetation on over 200 acres and remove invasive wetland plants on 45 acres
- Protect and restore approximately five to 10 acres of emergent wetland and riparian forest (Vancouver Water Resources)

The Action Agencies have not identified the specific projects that they will implement during 2010 to 2017. However, the projects selected will address limiting factors, based on the recommendations of the LCREP Science Workgroup.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.2.5.4 Effects of Prospective Hatchery Actions

Effects on Species Status

NOAA Fisheries cannot consult on the operation of existing or new hatchery programs until Hatchery and Genetic Management Plans (HGMPs) are updated and consultation is initiated. For more than 30 hatchery programs in the Snake River basin, including fall Chinook hatcheries, proposed programs are to be submitted to NOAA Fisheries by February 2010 and ESA consultation is expected to be completed by August 2010. Site specific application of BMPs will be defined in ESA Section 7, Section 10, or Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS BA, page 2-44). Based on the scientific work to date by the ICTRT and Hatchery Science Review Group (HSRG), NOAA Fisheries expects that implementation of the criteria and practices described in the Prospective Actions (RPA 39) will have a positive effect on the productivity and, particularly, on the diversity of SR fall Chinook.

Subject to subsequent hatchery specific ESA § 7(a)(2) Consultation, implement of MPS in NOAA Fisheries approved HGMPs are expected to 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations

However, Federal agencies have obligations in addition to implementing the Endangered Species Act and NOAA Fisheries must consider the effects of Prospective Actions on the exercise of treaty fishing rights and the Federal government's trust responsibilities to Tribes. Because Snake River fall Chinook provide a substantial contribution to tribal fisheries, the long-term recovery goals for this ESU will take into account tribal treaty rights and the federal trust responsibility. NOAA Fisheries will continue to work closely with the tribal and state fishery managers and evaluate all relevant scientific information, including the work of the Columbia Hatchery Science Review Group (HSRG), to find ways to reduce risk to this ESU, including modifications to hatchery programs, consistent with treaty rights and trust responsibilities.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on the primary constituent elements of critical habitat in subsequent consultations on site-specific actions.

8.2.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of SR fall Chinook will vary from year-to-year based on the following abundance-based harvest rate schedule (Table 8.2.5.5-1). Harvest will depend on the abundance of unlisted upriver fall Chinook and natural-origin SR fall Chinook. The allowable harvest rate will range from 21.5% to 45.0%.

**Table 8.2.5.5-1. Abundance-based harvest rate schedule for SR fall Chinook (TAC 2008).
State/Tribal Proposed Snake River Fall Chinook Harvest Rate Schedule**

State/Tribal Proposed Snake River Fall Chinook Harvest Rate Schedule					
Expected URB River Mouth Run Size^Y	Expected River Mouth Snake River Wild Run Size¹	Treaty Total Harvest Rate	Non-Treaty Harvest Rate	Total Harvest Rate	Expected Escapement of Snake R. Wild Past Fisheries
60,000	1,000	20%	1.50%	21.50%	784
60,000	1,000	23%	4%	27.00%	730
120,000	2,000	23%	8.25%	31.25%	1,375
200,000	5,000	25%	8.25%	33.25%	3,338
	6,000	27%	11%	38.00%	3,720
	8,000	30%	15%	45.00%	4,400

1. If the Snake River natural fall Chinook forecast is less than level corresponding to an aggregate URB run size, the allowable mortality rate will be based on the Snake River natural fall Chinook run size.

Notes:
Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from August 1-December 31.
Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the confluence of the Snake River and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from August 1-December 31.
The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.
Fishery impacts in Hanford sport fisheries count in calculations of the percent of harvestable surplus achieved.
When expected river-mouth run sizes of naturally produced Snake River Fall Chinook equal or exceed 6,000, the states reserve the option to allocate some proportion of the non-treaty harvest rate to supplement fall Chinook directed fisheries in the Snake River.

Since 1996, fall season fisheries in the mainstem Columbia River have been managed subject to an ESA harvest rate limit of 31.29%. This represented a 30% reduction in the 1988 to 1993 base period harvest rate. The status of Snake River fall Chinook has improved considerably over the last ten to fifteen years, and harvest reductions were among the actions taken to improve the overall status of this species.

The prospective harvest rate schedule modifies the past practice of managing fisheries subject to a fixed harvest rate, providing a management structure that is responsive to the status of the species. Under the new schedule, harvest may vary up or down depending on the overall abundance of unlisted upriver fall Chinook and listed natural-origin Snake River fall Chinook. The harvest rate schedule is generally calibrated to provide higher harvest rates when abundance is high enough to accommodate the increased harvest and still meet the TRT recovery abundance

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threshold of 3,000 natural-origin fish to Lower Granite Dam. Conversely, when numbers are low, harvest rates are reduced to provide greater protection.

The SCA Harvest Appendix describes an analysis that compares base, current, and future harvest rates and derives multipliers necessary for this analysis. The analysis was provided by a *U.S. v. Oregon* Work Group (*U.S. v Oregon* Workgroup 2008; Quantitative Analysis of Harvest Actions Appendix). As described above, a 1.09 base-to-current multiplier is estimated. The prospective harvest action will result in no change from the base harvest rate if only the authorized harvest rate is considered (i.e., harvest survival multiplier = 1.0). However, since 1996, based on a post season review, actual harvest rates have, with one exception, been less than the ESA-authorized limit. The difference between the allowed and observed harvest rate has ranged from -0.9% to 10.7% (Table 8.2.5.5-2). On average, the observed harvest rate has been 5.1% less than the 31.3% limit in absolute terms (i.e., 83.7% of the 31.3% limit). Assuming that this practice continues, the expected prospective harvest rate is therefore likely to be less than those in Table 8.2.5.5-1 and the survival multiplier associated with the expected prospective harvest rate will be 1.06. The range of prospective harvest multipliers recommended by the *U.S. v. Oregon* Work Group is therefore 1.00-1.06.

Table 8.2.5.5-2 Observed harvest rate on SR fall Chinook compared to the maximum allowable harvest rate limit (Observed HR from TAC 2008).

Year	Observed HR (%)	Allowed HR (%)	Difference
1996	26.4	31.3	4.9
1997	32.2	31.3	-0.9
1998	26.6	31.3	4.7
1999	30.3	31.3	1.0
2000	28.8	31.3	2.5
2001	21.0	31.3	10.3
2002	28.3	31.3	3.0
2003	21.5	31.3	9.8
2004	20.6	31.3	10.7
2005	25.6	31.3	5.7
2006	27.1	31.3	4.2
Average	26.2	31.3	5.1

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank

vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for Snake River fall Chinook.

8.2.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River fall Chinook from reduction in Caspian tern nesting habitat on East Sand Island, and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA 45) is 0.7% (CA Chapter 4, Table 4-7). Compensatory mortality may occur but based on the discussion in Section 8.2.5.7 is unlikely to significantly affect the results of the action.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA 48).

Effects on Critical Habitat

Reduction of Caspian tern nesting habitat on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport fishery, and continued implementation and improvement of avian deterrence at mainstem dam will improve the functioning of the PCE safe passage in the migration corridor for juvenile fall Chinook. These actions will enhance the conservation value of critical habitat over both the short- and long-term.

8.2.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the Supplemental Comprehensive Analysis.

8.2.5.8 Summary: Quantitative Survival Changes Expected from All Prospective Actions

Expected changes in productivity and quantitative extinction risk for those Prospective Actions that can be quantified (estuary habitat restoration, tern relocation, and Northern Pikeminnow reduction) are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.2.5.1 through 8.2.5.7 and quantitative estimates are summarized in Table 8.2.5-1. The net effect is 11-18% increased survival, compared to the “current” condition, and 24-32% increased survival, compared to the “base” condition (applied only to the

1977-present time series). These represent a subset of the effects of the Prospective Actions because hydro and hatchery effects are only considered qualitatively. These future survival changes expected from implementation of the Prospective Actions are applied to both the 1977-present and 1990-present time series.

8.2.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Table 8.2.6-1. In addition to this summary table, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to this ESU are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions.

8.2.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Snake River Mainstem MPG is the only MPG within the Snake River fall Chinook ESU. Because there is only one MPG, Section 8.2.7 applies to both the Snake River Mainstem MPG and the Snake River fall Chinook ESU. The single population in this MPG must be highly viable to achieve the ICTRT's suggested viability scenario (ICTRT 2007a, Attachment 2).

8.2.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Fall Chinook ESU

This section summarized the basis for conclusions at the ESU level.

8.2.7.1 Potential for Recovery

It is likely that the Snake River fall Chinook salmon ESU will trend toward recovery.

The future status of the single extant population and single MPG of Snake River fall Chinook salmon will be improved compared to its current status through the reduction of current adverse FCRPS and Upper Snake project effects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.2.5, 8.2.6, and 8.2.7.2. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to

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estuary habitat improvements (Section 5.2.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions include hydropower, predation, and estuary habitat actions that address limiting factors and threats and will reduce their negative effects. ICTRT concerns regarding high spatial structure risk and the need to begin assessing the feasibility of reintroducing historical populations above Hells Canyon are being addressed through other processes outside of the FCRPS, Upper Snake, and *U.S. v. Oregon* consultations. ICTRT concerns about high diversity risk are being addressed through hatchery Prospective Actions, which ensure that the Action Agencies will implement programmatic funding criteria, including those that will reform FCRPS hatchery operations to reduce genetic and ecological effects on ESA-listed salmon. This will have a positive effect on the diversity of Snake River fall Chinook. The harvest prospective action is to implement a *U.S. v. Oregon* process harvest rate schedule that is expected to either result in no change (authorized harvest) or a reduction (expected harvest) from the current harvest rates in the environmental baseline.

In addition, the harvest Prospective Action is to implement a *U.S. V. Oregon* process harvest rate schedule that is expected to either result in no change (authorized) or a reduction (expected) from the harvest rates in the environmental baseline.

Some threats to the recovery of Snake River fall Chinook salmon, such as diversity risk from ongoing hatchery actions, will probably take longer than 10 years to correct. The adaptive management Prospective Actions will quantify hatchery fish effectiveness and provide the first information on threats from the hatchery program. The Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

The Prospective Actions include a strong monitoring program to assess if implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays and regulation of late summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam. Estuary habitat projects include dike removal and opening off-channel habitat, which in some cases is likely to encourage hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

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In sum, these qualitative considerations suggest that the Snake River fall Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Productivity based on R/S, lambda, and BRT trend is expected to be greater than 1.0 for SR fall Chinook, using both the base-to-current method with the 1977-present time series and the unadjusted 1990-present method, except for estimated lambda of 0.99 with HF=1 for the 1977-present series (Table 8.2.6-1 for results; description in Section 8.2.3.1). Note that hydro improvements have not been quantified for this species, so all estimates would be greater than 1.0 if these improvements had been included in the calculations. This means that survival will be sufficient for the population to grow and that the abundance of spawners will have a positive trend.

Some important caveats that apply to all three quantitative estimates are as follows:

- In addition to unquantifiable hydro improvements, other beneficial effects of the Prospective Actions could not be quantified (e.g., habitat improvements that accrue over longer than a 10-year period), so these quantitative estimates of prospective productivity are low.
- This summary of productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. The ICTRT was not able to estimate ocean climate factors for this species. However, because productivity estimates were all greater than 1.0 based on the recent climate period, it is likely that under a longer historical ocean climate assumption all three metrics would also be greater than 1.0, and the positive trends would likely be greater. Under a “Warm PDO” ocean climate assumption, it is possible that productivity would be less than 1.0 for one or more metrics.
- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, the three metrics are generally less than 1.0 for the lower 95% confidence limits and are consistently higher than 1.0 at the upper 95% confidence limits (SCA Aggregate Analysis Appendix). This uncertainty is an important reason that NOAA Fisheries also considers qualitative factors in reaching its conclusions.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been

improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. Quantitative estimates indicate that survival will be sufficient for the population to grow and that the abundance of spawners will have a positive trend. Prospective Actions, which will implement programmatic funding criteria including those that will reform FCRPS hatchery operations to reduce genetic and ecological effects on ESA-listed salmon, will reduce the current diversity risk of SR fall Chinook.

This does not mean, however, that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes resulting from the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.2.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described in Sections 8.2.3 and 8.2.5.

As described above and in Section 8.2.6, Snake River fall Chinook abundance is expected to increase and natural productivity (R/S) is expected to be sufficient for population growth. The recent 10-year geometric mean abundance has been 1,273 natural spawning fish, which is well above the 50 fish QET (Table 8.2.2-1). Snake River fall Chinook have not dropped below 50 fish in any single year (Cooney and Ford 2007). These factors also indicate a decreasing risk of extinction.

Snake River fall Chinook are heavily supplemented and the hatchery fish are part of the ESU, contributing to total abundance and thereby reducing short-term extinction risk. Over time, this level of supplementation may result in a higher level of long-term risk to diversity and natural productivity than would occur in an un-supplemented population and there is uncertainty over whether the apparent increases in productivity and abundance reflect temporary or more sustained improvements in survival. However, it appears possible to further improve hatchery practices and reduce supplementation impacts on some portions of this ESU without reducing the overall level of hatchery production. The risks associated with supplementation will be reduced through on-going hatchery reviews and consultations as indicated in Section 8.2.5.4.

The Prospective Actions include a strong monitoring program (RPA Actions 50-73) to assess if implementation is on track and to signal potential problems early. The Prospective Actions include the monitoring of hatchery fish effectiveness and risk to the population. Other Prospective Actions

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include implementation planning, annual reporting, and comprehensive evaluations (RPA Actions 1-3) to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

The base period 24-year extinction risk is estimated to be 0-1%, depending on QET level (Table 8.2.2-3). Therefore, no survival improvement would be needed to reduce risk to <5%, so no additional survival gap was identified. Improvements associated with the Prospective Actions would further support the conclusion of low short-term extinction risk.

The base period extinction risk analysis described above assumes that all supplementation ceases. There is an ongoing hatchery program, which is included in both the environmental baseline and the Prospective Actions, to further reduce short-term extinction risk. A quantitative analysis of extinction risk with a continuing supplementation program indicates 0% risk over either 24- or 100-year periods (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

In addition to unquantifiable hydro improvements, other beneficial effects of the Prospective Actions could not be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of improvements in Table 8.2.5-1 may be low.

This summary of extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described above for recovery metrics and in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. The ICTRT was not able to estimate ocean climate factors for this species. However, because productivity estimates were all greater than 1.0 based on the recent climate period, it is likely that under a longer historical ocean climate assumption all three metrics would also be greater than 1.0, and the positive trends would likely be greater. Under a “Warm PDO” ocean climate assumption, it is possible that productivity would be less than 1.0 for one or more metrics.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an under-estimate of the short-term extinction risk, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from 0 to near 100% for SR fall Chinook (Table 8.2.2-3). This uncertainty is an important reason that NOAA Fisheries also considers qualitative factors in reaching its conclusions.

Taken together, the combination of all the factors above indicates that the SR fall Chinook ESU is likely to have a low short-term extinction risk when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements will result in lower short-term extinction risk than in recent years. Current abundance is well above the quasi-extinction threshold considered by the ICTRT. Quantitative analyses also support this conclusion. In addition, there are hydrosystem improvements with benefits that cannot be quantified, which will further reduce this risk compared to quantitative estimates. SR fall Chinook are heavily supplemented and the hatchery fish are part of the ESU, contributing to abundance and thereby reducing short-term extinction risk. However, over time this level of supplementation poses long-term risks to diversity and natural productivity as described in Section 8.2.5. Implementation of the Prospective Actions will help to reduce this long-term diversity risk and will confirm the benefits and risks of the hatchery mitigation program. In summary, it is likely that the SR fall Chinook ESU will have a low short-term extinction risk.

8.2.7.3. Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR fall Chinook salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. The environmental baseline within the action area, which encompasses all of these areas, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR fall Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns and northern pikeminnows will further improve safe passage for juveniles. Habitat work in estuarine areas used for rearing and migration will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation,

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space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River fall Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Snake River fall Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat.

Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁸

⁸ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.2.2-1. Status of SR fall Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated using two base time periods, as described in Section 8.2.3.

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	Median Population Growth Rate (lambda; HF=0) ³	Lower 95% CI	Upper 95% CI	Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope ⁴	Lower 95% CI	Upper 95% CI
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	1273	1995-2004	3000	0.81	0.46	1.21	1.09	0.91	1.30	0.95	0.80	1.12	1.09	1.06	1.13
		Lower Mainstem Fall Chinook 1990-	1273	1995-2004	3000	1.24	0.93	1.66	1.18	0.89	1.56	1.01	0.79	1.27	1.23	1.16	1.31

1 Most recent year for 10-year geometric mean abundance is 2004. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from draft ICTRT (2007c).

2 Mean returns-per-spawner are estimated from the most recent periods of 1977-2004 (1977 through 1999 brood years) and 1990-2004 (1990 through 1999 brood years). Averages are calculated from information in Cooney and Ford (2007), updated with information in Cooney (2007).

3 Median population growth rate (lambda) are estimated from the most recent periods of 1977-2004 (1977 through 1999 brood years) and 1990-2004 (1990 through 1999 brood years) using estimates from Cooney (2008d).

4 Biological Review Team (Good et al. 2005) trend estimates updated for recent years in Cooney (2008d).

Table 8.2.2-2. Status of SR fall Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	BRT Current Risk For Distribution ¹	BRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook	"Moderately High" (Large portion of historical habitat is inaccessible and the distribution of the extant population makes it vulnerable to variable environmental conditions and large disturbances)	"Moderately High" (Loss of diversity associated with extinct populations and significant hatchery influence for the extant population)	0.46

1 The ICTRT has not assigned specific risk levels to this population at this time. Biological Review Team (BRT) assessments are from Good et al. (2005).

2 Average fraction of natural-origin natural spawners from ICTRT (2007c).

Table 8.2.2-3. Status of SR fall Chinook salmon with respect to extinction risk. Short-term (24-year) extinction risk is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY). It was not possible to estimate short-term extinction risk from the more recent 1990-1999 BY data set.

ESU	MPG	Population	24-Year Extinction Risk											
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.01	0.00	1.00
		Lower Mainstem Fall Chinook 1990-												

1 Short-term (24-year) extinction risk from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

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Table 8.2.2-4. Changes in density-independent survival (“gaps”) necessary for indices of productivity to equal 1.0 and estimates of extinction risk no higher than 5% for SR fall Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1 ²	Upper 95% CI	Lower 95% CI	Survival Gap For BRT trend = 1.0 ³	Upper 95% CI	Lower 95% CI	Survival Gap for 24 Yr Ext. Risk <5% (OET=1) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=10) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=30) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=50) ⁴
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	1.34	2.17	0.83	0.68	1.52	0.31	1.27	2.73	0.59	0.67	0.78	0.58	<1.0	<1.0	<1.0	<1.0
		Lower Mainstem Fall Chinook 1990-	0.80	1.07	0.60	0.48	1.66	0.14	0.98	2.86	0.34	0.39	0.51	0.30				

1 R/S survival gap is calculated as $1.0 \div \text{base R/S}$ from Table 8.2.2-1.

2 Lambda survival gap is calculated as $(1.0 \div \text{base lambda from Table 8.2.2-1})^{\text{Mean Generation Time}}$. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as $(1.0 \div \text{base BRT slope from Table 8.2.2-1})^{\text{Mean Generation Time}}$. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt “a” value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt “a” value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

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Table 8.2.3-1. Proportional changes in average base period survival expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average). The 1990-present estimate, which likely includes recent harvest and hydro survival, is not adjusted.

ESU	MPG	Population	Base-to-Current Adjustment (Survival Multiplier)						Total Base-to-Current Survival Multiplier ⁷
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Harvest ⁵	Hatcheries ⁶	
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	N/A	1.00	1.01	1.02	1.09	N/A	1.12
		Lower Mainstem Fall Chinook 1990-							1.00

1 Hydro survival cannot be quantified or compared between the base and current periods for this species.

2 No tributary habitat actions are relevant per CA Section 4.3.1.2.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Current 2 S/Baseline 2 S” approach, as described in Attachment F-2.

5 From SCA Quantitative Analysis of Harvest Actions Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

6 Hatchery survival is not quantified for comparison between the base and current period

7 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

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Table 8.2.5-1. Proportional changes in survival expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Survival Multiplier)										Total Base-to-Future Survival Multiplier ¹⁰	
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Hatcheries ⁶	Low Harvest ⁷	High Harvest ⁷	Non-Hydro Current-to-Future Survival Multiplier ⁸	Total Current-to-Future Survival Multiplier ⁹		
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-1999 with Allowable Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00	1.00		1.11	1.11		1.24
		Lower Mainstem Fall Chinook 1977-1999 with Expected Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00		1.06	1.18	1.18		1.32
		Lower Mainstem Fall Chinook 1990-1999 with Allowable Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00	1.00		1.11	1.11		1.11
		Lower Mainstem Fall Chinook 1990-1999 with Expected Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00		1.06	1.18	1.18		1.18

1 Hydro survival cannot be quantified or compared between the base and current periods for this species.

2 No tributary habitat actions are relevant per CA Section 4.3.3.2.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 Hatchery survival is not quantified for comparison between the current and future period

7 Harvest estimates from SCA Quantitative Analysis of Hatchery Actions Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

8 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

9 Same as Footnote 7, except it is calculated from all Prospective Actions. For SR fall Chinook, hydro survival changes cannot be quantified, so this number represents a minimum survival change.

10 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.2.3-1. For SR fall Chinook, hydro survival changes cannot be quantified, so this number represents a minimum survival change.

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Table 8.2.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR fall Chinook. The 1977-present time series was adjusted for base-to-current survival changes other than hydro, which could not be estimated quantitatively. The 1990-present time series was not adjusted for base-to-current changes. Estimates of productivity expected under the Prospective Actions do not include future hydro survival improvements, which could not be quantified for this species.

ESU	MPG	Population	R/S Recent Climate ¹	Lambda Recent Climate @ HF=0 ²	Lambda Recent Climate @ HF=1 ³	BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ⁵
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-1999 with Allowable Future Harvest	1.01	1.14	0.99	1.15	Must be HV	All three metrics >1, with both a base-to-current adjusted 1977-present time series or a 1990-present time series with no base-to-current adjustment, except for lambda = 0.99 with HF=1 for the 1977-1999 series. Note that hydro improvements have not been quantified for this species.	"Moderately High" (Large portion of historical habitat is inaccessible and the distribution of the extant population makes it vulnerable to variable environmental conditions and large disturbances)	"Moderately High" (Loss of diversity associated with extinct populations and significant hatchery influence for the extant population)
		Lower Mainstem Fall Chinook 1977-1999 with Expected Future Harvest	1.07	1.16	1.01	1.16				
		Lower Mainstem Fall Chinook 1990-1999 with Allowable Future Harvest	1.38	1.21	1.03	1.26				
		Lower Mainstem Fall Chinook 1990-1999 with Expected Future Harvest	1.47	1.22	1.04	1.28				

1 Calculated as the base period R/S productivity from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1.

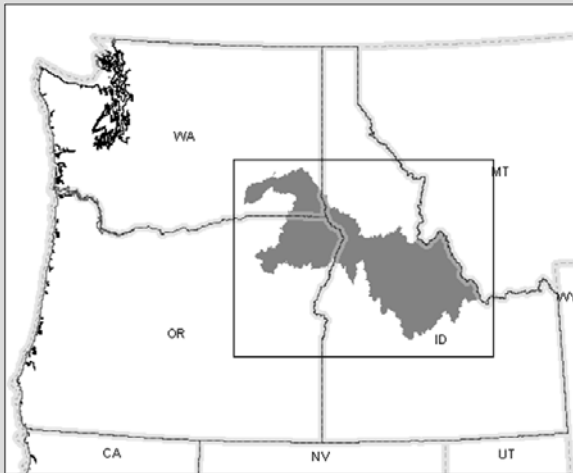
2 Calculated as the base period mean population growth rate (lambda) from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

3 Calculated as the base mean BRT abundance trend from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

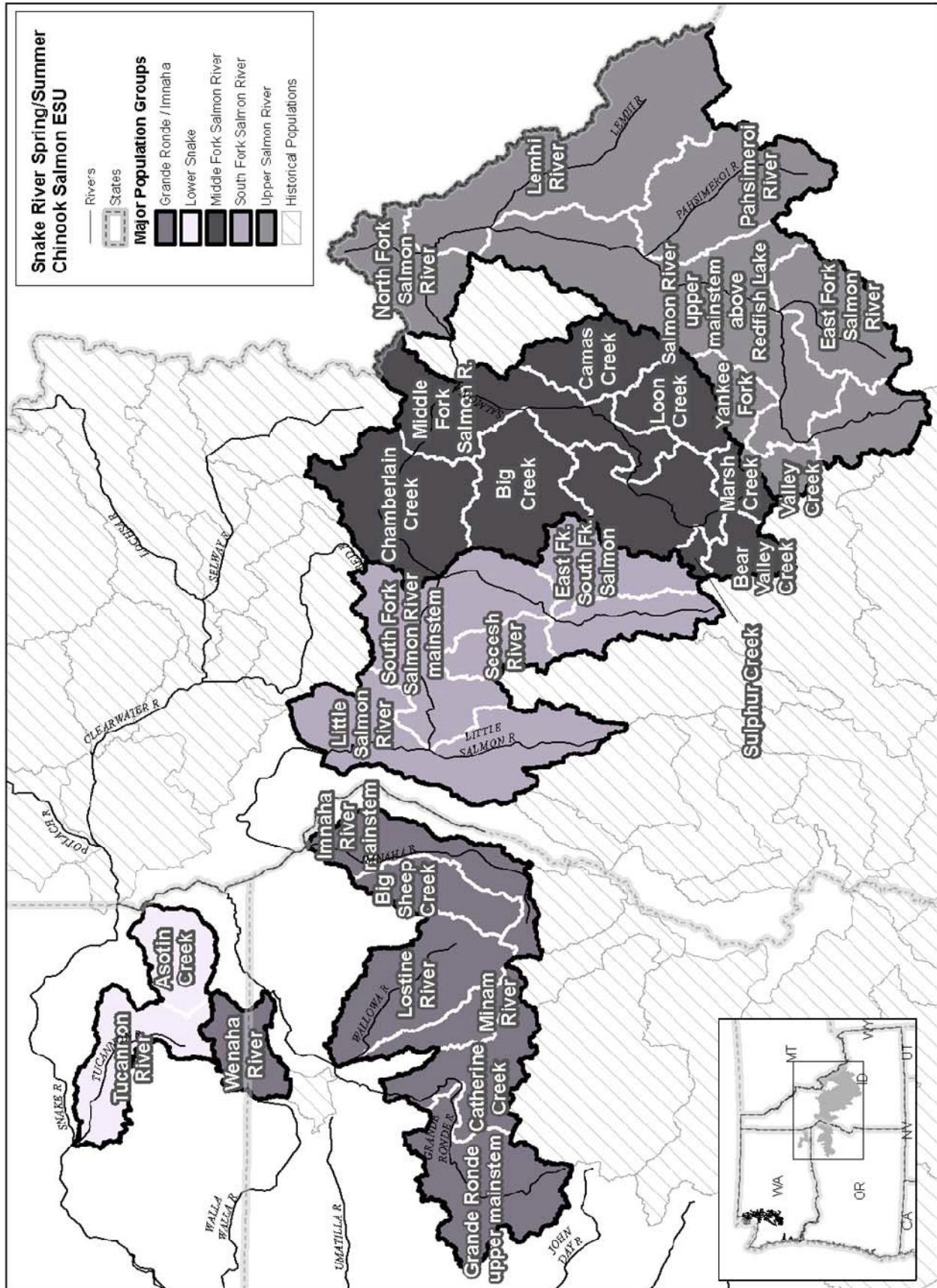
4 From ICTRT (2007a), Attachment 2

5 From Table 8.2.2-2

Section 8.3 Snake River Spring/Summer Chinook Salmon



- 8.3.1 Species Overview
- 8.3.2 Current Rangewide Status
- 8.3.3 Environmental Baseline
- 8.3.4 Cumulative Effects
- 8.3.5 Effects of the Prospective Actions
- 8.3.6 Aggregate Effects by MPG
- 8.3.7 Aggregate Effect on ESU



Section 8.3

Snake River Spring/Summer Chinook Salmon

Species Overview

Background

The Snake River (SR) spring/summer Chinook consists of five major population groups that spawn and rear in the tributaries of the Snake River between the confluence of the Snake and Columbia rivers and the Hells Canyon Dam. The factors that contributed to their decline include intensive harvest and habitat degradation in the early and mid 1900s, high harvest in the 1960s and early 1970s, and Federal and private hydropower development, as well as poor ocean productivity in the late 1970s through the late 1990s. Snake River spring/summer Chinook were listed under the ESA as threatened in 1992.

Designated critical habitat for SR spring/summer Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers and a number of tributary subbasins.

Current Status & Recent Trends

The SR spring/summer Chinook's five major population groups (MPGs) are further composed of 28 extant populations. Abundance has been stable or increasing on average over the last 20 years. In 2007, jack counts (a qualitative indicator of future adult returns) were the second highest on record. However, on average, the natural-origin components of SR spring/summer Chinook populations have not replaced themselves.

Limiting Factors and Threats

Limiting factors for the Snake River spring/summer Chinook include the Federal and private hydropower projects, predation, harvest, the estuary, and tributary habitat. Ocean conditions have also affected the status of this ESU. These conditions have been generally poor for this ESU over the at least the last four brood cycles, improving only in the last few years. Although hatchery management is not identified as a limiting factor for the ESU as a whole, the ICTRT has indicated potential hatchery impacts for a few individual populations.

Recent Ocean and Mainstem Harvest

The ocean fishery mortality on Snake River spring/summer Chinook is very low and, for practical purposes, assumed to be zero. Incidental take of Snake River spring/summer Chinook occurs in spring and summer season fisheries in the mainstem

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Columbia River that target harvestable hatchery and natural-origin stocks. The fisheries on harvestable runs were limited to ensure that incidental take of ESA-listed Snake River Spring/Summer Chinook does not exceed a rate of from 5.5 to 17%. The incidental take of natural-origin upriver spring/summer Chinook averaged 10.2% since 2001.

8.3.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.3.2.1 Current Rangewide Status of the Species

Snake River (SR) spring/summer Chinook is a threatened species composed of 28 extant populations in five major population groups (MPGs). Key statistics associated with the current status of SR spring/summer Chinook salmon are summarized in Tables 8.3.2-1 through 8.3.2-4 and are discussed below.

Limiting Factors and Threats

The key limiting factors and threats for the Snake River spring/summer Chinook include hydropower projects, predation, harvest, degraded estuary habitat, and degraded tributary habitat. Ocean conditions generally have been poor for this ESU over the last 20 years, improving only in the last few years. Eleven populations spawn in wilderness areas, where the habitat is considered functional. Limiting factors are discussed in detail in the context of the conservation value of critical habitat in Section 8.3.3.3.

Abundance

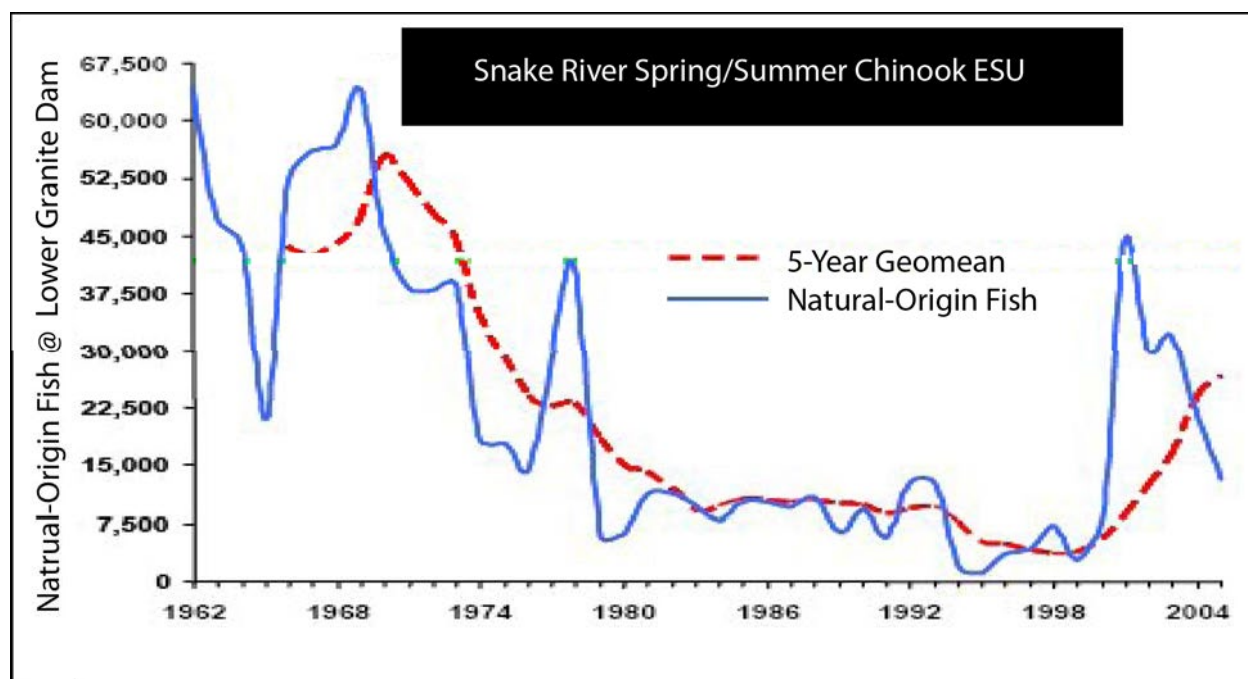
For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.3.2-1).¹ Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels near the recovery abundance thresholds in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Corps et al. 2007a Chapter 5, Figure 5-2 showing annual abundance of combined populations). The 2007 Snake River jack counts at Lower Monumental Dam are the second highest on record. Qualitatively, Chinook jacks are an indicator of future adult returns. While jack returns include both hatchery and wild fish, these numbers suggest a larger than average return of adults from the 2005 brood year. The majority of these fish will return in 2008 and 2009.

Although recovery criteria rely on the abundance of individual spawning populations, evaluated at the MPG and ESU level, the quality of information varies among populations. The aggregate abundance of all populations of natural-origin SR spring/summer Chinook has been measured since 1962 by counts at the four dams on the lower Snake River. Since 1975 counts have been made at Lower

¹ BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for “no jeopardy” determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Granite Dam, which encompass most populations within the ESU. Abundance and a rolling 5-year geometric mean of abundance for the aggregate of most populations in the ESU are shown in Figure 8.3.2-1. Geometric mean abundance peaked in the late 1960s and continued to decrease until the late 1990s. Geometric mean abundance since the late 1990s has increased substantially for the Lower Granite aggregate count. Geomean abundance of natural-origin fish for the 2001 to 2005 period was 25,957 compared to 4,840 for abundance of natural-origin fish for the 1996 to 2000 period, a 436 percent improvement (Fisher and Hinrichsen 2006). As a point of reference, the sum of the TRT's minimum abundance thresholds for all populations in this ESU is 26,500 (ICTRT 2007c).

Figure 8.3.2-1. Snake River Spring Summer Chinook Abundance Trends (adopted from Fisher and Hinrichsen 2006)



“Base Period” Productivity

On average over the last 20 full brood year returns (~1980-1999 brood years [BY], including adult returns through ~2004), approximately two-thirds of SR spring/summer Chinook populations have not replaced themselves (Table 8.3.2-1) when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries, ICTRT 2007d, updated with Cooney 2007b).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at $\leq 5\%$ extinction risk (ICTRT 2007c).

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While natural productivity has been, for most populations, low during this period, the BRT trend in abundance of natural fish has been stable or increasing for nearly all populations (Table 8.3.2-1).

Median population growth rate (λ) results are intermediate to those of R/S and the BRT trend. When calculated with an assumption that hatchery-origin natural spawners do not reproduce successfully ($HF=0$), results are similar to the BRT trend, and when calculated with an assumption that hatchery-origin natural spawners' fitness and effectiveness are as successful as natural-origin natural spawners ($HF=1$), results are similar to the average R/S (Table 8.3.2-1). The ICTRT is incorporating this range of hatchery effectiveness assumptions into updated λ estimates in the ICTRT Current Status Summaries, so NOAA Fisheries considers the full range.

In summary, abundance of natural-origin and total spawners has been stable or increasing for most SR spring/summer Chinook populations over the last 20 full brood years, based on λ ($HF=0$) and BRT trend estimates, generally >1.0 . For many populations, this stability or increase has been at least partially dependent on production from naturally spawning hatchery fish, the progeny of which (F_2 generation) are considered natural-origin fish in these calculations. For most populations, natural survival rates have not been sufficient for spawners to replace themselves, as indicated by average R/S and λ ($HF=1$) estimates <1.0 . The presence of hatchery-origin natural spawners does not explain, in its entirety, the differences among the three metrics, as evidenced by populations in the Middle Fork Salmon MPG which are not affected by hatcheries. As described in Chapter 7, each metric requires different types of information and assumptions, and each encompasses a somewhat different time period.

Spatial Structure

The ICTRT characterizes the spatial structure risk to nearly all SR spring/summer Chinook populations as "low" or "moderate" (Table 8.3.2-2). "High" risk exceptions are the Upper Grande Ronde and Lemhi populations, which are a result of accessible but currently unoccupied historically significant spawning areas.

Diversity

The ICTRT characterizes the diversity risk to nearly all SR spring/summer Chinook populations as "low" or "moderate" (Table 8.3.2-2). "High" risk exceptions are found in the Upper Salmon MPG. Factors indicating high risk include loss of the summer-run life history characteristic for the Lemhi population. Ten of the fourteen hatchery programs use fish included in the ESU and are thought to have preserved some of the remaining diversity in this ESU, particularly when individual populations declined to very low numbers in 1994 and 1995 (See NMFS' May 2004 SHIEER NMFS 2004b).

"Base Period" Extinction Risk

The ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the "base period" described above for R/S productivity estimates, as "Moderate" (5-25% 100-year extinction risk) for most SR spring/summer Chinook populations. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive

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years in these analyses (QET=50). Those populations classified at “high” long-term risk of extinction (>25% risk) are the Tucannon, Upper Grande Ronde, Lemhi, Yankee Fork Salmon R., East Fork Salmon R., and Pahsimeroi populations. Six populations are characterized as having a “low” risk of long-term extinction (<5% risk).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk, as discussed in Section 7.1.1.1 of this Supplemental Comprehensive Analysis. Table 8.3.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish). This “base” short-term extinction risk analysis assumes that productivity observed during the “base period” will be unchanged in the future. At QET=50, nearly all populations have greater than a 5% risk of extinction. The exceptions are the three South Fork Salmon MPG populations and the Upper Salmon River population. Confidence limits on these estimates are extremely high, with many estimates ranging from 0% to close to 100% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET levels below 50 spawners, more populations have <5% short-term extinction risk.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately, which is not consistent with the Prospective Actions. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. When hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, the estimated extinction risk is lower for the affected populations, even at QET=50 (Hinrichsen 2008 in the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival (see Table 7.4.1) that would be necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.3.2-4. Mean base period R/S survival gaps range from no needed change to approximately 3-fold needed survival improvements, depending on population. Many populations have no lambda or BRT gaps, but some populations require nearly 2-fold survival improvements. While a few populations have no extinction risk gap at QET=50, most populations have gaps between approximately 1.2 and 5.4. Gaps are much smaller at QET levels less than 50 spawners.

8.3.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR spring/summer Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers, and all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam (NMFS 1999a). Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls, including Napias Creek Falls, and Dworshak and Hells Canyon dams) in the following subbasins: Hells Canyon, Imnaha,

Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, Pahasimeroi, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa. The lower Columbia River corridor is among the areas of high conservation value to the ESU because it connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Designated areas consist of the water, waterway bottom, and the adjacent riparian zone (defined as an area 300 feet from the normal high water line on each side of the river channel) (NMFS 1999a). Designation did not involve rating the conservation value of specific watersheds as was done in subsequent designations (NMFS 2005b). The status of critical habitat is discussed further in Section 8.3.3.3.

8.3.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.3.3.1 “Current” Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk were based on performance of populations during a 20-year “base period,” ending in most cases with the 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity through bank stabilization, shading, etc).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, Table 8.3.3-1 includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7.2 and the Aggregate Analysis Appendix of this document). Results are presented in Table 8.3.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 4% survival change [see Quantitative Analysis of Harvest Actions Appendix in the SCA, based on *U.S. v. Oregon* estimates]), improvements in FCRPS configuration and operation (approximately a 20% survival

change, based on ICTRT base survival and COMPASS analysis of current survival in the SCA Hydro Modeling Appendix), and estuary habitat projects (a less than 1% survival change, based on Corps et al. 2007a Appendix D) result in a survival improvement for all SR spring/summer Chinook populations. Tributary habitat projects and changes in hatchery operations result in survival improvements for some specific populations within the ESU. Populations affected by tributary improvements experience survival changes ranging from 1-4% (CA Chapter 5, Table 5-7). In contrast, development of tern colonies in the estuary results in less than a 1% reduction in survival for all populations. Additionally, increased adult Chinook predation by marine mammals (primarily California sea lions) in the Columbia River immediately downstream of Bonneville Dam has likely resulted in approximately a 8.5% reduction in survival for SR spring Chinook salmon populations (SCA Marine Mammal Appendix).

Base-to-current adjustments in survival resulting from changing hatchery practices are described in the SCA Quantitative Analysis of Hatchery Actions Appendix. Hatchery reforms in the Grande Ronde have eliminated the use of broodstock originating from outside the area and ESU and have reduced straying, likely resulting in increased hatchery fish effectiveness or fitness in the wild and reduced impacts on genetic diversity. Some populations affected by hatchery operational changes experience improvements estimated at up to 39%. Adjustments in survival are described in the SCA Hatchery Effects Appendix, as estimated survival improvements in Table 5-7 of the CA use hatchery fish effectiveness values that are too high. Effectiveness values reported by Berejikian and Ford 2004 and Araki et al. 2007b were used to generate survival changes in this analysis.

The net result is that, if these recent human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 21-68%, depending on the particular population (Table 8.3.3-1). This also means that the survival “gaps” described in Table 8.3.2-4 would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.21] to [“Gap” ÷ 1.68], depending on the population).

8.3.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.3.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by SR spring/summer Chinook salmon. Factors affecting the conservation value of critical habitat vary from mortality in the mainstem hydrosystem to lack of adequate pool/riffle channel structure in tributaries, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

SR spring/summer Chinook salmon spawn at high elevations in the headwater tributaries of the Clearwater, Grande Ronde, Salmon, and Imnaha rivers. Spawning is complete by the second week of September. Natural-origin juveniles start moving downstream the following autumn, but typically overwinter in streams, becoming active seaward migrants during the following spring as yearlings (stream-type juvenile life history) (Connor et al. 2005).

The following are the major factors that have limited the functioning and thus the conservation value of tributary habitat used by SR spring-summer Chinook salmon for these purposes (i.e., spawning and juvenile rearing areas with spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Physical passage barriers [*culverts; push-up dams; low flows*]
- Reduced tributary stream flow, which limits usable stream area and alters channel morphology by reducing the likelihood of scouring flows [*water withdrawals*]
- Altered tributary channel morphology [*bank hardening for roads or other development and livestock on soft riparian soils and streambanks*]
- Excess sediment in gravel [*roads; mining; agricultural practices; livestock on soft riparian soils and streambanks, and recreation*]²
- Degraded tributary water quality including high summer temperatures and in some cases, chemical pollution from mining [*water withdrawals; degraded riparian condition*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors for this ESU in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]

² In some subbasins (e.g., Upper Middle Fork and Upper Salmon), high levels of sediment in gravel are due, at least in part, to the geologically unstable nature of the watershed.

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- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Pinniped predation on adults due to habitat changes in the lower river [*existence and operation of Bonneville Dam and an increased sea lion population*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for yearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 5.3.1.1 in Corps et al. (2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the absolute survival of spring-run Chinook by 5.5%. Thus, the continuing negative impact of sea lions will likely be approximately 3% for spring Chinook populations.

The safe passage of yearling Chinook through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For juvenile Chinook with a stream-type life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although SR spring/summer Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.3.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that could be used to adjust the status of the populations between the base and current periods. No such

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actions were found for the extant population within the Lower Snake MPG (Tucannon River population). Results for the other MPGs/populations are described below.³

Grande Ronde/Imnaha MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Wenaha or Lostine river populations.

Catherine Creek

The USFS consulted on a single forestry thinning project to reduce fire danger.

Upper Mainstem Grande Ronde

The USFS consulted on two grazing allotments and a rangeland analysis and the Federal Highways Administration consulted on a bridge repair project.

Imnaha River

The USFS consulted on a timber harvest/vegetation management project in the Upper Imnaha and a bridge replacement project in the Middle Imnaha River watershed. The USFS also consulted on granting a special use permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed. The USFS also consulted on a culvert replacement project in the upper Imnaha watershed that was designed to restore access to 3.5 miles of rearing habitat.

South Fork Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the South Fork Salmon River mainstem, Secesh River, or East Fork South Fork Salmon River populations. Under the 2000 RPA and 2004 Biological Opinion, Reclamation decommissioned a water diversion structure—restoring fish passage to three miles of Squaw Creek—and consolidated water rights from Squaw Creek with those in the Little Salmon River, increasing flows in Squaw Creek 4 cfs (enough to support a low temperature thermal refuge at the confluence with the Little Salmon River). Reclamation also consulted on a culvert replacement that will improve access to four miles of habitat in Squaw Creek and will improve habitat complexity in Squaw and Papoose creeks. The USFS consulted on a project to treat weeds within a wilderness area at a rate of approximately 6,250 acres per year.

During the summer of 2007, wildfires burned approximately 310,000 acres of forested habitat within the range of South Fork and Middle Fork Salmon River (see below) MPGs. NOAA Fisheries expects that instream habitats will experience increased temperatures, sediment, and large woody debris delivery in the near term. Recovery times for pre-existing conditions will depend on the effects of the fire at each location, which are unknown at this time.

³ This information does not include any habitat conservation or restoration projects funded by BPA under NOAA Fisheries' programmatic Biological Opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

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Middle Fork Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Middle Fork Salmon River populations above or below Indian Creek or the Big, Camas, Loon, Sulphur, Bear Valley, or Marsh Creek populations. The USFS consulted on a timber sale/salvage project in the lower South Fork Salmon River.

Upper Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the Yankee Fork or Valley Creek populations.

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood.

Lemhi River

The FHWA/IDT consulted on the construction of a pedestrian bridge over the Salmon River (Middle Salmon River—Williams Creek watershed).

The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi watershed) and two projects to rehabilitate stream channels and their respective riparian zones in the Middle Salmon River—Carmen Creek and Hayden Creek watersheds. The USFS also consulted on a riparian restoration project in Big Creek.

NOAA Fisheries consulted with itself on funding to screen a water diversion on Kenney Creek and to remove a barrier that will restore passage to 144 miles of rearing habitat and will increase flows 7 to 12 cfs over at least three miles in the Upper Lemhi River (Whitefish Ditch Project). Both projects are in the Eighteenmile Creek watershed.

Lower Mainstem Salmon River—below Redfish Lake

The USFS consulted on a whitebark pine treatment project and FHWA/IDT consulted on two bridge construction/repair projects. The USFS consulted on habitat improvement projects in Slate Creek (Salmon River—Slate Creek watershed), which are expected to add LWD and pool structure while preventing the introduction of excess sediment from forest roads.

Pahsimeroi

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River watershed with disease. The BLM proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NOAA Fisheries and USFWS each consulted on projects intended to remove passage barriers and improve stream flows by modifying water diversions and irrigation practices in the Lower Pahsimeroi River watershed. The Natural Resources Conservation Service consulted on instream flow work (conversion from flood irrigation to sprinklers) along Iron Creek.

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East Fork Salmon River

The USFS consulted on a road reconstruction and maintenance project in the Lower East Fork Salmon River watershed.

Upper Mainstem Salmon River—above Redfish Lake

The USFS consulted on an emergency fire project and whitebark pine treatment in the Salmon River—Pole Creek and Salmon River—Redfish Lake watersheds. The USFS also consulted on the Alturas Spur Road Obliteration and Cabin Creek Reconnect projects. These projects removed fish passage barrier in Cabin Creek and may reduce road generated sediment from entering Alturas Lake Creek (Alturas Lake Creek watershed).

Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which will result in the conversion of irrigated agricultural land to low density residential housing. The project is expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns when water was withdrawn from irrigation ditches. The BLM consulted on watershed rehabilitation activities associated with while managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

Projects Affecting Multiple MPGs/Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid “double counting,” NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.3.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of SR spring/summer Chinook salmon that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and create thermal refuges. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration

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actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including forest thinning, grazing, bridge repairs, whitebark pine treatment, bank stabilization, and road construction/maintenance, will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.3.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment (Corps et al. 2007a). They include tributary habitat actions that will benefit the Lemhi and Asotin populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.⁴ Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly

⁴ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects submitted.

improve conditions for Snake River spring/summer Chinook. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.3.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.3.5.1 and 8.3.5.2. However, the Prospective Actions will ensure that these adverse effects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will also provide some benefits. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be more than balanced by short -and long- term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are discussed in Chapter 10 of the FCRPS Biological Opinion. The expected use of transportation under the permit is discussed in the effects of the FCRPS Prospective Action, which is described in Section 8.3.5.1.

8.3.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (from Lower Granite to the Bonneville tailrace) of SR spring/summer Chinook salmon from 48.5% (Current) to 55.0% (Prospective), a relative change of 13.3%. The average proportion of juveniles destined for transportation is expected to drop from 78.1 to 73.5%. The altered timing of spill and transportation operations (see FCRPS RPA Table 3) will, in most years (about 80%) result in (1) no fish being collected and transported prior to April 21 (when SARs generally favor in-river migrants), (2) > 90% of juveniles being transported after May 15 (when SARs generally favor transported juveniles), and (3) an intermediate number of juveniles being transported between April 21 and May 14 (when SARs do not clearly favor in-river or transported migrants on a consistent basis). During the lowest flow years (about 20% of years when spring flows are predicted to be < 65 kcf at Lower Granite Dam), over 95% of juveniles are likely to be transported to below Bonneville Dam.

Implementation of the Prospective Actions is not expected to substantially affect total system survival. The total percentage of fish arriving at Lower Granite Dam expected to survive to below Bonneville Dam via in-river migration and transportation should increase slightly from about 85% to nearly 87%. However, the COMPASS model estimates that Lower Granite Dam to Lower Granite Dam smolt-to-adult returns (LGR to LGR SARs) are expected to increase from about 0.87 to 0.91% (a relative improvement of 5.2%) as a result of the hydro Prospective Actions governing spill and transport operations and their effect on migration timing to below Bonneville Dam (see discussion above).⁵

The hydro Prospective Actions, including the RM&E program are likely to maintain the high levels of survival currently observed for adult SR spring/summer Chinook salmon migrating from Bonneville Dam upstream to Lower Granite Dam. The current PIT tag based average survival estimate, taking

⁵ NOTE: The COMPASS model estimates SARs for in-river and transported migrants separately before combining them (with the estimated percentage of in-river and transported juveniles surviving to below Bonneville Dam) to provide an overall LGR to LGR SAR. Thus, the COMPASS model SAR estimates include (through the transport SAR estimate) the increased stray rates that are often observed for adult fish transported as juveniles (compared to stray rates of those that migrated in-river as juveniles) – a negative effect of transportation.

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account of harvest and “natural” stray rates within this reach, is 91.0% (about 98.6% per project) for spring and summer Chinook populations (SCA, Adult Survival Estimates Appendix). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to Lower Granite Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Actions are also likely to positively affect the survival of SR spring/summer Chinook salmon in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits qualitatively below, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects where predation rates are currently often the highest (see Section 8.1.1.1.) Taken together, surface passage routes should increase migration rates (decrease travel time) of in-river migrants through the migration corridor, which is likely to improve the post-Bonneville survival (i.e., SARs) of in-river migrants to a greater degree than has been estimated in the quantitative analysis. Additional benefits are likely to the extent that faster migrating juveniles would be in better condition (i.e., are less stressed, have more energy reserves, etc.) upon reaching the Bonneville tailrace than is currently the case.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from Lower Granite Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem’s effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to nearly 68%. A portion of the 39% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling SR spring/summer Chinook in a hypothetical unimpounded Columbia River would be 78%. Therefore, approximately 56% (22%/39%) of the expected mortality experienced by in-river migrating juvenile spring/summer Chinook is probably due to natural factors.

In recent years, scientists in the U.S. and Canada have started to investigate survival in unimpounded rivers (West Coast River Survival Appendix). Results for the Thompson-Frasier basin are preliminary, but the 78% natural survival rate assumed for the Snake-Columbia migration corridor in the 2004 FCRPS Biological Opinion may have been high.⁶ That is, yearling survival through the Prospective operations and configuration of the hydrosystem may be closer to “natural” than previously thought.

⁶ The West Coast River Survival Appendix describes a presentation by Dr. David Welch (Kintama Research, Nanaimo, BC) in July 2007. Dr. Welch presented survival data from acoustic tag studies with yearling Chinook in 2006. Additional studies will be needed before NOAA Fisheries considers these data reliable indicators of juvenile survival through a free flowing reach.

The direct survival rate of adults through the FCRPS is already quite high. The Prospective Actions include additional passage improvements (to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in section 5.3.3.1 in Corps et al. 2007a). Adult spring/summer Chinook survival from Bonneville to Lower Granite Dam will be approximately 91.0%.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will benefit the yearling migrants by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.3.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the functioning of safe passage in the juvenile and adult migration corridors by addressing water quality, water velocity, project mortality, and exposure to predators. To the extent that these improvements result in more adults returning to spawning areas, the hydro Prospective Actions will improve water quality and forage for juveniles by increasing the return of marine derived nutrients. However, the Remand Collaboration Habitat Technical Subgroup did not identify nutrients as a limiting factor for this species.

8.3.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Table 5-9, p. 5-20. For targeted populations in this ESU the effect is a <1 - 41% expected increase in low density egg-smolt survival, depending on population, as a result of implementing tributary habitat Prospective Actions that improve habitat function by addressing significant limiting factors and threats.⁷ For example, water withdrawals in the Lemhi watershed (upper Salmon River subbasin) currently reduce streamflow enough to block access to spawning and rearing habitat and unscreened water diversions entrain yearling Chinook. As part of their implementation of the RPA (Action 34), the Action Agencies will address this limiting factor by securing water to improve baseflow in the Lemhi River and move points of diversion downstream (to provide more flow in the upstream reach). The Action Agencies will also complete riparian improvement projects and take actions to reduce entrainment. The Action Agencies will assess stream crossings and determine actions needed to provide passage where culverts create barriers the upper mainstem Salmon River.

⁷ The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 3b; 4a; and 5a,b in Attachment B.2.2-2 to Corps et al. (Corps et al. 2007b).

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access.

Restoration actions will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.3.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Snake River Spring/Summer Chinook (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007-2010 is 1.4 %. The survival benefit for Snake River Spring/Summer Chinook (stream-type life history) associated with actions to be implemented from 2010 through 2017 is 4.3 %. The total survival benefit for Snake River Spring/Summer Chinook, as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats, is approximately 5.7% (Corps et al. 2007a Section 5.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats needed by yearling Chinook migrants from the Snake River to increase life history diversity, and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 5.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by yearling Chinook from the Snake River (safe passage). Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction (Section 8.5.5.2) are expected to be minor, occur only at the project scale, and persist for a short time.

8.3.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Hatchery actions are summarized in Section 5.3.3.5 of the CA. The actions fall into two general categories, reforms of existing hatchery programs and new programs that are part of a specific initiative to recover any ESA-listed anadromous salmonid. The reforms and new programs will be

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determined after site specific consultations guided by available scientific information and Best Management Practices (BMPs) (Framework Work Group 2006).

The hatchery Prospective Actions include the continued funding of hatcheries and the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. The criteria for making future funding decisions on hatchery programs for the FCRPS that incorporate BMPs is described in NOAA Fisheries' guidance (See Artificial Propagation for Pacific Salmon Appendix) and Appendix F of the CA. Site specific application of BMPs will be defined in subsequent discussions regarding ESA Section 7, Section 10, or Section 4(d) limits with NOAA Fisheries, to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44).

NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The Prospective Actions (RPA Action 39) require the submittal of updated HGMPs for the more than 30 hatchery programs in the Snake River basin and initiation of ESA consultation with NOAA Fisheries by February 2010. Hatchery reforms will be implemented upon NOAA Fisheries' completion of these ESA consultations in August 2010. Available information, principles, and guidance for operating hatchery programs are described in the SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) preserve mitigation obligations and integrate hatchery mitigation and conservation objectives; 2) preserve genetic resources; and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations

Future actions described in Section 5.3.3.5 of the CA are important because they will effectively integrate hatchery mitigation and conservation objectives, which additionally will support ESU recovery. The Prospective Actions call for implementing new scientific information at existing federally funded spring/summer Chinook hatchery programs. The hatchery programs are mitigation for construction and operation of Federal hydro projects and are interrelated and interdependent to the continued operation of the FCRPS itself. Continued reform of these facilities will preserve genetic resources, and accelerate the trend toward recovery as limiting factors and threats are addressed and natural productivity increases.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.3.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of SR spring/summer Chinook will vary from year-to-year based on an abundance-based harvest rate schedule (Table 8.3.5.5-1). Harvest will depend

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on the total abundance of upriver spring, natural-origin SR spring/summer Chinook, and may be further limited by natural-origin Upper Columbia River spring Chinook (see footnote 4 of table 8.3.5.5-1). The allowable harvest rate will range from 5.5% to 17%. As indicated in Table 8.3.5.5-1, most of the prospective harvest would occur in treaty Indian fisheries.

Table 8.3.5.5-1. Abundance-based harvest rate schedule for upriver spring Chinook and Snake River spring/summer Chinook in spring management period fisheries (TAC 2008).

Harvest Rate Schedule for Chinook in Spring Management Period					
Total Upriver Spring and Snake River Summer Chinook Run Size	Snake River Natural Spring/Summer Chinook Run Size¹	Treaty Zone 6 Total Harvest Rate^{2,5}	Non-Treaty Natural Harvest Rate³	Total Natural Harvest Rate⁴	Non-Treaty Natural Limited Harvest Rate⁴
<27,000	<2,700	5.0%	<0.5%	<5.5%	0.5%
27,000	2,700	5.0%	0.5%	5.5%	0.5%
33,000	3,300	5.0%	1.0%	6.0%	0.5%
44,000	4,400	6.0%	1.0%	7.0%	0.5%
55,000	5,500	7.0%	1.5%	8.5%	1.0%
82,000	8,200	7.4%	1.6%	9.0%	1.5%
109,000	10,900	8.3%	1.7%	10.0%	
141,000	14,100	9.1%	1.9%	11.0%	
217,000	21,700	10.0%	2.0%	12.0%	
271,000	27,100	10.8%	2.2%	13.0%	
326,000	32,600	11.7%	2.3%	14.0%	
380,000	38,000	12.5%	2.5%	15.0%	
434,000	43,400	13.4%	2.6%	16.0%	
488,000	48,800	14.3%	2.7%	17.0%	

1. If the Snake River natural spring/summer forecast is less than 10% of the total upriver run size, the allowable mortality rate will be based on the Snake River natural spring/summer Chinook run size. In the event the total forecast is less than 27,000 or the Snake River natural spring/summer forecast is less than 2,700, Oregon and Washington would keep their mortality rate below 0.5% and attempt to keep actual mortalities as close to zero as possible while maintaining minimal fisheries targeting other harvestable runs.
2. Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from January 1-June 15. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
3. Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the Hwy 395 Bridge in the Tri-Cities and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from January 1-June 15; Wanapum tribal fisheries, and Snake River mainstem recreational fisheries upstream to the Washington-Idaho border from April through June. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
4. If the Upper Columbia River natural spring Chinook forecast is less than 1,000, then the total allowable mortality for treaty and non-treaty fisheries combined would be restricted to 9% or less. Whenever Upper Columbia River natural fish restrict the total allowable mortality rate to 9% or less, then non-treaty fisheries

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would transfer 0.5% harvest rate to treaty fisheries. In no event would non-treaty fisheries go below 0.5% harvest rate.

5. The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

The prospective harvest schedule is similar to that first used in 2001, as well as in the most recent 2005 to 2007 Agreement. Since 2001, the allowable harvest rates ranged from 5.5 to 17%. The 2001 schedule did not include SR summer Chinook as part of the abundance indicator. The 2005 schedule was modified to include SR summer Chinook, but the abundance levels were adjusted accordingly to provide a comparable level of harvest for the adjusted run size. The harvest rate schedule proposed for use in 2008 and beyond differs from the 2005 schedule only in that it adjusts the allocations between the treaty Indian and non-treaty fisheries, but the total allowable harvest for all abundance levels is otherwise unchanged from the 2005 Agreement.

Harvest rates under the Prospective Actions will be the same as they have been in recent years. Therefore, no additional current-to-future survival adjustment is necessary for the prospective harvest action for this species.

It is also pertinent to consider the potential effects of conservative management. Fisheries directed at upriver spring Chinook can be managed with relative precision. Catch is tracked on a daily basis, and runsize estimates can be adjusted in-season using counts at Bonneville dam. Since 2001, actual harvest rates have ranged between 1.1 and 2.6% less than those allowed (Table 8.3.5.5-2). Any analysis that assumes that the allowed harvest rates will always be fully used would therefore be conservative.

Table 8.3.5.5-2. Actual harvest rate on SR spring/summer Chinook, & those allowed under the applicable abundance based harvest rate schedule (Observed HR from TAC 2008).

Year	Actual HR (%)	Allowed HR (%)	Difference (%)
2001	14.6	16.0	1.4
2002	12.7	14.0	1.3
2003	9.4	12.0	2.6
2004	10.8	12.0	1.2
2005	7.9	9.0	1.1
2006	8.0	10.0	2.0

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due

to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for SR spring/summer Chinook salmon.

8.3.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River spring/summer Chinook from the reduction in Caspian tern nesting habitat and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45), is 2.1 % (CA Attachment F-2, Table 4).

The projected benefit of reduced tern predation is sensitive to assumptions about the additive or compensatory nature of mortality from tern predation. The projected benefits identified in the CA (Appendix F) assume complete additivity (no compensatory mortality (i.e., every salmonid not consumed by terns survives all other sources of mortality)). However, if some portion of the tern's prey consists of salmonids predestined to die as a result of illness or poor condition or to be caught by other predators, the survival improvements modeled above would need to be reduced. Although tern predation likely falls in a class between completely additive and completely compensatory (Roby et al. 2003), current literature and empirical data do not identify more specific estimates or ranges. However, assuming a hypothetical compensatory mortality of 50% (Roby et al. 2003), the range of survival benefits from reducing tern predation across the affected ESUs would decline from 0.7 - 3.4% to 0.3 - 1.7%, approximately. As a result of the small incremental reduction in survival that results from reducing predation by terns nesting on East Sand Island, consideration of compensatory mortality does not significantly alter the estimated benefits of this action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 34) should further reduce consumption rates of juvenile salmon by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve

the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.3.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the Supplemental Comprehensive Analysis.

8.3.5.8 Summary: Quantitative Survival Changes Expected from All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.3.5.1 through 8.3.5.8 and are summarized in Table 8.3.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the ESU. Tributary habitat Prospective Actions are expected to increase survival for selected populations. The net effect, which varies by population, is 15-62% increased survival, compared to the “current” condition, and 39-115% increased survival, compared to the “base” condition.

8.3.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.3.6-1 and 8.3.6-2 and in Figures 8.3.6-1 through 8.3.6-4. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and ESU level.

8.3.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Lower Snake River MPG

This MPG consists of only one extant population (Tucannon), which must be highly viable to achieve the ICTRT’s suggested MPG viability scenario. The ICTRT also recommends conducting scoping efforts for re-introduction of the functionally extirpated Asotin population.

The estimated prospective trend in abundance for the Tucannon population (based on R/S, lambda with the HF=0 assumption, and BRT trend) is greater than 1.0, meaning that with implementation of the Prospective Actions the population is expected to replace itself and grow (Table 8.3.6.1-1). When hatchery-origin spawners are considered as effective as natural-origin spawners (HF=1), lambda is estimated to be less than 1.0 (0.98). However, there is considerable uncertainty regarding the reliability of quantitative estimates of productivity. The broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in tributary habitat as a result of the Prospective Actions, as described in Section 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal (i.e., as long as survival in some other life stage does not decrease), survival over the life cycle should also increase. It also indicates that estimates of productivity greater than 1.0 for this population are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “moderate,” as defined by the ICTRT (Table 8.3.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds. The Prospective Actions are unlikely to negatively affect spatial structure and diversity, so spatial structure and diversity risks are not expected to increase under the Prospective Actions. In the near term, the Tucannon hatchery supplementation program provides a reserve for maintaining diversity, potentially accelerating recovery pending increases in natural productivity. In the longer term, proportional contributions of hatchery fish to natural spawning would have to be reduced to achieve the ICTRT diversity criteria associated with low risk.
- Prospective Actions include tributary habitat improvements in the Asotin River. These actions are a necessary step toward potentially re-establishing the Asotin population. The problems facing this ESU, such as the need to re-establish the functionally extirpated Asotin population, will take longer than 10 years to resolve; however, the Prospective Actions take the necessary steps within the next ten years.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario the Tucannon population is expected to have R/S considerably greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, the estimate is lower but still greater than 1.0.

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- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Short-term extinction risk is estimated to be <5% at QET=50, whether Prospective Actions occur immediately or not (Table 8.3.6.1-2).

As discussed in Section 7.1.1.1 of the Supplemental Comprehensive Analysis, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses to QET levels of 30 fish or less also indicate <5% extinction risk, even if no Prospective Actions were to be implemented immediately (Table 8.3.6.1-2).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (see 95% confidence limits in Table 8.3.2-3). For this reason, other qualitative information is also considered:

- There is a safety-net hatchery program for this population, which is required to continue under the Prospective Actions, to further reduce short-term extinction risk.
- The recent 10-year geometric mean abundance has been 88 fish, which is above the 50 fish QET (Table 8.3.2-1). Only 2 of the last 25 years of returns have been below 50 fish (Cooney 2007).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Grande Ronde/Imnaha MPG

This MPG consists of six extant populations. The ICTRT recommends that four of these populations be viable or highly viable for MPG viability. Key populations within this MPG include the Imnaha because of its unique life history strategy (summer spawning timing and associated juvenile rearing patterns) and the Lostine/Wallowa, which is one of only three “large” populations. The ICTRT also suggests choices among two pairs of populations: Catherine Creek or Upper Grande Ronde (both representing “large” populations) and Minam or Wenaha (populations least affected by hatchery fish and with little spatial structure or diversity impairment). The ICTRT considers two additional populations (Big Sheep Creek and Lookingglass Creek) functionally extirpated. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

All of the populations are likely to increase in abundance, based on estimated lambda (HF=0) and BRT trends greater than 1.0 with the implementation of the Prospective Actions (Table 8.3.6.1-1). Additionally, three of the six populations are likely to have R/S and lambda (HF=1) greater than 1.0, indicating natural survival sufficient for the population to grow, and three of the populations are not likely to have R/S and lambda (HF=1) greater than 1.0. Furthermore, two of three populations with R/S<1 (Imnaha and either Catherine Creek or the Upper Grande Ronde) would need to be viable or highly viable under the ICTRT’s recommended MPG viability scenario. Additional survival improvements of 8% for Catherine Creek and 20% for the Imnaha would be necessary for two of these populations to exceed 1.0 for R/S (Aggregate Analysis Appendix).

There is considerable uncertainty regarding the reliability of quantitative productivity estimates because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- As a result of the Prospective Actions, life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in selected tributaries, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not solely determined by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “low” to “moderate” for all populations except the Upper Grande Ronde, which is at a “high” spatial structure risk because of unoccupied major and minor spawning areas (Table 8.3.2-2). The Upper Grande Ronde hatchery program has transitioned into a supplementation program that will build genetic resources and diversity. The MPG can achieve the ICTRT-suggested MPG viability scenario with the remaining populations having “low” to “moderate” risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- For these populations, the problems that must be addressed, in order to have higher R/S, will take longer than 10 years to resolve. In particular, the water quality and quantity problems in the lower

reaches of the Upper Grande Ronde and Catherine Creek will require a long-term program working with private landowners.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario all populations in the Grande Ronde MPG are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, four of six populations are expected to have R/S less than 1.0.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of short-term extinction risk indicate <5% risk at QET=50 or less for two populations (Minam and Imnaha), but >5% risk at QET=50 for the remaining four populations (Catherine Creek, Upper Grande Ronde, Wenaha, and Lostine/Wallowa; Table 8.3.6.1-2). For the Wenaha population, nearly all of the Prospective Actions survival improvements would have to occur immediately to reduce risk below 5% at QET=50. This is not expected to occur. For Catherine Creek, Lostine/Wallowa, and Upper Grande Ronde, extinction risk would be >5%, even if all Prospective Actions were implemented immediately.

As discussed in Section 7.1.1.1, CA Chapter 3, and the Aggregate Analysis Appendix, QET levels less than 50 fish are also relevant to short-term extinction risk. Sensitivity analyses to QET levels of 30 fish or less indicate approximately 5% extinction risk for the Lostine/Wallowa population (Table 8.3.6.1-2). QET levels of 10-30 (depending on speed of Prospective Actions implementation) or less would result in <5% risk for the Upper Grande Ronde population.

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There is considerable uncertainty regarding the reliability of quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3). For this reason, other qualitative information is also considered:

- The recent 10-year geometric mean abundance is above 50 fish for all populations except the Upper Grande Ronde (Table 8.3.2-1).
- The Upper Grande Ronde, Catherine Creek, and Lostine/Wallowa populations have dropped below 50 fish in some individual years since 1980 (Cooney 2007). No other populations have fallen below 50 fish.
- There is a hatchery program, which is required to continue under the Prospective Actions, acting as a safety net for most of the affected populations to reduce short-term extinction risk.
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

South Fork Salmon MPG

This MPG consists of four extant populations. The two largest of the four populations (South Fork Mainstem and East Fork South Fork) must be viable or highly viable to achieve the ICTRT suggested MPG viability scenario. Please see Section 7.3 of the SCA for a discussion of these MPG viability scenarios.

The productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 with implementation of the Prospective Actions (Table 8.3.6.1-1). This means that these populations are expected to have survival sufficient to grow and that the abundance of spawners will increase.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) for two of the three populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in selected tributaries as a result of the Prospective Actions, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. These improvements also indicate that estimates of productivity >1 for this population are not driven solely by favorable environmental conditions.

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- Current risk associated with spatial structure and diversity is “low” to “moderate” (Table 8.3.2-2). The MPG can achieve the ICTRT-suggested recovery scenario with moderate risk for these factors and sufficient productivity, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario all South Fork Salmon MPG populations are expected to have R/S greater than 1.0 and to be farther above 1.0 than under the recent climate scenario (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, all populations are expected to have R/S greater than 1.0.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of extinction risk indicate <5% risk at QET=50 or less for all three populations for which estimates can be made, even if no Prospective Actions are implemented immediately (Table 8.3.6.1-2).

There is some uncertainty regarding the reliability of quantitative estimates of extinction risk because of the range of statistical results (95% confidence limits in Table 8.3.2-3). For this reason, other qualitative information is also considered:

- There is a safety-net hatchery program for the East Fork South Fork (including Johnson Creek) population in this MPG to further reduce short-term extinction risk.
- The recent 10-year geometric mean abundance is above 50 fish for all three populations (Table 8.3.2-1). Returns have not dropped below 50 fish in individual years (Cooney 2007). Population

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abundance is expected to increase in the future as a result of actions already completed and additional Prospective Actions.

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Middle Fork Salmon MPG

There are nine populations in this MPG and five must be viable or highly viable to achieve the ICTRT suggested MPG viability scenario. Important populations include: Big Creek (the only large population), Chamberlain Creek (unique geographical position between MPGs and one of two needed “intermediate” sized populations), Bear Valley/Elk Creek (a second “intermediate” sized population, after Chamberlain Creek), Marsh Creek (one of two needed “basic” sized populations, with a larger production area and somewhat less isolation than others), and either Camas Creek or Loon Creek (one of which is needed for second “basic” sized population). Please see Section 7.3 for a discussion of these MPG viability scenarios.

Quantitative information is sufficient to estimate productivity for six of the nine populations (R/S, lambda, and BRT trend). Productivity (based on all three metrics: R/S, lambda, and BRT trend) is estimated to be greater than 1.0 for all 6 populations under the Prospective Actions (Table 8.3.6.1-1). This means that the populations will have survival sufficient to grow and that the abundance of spawners will achieve a positive trend.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1 for most of the R/S estimates; Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- As a result of the Prospective Actions, life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and tributary habitat survival (in Big Creek only), as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of expected productivity >1 for these populations are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “very low” to “moderate” (Table 8.2.2-2). The MPG can achieve the ICTRT-suggested recovery scenario with moderate risk for these factors and sufficient productivity, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

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- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, all populations in the Middle Fork MPG are expected to have productivity (all three metrics) greater than 1.0 (SCA Aggregate Analysis Appendix). Under the “Warm PDO” ocean scenario, in which all years are anomalously warm, 5 of 6 populations in the Middle Fork MPG are expected to have productivity (all three metrics) greater than 1.0.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Although quantitative estimates of extinction risk are not available for five of the nine populations in this MPG, quantitative estimates of extinction risk indicate that each of the four populations with sufficient data to make an estimate have >5% risk at QET=50 under current conditions (Table 8.3.6.1-2). If the Prospective Actions result in at least a 4% immediate improvement, then the Bear Valley/Elk Creek population will have <5% risk.

As discussed in Section 7.1.1.1, QET levels of less than 50 fish may be relevant to short-term extinction risk. This may be especially relevant for the small populations in the Middle Fork MPG, which have fallen below 50 spawners frequently during the last 20 years and yet survived (Cooney 2007; Figure 7.1-3). Within the last 20 years, seven populations in this MPG have fallen below 50 spawners four years in a row, yet have survived and rebounded to much higher levels (although not as high as historical abundance). This lends some empirical support to the view that QET=50 spawners may overstate the risk of actual biological extinction for some of these populations. A QET level of 30 spawners would result in <5% extinction risk for one of the four populations in this MPG for which quantitative estimates are possible, while a QET of 10 spawners would result in <5% risk for three of the four populations.

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There is considerable uncertainty regarding the quantitative estimates of extinction risk, both because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3) and because of uncertainty regarding the appropriate QET for short-term risk. For this reason, other qualitative information is also considered:

- There is not a safety-net hatchery program operating in the Middle Fork Salmon MPG to further reduce extinction risk but the hatchery Prospective Actions require the FCRPS Action Agencies to “identify and plan for additional safety-net programs. This MPG is primarily located in National Forest and wilderness areas and has been managed for wild fish production.
- The recent 10-year geometric mean abundance is above 50 fish for Big Creek, Bear Valley/Elk, and Loon Creeks, but is below 50 fish for Marsh, Sulphur, and Camas Creeks (Table 8.3.2.1-1). No estimates are available for the Upper Middle Fork, Lower Middle Fork, or Chamberlain populations. Since 1980, returns have dropped below 50 fish in individual years for all six populations for which abundance estimates are available (Cooney 2007). Population abundance is expected to increase in the future as a result of actions already completed and additional Prospective Actions.
- Fish management agreements do not currently support hatchery supplementation for these populations. However, if these populations fall to critically low levels, a hatchery safety net program could be implemented.
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Upper Salmon MPG

There are eight populations in the Upper Salmon MPG, five of which have to be viable or highly viable to achieve the ICTRT suggested recovery scenario. Important populations include: Lemhi River (one of two very large populations, connectivity to other MPGs), Pahsimeroi River (unique life history pattern), East Fork Salmon River (one of two needed large populations), Upper Salmon River (second needed large population), and Valley Creek (historically larger production than most basic-sized populations). Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Quantitative information is sufficient to estimate 20-year productivity for six of the eight populations (lambda, R/S, and BRT trend). Only 15 brood years are available for the Pahsimeroi population, but

R/S based on these 15 years is also displayed for this population. Productivity (based on all three metrics: R/S, lambda, and BRT trend) is estimated to be 1.0 or greater than 1.0 for all 6-7 populations under the Prospective Actions (Table 8.3.6.1-1). This means that the population will have survival sufficient to grow and that the abundance of spawners will achieve a positive trend.

For most of the populations with sufficient information for productivity estimates, there is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1, while lower 95% confidence intervals indicate productivity <1; Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not driven solely by favorable environmental conditions.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario all Upper Salmon MPG populations are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” (poor) climate scenario, five of seven populations are expected to have R/S greater than 1.0.
- Current risk associated with spatial structure and diversity is “high” for the Lemhi population and risk associated with diversity is “high” for the East Fork Salmon and Pahsimeroi populations, which also must be viable to achieve the long-term viability scenario suggested by the ICTRT (Table 8.3.2-2). Problems for these populations include unoccupied major and minor spawning areas and loss of the summer life history strategy for the Lemhi population.
- The problems associated with these populations that need to be addressed in order to have lower short-term extinction risk will take longer than 10 years to resolve. In particular, the occupation of sufficient major and minor spawning areas and loss of the Lemhi summer life history strategy involve long-term improvements.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to

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reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Short-term extinction risk could be estimated quantitatively for only three populations (Valley Creek, Upper Salmon, and Lower Salmon). Quantitative estimates of extinction risk indicate that the Upper Salmon River population has <5% risk at QET=50 (Table 8.3.6.1-2). The other two populations have >5 risk at QET=50.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate that QET would need to be between 10-30 spawners (depending on the degree to which Prospective Actions are implemented immediately) to conclude that two of the three available populations have <5% extinction risk (Table 8.3.6.1-2).

There is considerable uncertainty regarding the quantitative estimates of extinction risk, both because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3) and because of uncertainty regarding the appropriate QET for short-term risk. For this reason, other qualitative information is also considered:

- There is a captive rearing program to reduce short-term extinction risk for the Yankee Fork population. A captive broodstock program for the Lemhi has existed since 1995. There are no other safety-net hatchery programs for other populations in the Upper Salmon MPG.
- The recent 10-year geometric mean abundance is above 50 fish for the Lemhi, Upper Salmon, Lower Salmon, East Fork Salmon, and Pahsimeroi populations, but mean abundance is below 50 fish for the Valley Creek and Yankee Fork populations (Table 8.3.2-1). No estimates are available for the North Fork Salmon population. Returns have dropped below 50 fish in individual years since 1980 for all seven populations for which abundance estimates are available (Cooney 2007).
- While NOAA Fisheries would have greater confidence that populations in this MPG will not go extinct while recovery actions are being implemented if results showed a low likelihood of dropping below QET=50 fish, these populations have dropped below 50 spawners in the past and then increased dramatically when survival conditions were more favorable. For example, the abundance of Yankee Fork spawners ranged from 0-21 in the eight years between 1993-2000. However, from 2001-2003 (the last available year in the ICTRT data set) abundance has ranged from 92-161 (Cooney 2007).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.3.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Spring/Summer Chinook Salmon ESU

This section summarizes the basis for conclusions at the ESU level.

8.3.7.1 Potential for Recovery

It is likely that the Snake River spring/summer Chinook salmon ESU will trend toward recovery.

The future status of all populations and MPGs of SR spring/summer Chinook salmon will be improved from their current status through the reduction of current adverse effects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.3.5, 8.3.6, and 8.3.7.2. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.3.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions include hydropower, predation, and estuary and tributary habitat actions that address limiting factors and threats and will reduce their negative effects. As described in Section 8.3.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, and degradation of tributary and estuary habitat. Prospective habitat improvements will initiate and at least partially address concerns regarding high spatial structure risk for the Lemhi and Lostine/Wallowa populations. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to be no change from the current harvest rates in the environmental baseline. Although hatchery management is not identified as a current limiting factor for the ESU as a whole, the ICTRT has identified concerns for a few individual populations with high diversity risk. Additionally, the longer hatchery programs continue the more likely their effects will limit recovery potential. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized.

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Some of the problems limiting recovery of SR spring/summer Chinook salmon, such as tributary habitat problems affecting some Grande Ronde MPG populations, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years. Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays and regulation of late summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

In sum, these qualitative considerations suggest that the SR spring/summer Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.3.6, R/S is expected to be >1.0 for 19 of 23 populations in this ESU for which estimates are available in this ESU and stable (1.0) for one additional population (Figure 8.3.6-1). R/S is expected to be >1.0 for most of the important populations identified by ICTRT in four of the five MPGs in this ESU (Table 8.3.6.1-1). The Grande Ronde is the MPG with key populations that are expected to have $R/S < 1.0$ after implementation of the Prospective Actions.

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Populations for which R/S is expected to be greater than 1.0 generally have estimates that are considerably greater than 1.0 (range 1.1-2.4; mean 1.5). By providing additional benefits to stronger populations, the Prospective Actions help offset problems with more poorly performing populations, supporting the viability of the ESU as a whole.

Population growth rate (λ) and BRT trend estimates are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. The method of calculating λ leads to a range of results for populations influenced by hatchery production, depending upon assumed effectiveness of hatchery-origin spawners. These estimates require fewer assumptions and less data than R/S estimates, but still depend on data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by or dependent on hatchery programs, since recovery implies self-sustaining populations.

With implementation of the Prospective Actions, all populations in this ESU have λ (with the HF=0 assumption that hatchery-origin spawners are completely ineffective) and BRT trends that are expected to be greater than 1.0, as described in Section 8.3.6. For λ under the HF=1 assumption that hatchery-origin spawners are as effective as natural-origin spawners, estimates are less than 1.0 for four populations in two MPGs (Lower Snake and Grande Ronde). As with R/S, the estimates that are greater than 1.0 are considerably higher. Therefore, all important populations identified by the ICTRT are expected to have λ (HF=0) and BRT trend greater than 1.0 for all five MPGs, but key populations in two of the five MPGs have expected λ (HF=1) less than 1.0.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate and effects on early ocean survival will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario, all but one population are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.3.6-2). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, the number of populations with R/S less than 1.0 increases to seven (out of 22), compared to three under the “recent” climate scenario.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

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- The mean results represent the most likely future condition, but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 at the upper 95% confidence limits for all populations. R/S is expected to be less than 1.0 for most populations at the lower 95% confidence limits (SCA Aggregate Analysis Appendix; Figure 8.3.6-1). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. NOAA Fisheries cannot demonstrate quantitatively that all populations (including important populations in the Upper Grande Ronde MPG) will be increasing as a result of the actions considered in the aggregate analysis and as indicated by expected $R/S > 1$. However, the majority of populations are likely to increase in abundance and enough populations are likely to be increasing to conclude that the ESU as a whole will be trending toward recovery. Those populations that do have R/S greater than 1.0 have considerably higher R/S, in part due to the Prospective Actions. These populations with high productivity help offset problems with more poorly performing populations, making the ESU as a whole more viable.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes resulting from the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.3.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described above and in Sections 8.3.3 and 8.3.5. Additionally, implementation of Prospective Actions in other life stages is expected to further improve survival and reduce extinction risk.

As described in Section 8.3.6, abundance is expected to be stable or increasing for most populations and natural productivity (R/S) is expected to be sufficient for most populations to grow. These factors also indicate a decreasing risk of extinction.

A number of critical populations are supported in part by safety-net hatchery supplementation programs. These programs ensure that the affected populations will not go extinct in the short term,

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although, as described above, they increase diversity risk to the ESU if continued over a long time period. Safety-net hatchery supplementation programs protect the single extant population in the Lower Snake MPG, all high-risk populations in the Grande Ronde MPG, the East Fork South Fork Salmon population in the South Fork Salmon MPG, and the Yankee Fork population in the Upper Salmon MPG. There are no hatchery programs affecting the Middle Fork Salmon MPG.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 and above, some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.3.6, short-term extinction risk is expected to be $\leq 5\%$ at QET=50 for seven to nine of 17 populations in this ESU for which estimates were available (Figure 8.3.6-3). Critical populations have $\leq 5\%$ risk at QET=50 for three of the five MPGs. The range reflects whether the estimate is based on a continuation of current baseline management practices (low estimate) or if the Prospective Actions are considered (higher estimate). These estimates assume no continued hatchery supplementation and assume that the population will be extinct if it falls below 50 fish for four years in a row.

Quantitative estimates of short-term extinction risk, assuming base period conditions and that supplementation continues (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix), indicate that the Lostine and Imnaha populations in the Grande Ronde MPG have $\leq 5\%$ risk at QET=50 and the Upper Grande Ronde and Catherine Creek populations have greatly reduced extinction risk, although it is still $>5\%$ at QET=50. These estimates do not consider base-to-current improvements and improvements expected from Prospective Actions. If an analysis, assuming continued supplementation, were applied to all populations with safety-net hatchery programs, it is

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likely that only a few populations would remain with a high extinction risk at QET=50. Most of these populations are in the Middle Fork Salmon MPG, which has no supplementation program.

For the Middle Fork Salmon MPG, it was only possible to quantitatively estimate short-term extinction risk for four of the nine populations. One of these populations has $\leq 5\%$ at QET=50 if some of the Prospective Actions achieve immediate benefits and the other three populations have higher risk. While these results are a cause for concern, two factors indicate that the short-term extinction risk for the Middle Fork Salmon MPG populations may not be as high as indicated by these quantitative results.

- First, as discussed in Section 7.1, the ICTRT selected a QET of 50 fish to represent a point at which long-term (100-year) extinction risk is qualitatively high, based on a combination of demographic considerations that would also apply in the short term and genetic considerations that may have less relevance to short-term survival. It is likely that a lower QET could be equally relevant to an assessment of short-term risk.
- Second, as described in Section 7.1, a QET of 50 overstates the true extinction risk of populations that have averaged less than 50 fish during the extinction model's base period. These populations must by definition have a very high extinction risk when the projection model compares to a 50 fish quasi-extinction threshold, yet the empirical evidence indicates that the populations in question clearly have not gone extinct during this period. Within the last 20 years, seven populations in the Middle Fork MPG have fallen below 50 spawners four years in a row, yet have survived and rebounded to much higher levels (although not as high as historical abundance).

At a QET of 10 fish, three out of four populations for which extinction risk could be estimated have low risk.

This summary of quantitative extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario 10-11 of 17 populations are expected to have $\leq 5\%$ risk at QET=50 (Aggregate Analysis Appendix; Figure 8.3.6-4). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, the number of populations with $\leq 5\%$ risk at QET=50 decreases to 5-7, compared to 7-9 under the "recent" climate scenario.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the

confidence intervals for the base condition range from near 0% to near 100% for many populations. This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the ESU as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that all populations or all MPGs will have a low short-term extinction risk, as indicated by quantitative estimates and a quasi extinction threshold of 50 fish, which the ICTRT associated with long-term viability. These extinction risk estimates assume that all hatchery supplementation ceases. However, most of the populations with high short-term extinction risk are protected from extinction by safety-net hatchery programs. Quantitative estimates, with an assumption of continuing supplementation, indicate that supplemented populations have low short-term extinction risk. The exceptions are populations in the Middle Fork Salmon MPG, which are not influenced by hatchery programs. The Middle Fork MPG is a concern and these populations will be closely monitored under the Prospective Actions to ensure that any changes in status are detected and appropriate actions taken. However, although these populations appear to have high risk at QET=50, it is likely that a lower QET level is appropriate for some of the smaller populations. Most of these populations have dropped to levels below 50 fish, and in some cases for four years in a row, yet have not gone extinct and have increased to higher numbers in recent years. In summary, enough populations are likely to have a low enough risk of extinction to conclude that the ESU as a whole will have a low risk of short-term extinction.

8.3.7.3 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR spring/summer Chinook salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; and river reaches presently or historically accessible in the Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, Pahsimeroi, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa subbasins. The environmental baseline within the action area, which encompasses these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR spring/summer Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

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Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, double-crested cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat spring Chinook in the tailrace of Bonneville Dam will do the same for adults. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Spring Summer Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Snake River Spring Summer Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat.

Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.

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- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁸

⁸ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.3.2-1. Status of SR spring/summer Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: 20-yr non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0) ³	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current ⁴	Lower 95% CI	Upper 95% CI
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	82	1997-2006	750	0.72	0.48	1.10	0.96	0.67	1.38	0.87	0.63	1.21	0.92	0.85	0.99
		Asotin - Functionally Extirpated															
	Grande Ronde / Imnaha	Catherine Creek	107	1996-2005	1000	0.44	0.22	0.84	0.93	0.66	1.30	0.81	0.53	1.26	0.92	0.87	0.98
		Lostine/Wallowa Rivers	276	1996-2005	1000	0.72	0.41	1.26	0.95	0.77	1.17	0.82	0.59	1.13	1.01	0.96	1.06
		Minam River	337	1996-2005	750	0.80	0.47	1.37	1.05	0.82	1.35	0.98	0.71	1.36	1.02	0.97	1.07
		Imnaha River	380	1996-2005	750	0.59	0.40	0.86	1.04	0.80	1.37	0.93	0.65	1.33	0.98	0.94	1.02
		Wenaha River	376	1996-2005	750	0.66	0.41	1.08	1.03	0.78	1.36	0.94	0.68	1.32	1.04	0.99	1.10
		Upper Grande Ronde	38	1996-2005	1000	0.32	0.18	0.57	1.00	0.74	1.36	0.85	0.67	1.09	0.92	0.87	0.97
		Big Sheep Creek - Functionally Extirpated Lookingglass- Functionally Extirpated															
	South Fork Salmon	South Fork Salmon Mainstem	601	1994-2003	1000	0.86	0.59	1.28	1.09	0.83	1.43	0.99	0.74	1.33	1.05	1.01	1.10
		Secesh River	403	1996-2005	750	1.19	0.81	1.76	1.06	0.86	1.32	1.06	0.85	1.31	1.05	1.01	1.09
		East Fork S. Fork Salmon (including Johns)	105	1994-2003	1000	0.97	0.67	1.41	1.06	0.88	1.28	1.05	0.87	1.26	1.02	0.97	1.08
		Little Salmon River (including Rapid R.)			500												
	Middle Fork Salmon	Big Creek	90	1995-2004	1000	1.20	0.66	2.19	1.09	0.78	1.53	1.09	0.78	1.53	1.02	0.94	1.10
		Bear Valley/Elk Creek	182	1994-2003	750	1.35	0.82	2.22	1.11	0.79	1.55	1.11	0.79	1.55	1.05	0.98	1.13
		Marsh Creek	42	1994-2003	500	0.95	0.52	1.75	1.09	0.78	1.52	1.09	0.78	1.52	1.01	0.92	1.10
		Sulphur Creek	21	1994-2003	500	0.97	0.45	2.09	1.07	0.68	1.68	1.07	0.68	1.68	1.02	0.94	1.11
		Camas Creek	28	1995-2004	500	0.79	0.39	1.62	1.04	0.69	1.57	1.04	0.69	1.57	1.00	0.93	1.07
		Loon Creek	51	1995-2004	500	1.11	0.54	2.31	1.12	0.79	1.58	1.12	0.79	1.58	1.07	0.98	1.16
		Chamberlain Creek			500												
		Lower Middle Fork Salmon (below Ind. Cr.)			500												
		Upper Middle Fork Salmon (above Ind. Cr.)			750												
	Upper Salmon	Lemhi River	79	1994-2003	2000	1.08	0.63	1.84	1.03	0.66	1.59	1.03	0.66	1.59	0.98	0.92	1.05
		Valley Creek	34	1994-2003	500	1.07	0.61	1.87	1.07	0.72	1.59	1.07	0.72	1.59	1.03	0.96	1.11
		Yankee Fork	13	1994-2003	500	0.61	0.28	1.29	1.06	0.67	1.68	1.06	0.67	1.68	1.05	0.96	1.15
		Upper Salmon River (above Redfish L.)	246	1996-2005	1000	1.51	0.84	2.72	1.04	0.74	1.46	0.98	0.69	1.38	1.01	0.95	1.06
		North Fork Salmon River			500												
		Lower Salmon River (below Redfish L.)	103	1996-2005	2000	1.20	0.75	1.92	1.03	0.76	1.40	1.03	0.76	1.40	1.00	0.95	1.05
		East Fork Salmon River	148	1996-2005	1000	1.06	0.54	2.08	1.05	0.70	1.57	1.02	0.66	1.56	1.01	0.94	1.09
		Pahsimeroi River	127	1996-2005	1000	0.51	0.22	1.18									
	Panther - Extirpated																

1 ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from the ICTRT (2007c).

2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 brood years in Cooney (2007). Actual years in average vary by population.

3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008c).

4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008c).

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Table 8.3.2-2. Status of SR spring/summer Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure ¹	ICTRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	Currently Moderate Risk	Currently Moderate Risk	0.47
		Asotin - Functionally Extirpated			
	Grande Ronde / Imnaha	Catherine Creek	Currently Moderate Risk	Currently Moderate Risk	0.71
		Lostine/Wallowa Rivers	Currently High Risk (Loss of occupancy in 1.5 MaSA and 2 MiSA)	Currently Moderate Risk	0.72
		Minam River	Currently Low Risk	Currently Moderate Risk	0.96
		Imnaha River	Currently Low Risk	Currently Moderate Risk	0.35
		Wenaha River	Currently Low Risk	Currently Moderate Risk	0.95
		Upper Grande Ronde	Currently Low Risk	Currently Moderate Risk	0.77
		Big Sheep Creek - Functionally Extirpated			
		Lookingglass- Functionally Extirpated			
	South Fork Salmon	South Fork Salmon Mainstem	Currently Low Risk	Currently Moderate Risk	0.62
		Secesh River	Currently Low Risk	Currently Low Risk	0.96
		East Fork S. Fork Salmon (including Johns)	Currently Low Risk	Currently Low Risk	0.90
		Little Salmon River (including Rapid R.)			
	Middle Fork Salmon	Big Creek	Currently Low Risk	Currently Low Risk	1.00
		Bear Valley/Elk Creek	Currently Very Low Risk	Currently Moderate Risk	1.00
		Marsh Creek	Currently Low Risk	Currently Low Risk	1.00
		Sulphur Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Camas Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Loon Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Chamberlain Creek	Currently Low Risk	Currently Low Risk	
		Lower Middle Fork Salmon (below Ind. Cr.)	Currently Moderate Risk	Currently Moderate Risk	
		Upper Middle Fork Salmon (above Ind. Cr.)			
	Upper Salmon	Lemhi River	Currently High Risk (Loss of occupancy of 2 upstream MaSA and 1 downstream MiSA)	Currently High Risk (Loss of summer-run life history)	1.00
		Valley Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Yankee Fork	Currently Moderate Risk	Currently High Risk (Out of population and out of MPG hatchery straying)	1.00
		Upper Salmon River (above Redfish L.)	Currently Very Low Risk	Currently Moderate Risk	0.75
		North Fork Salmon River	Currently Low Risk	Currently Low Risk	
		Lower Salmon River (below Redfish L.)	Currently Low Risk	Currently Low Risk	1.00
		East Fork Salmon River	Currently Low Risk	Currently High Risk (Genetic diversity and legacy effects of hatchery fish)	0.92
		Pahsimeroi River	Currently Moderate Risk	Currently High Risk (High proportion of hatchery fish in multi-year program)	0.58
		Panther - Extirpated			

1 ICTRT conclusions for Snake River spring/summer Chinook are from ICTRT Current Status Summaries (ICTRT 2007d).

2 Average fractions of natural-origin natural spawners are from the ICTRT (Cooney 2007).

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Table 8.3.2-3. Status of SR spring/summer Chinook salmon with respect to extinction risk. Extinction risk is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	24-Year Extinction Risk											
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	0.00	0.00	0.13	0.00	0.00	0.30	0.02	0.00	0.55	0.07	0.00	0.71
		Asotin - Functionally Extirpated												
	Grande Ronde / Imnaha	Catherine Creek	0.09	0.00	0.77	0.23	0.00	0.90	0.37	0.00	0.96	0.45	0.01	0.98
		Lostine/Wallowa Rivers	0.00	0.00	0.46	0.03	0.00	0.62	0.10	0.00	0.74	0.18	0.00	0.81
		Minam River	0.00	0.00	0.31	0.00	0.00	0.42	0.02	0.00	0.57	0.06	0.00	0.68
		Imnaha River	0.00	0.00	0.22	0.01	0.00	0.45	0.04	0.00	0.66	0.09	0.00	0.73
		Wenaha River	0.00	0.00	0.35	0.04	0.00	0.57	0.15	0.00	0.74	0.26	0.00	0.83
		Upper Grande Ronde	0.00	0.00	0.11	0.09	0.00	0.57	0.41	0.01	0.89	0.70	0.07	0.97
		Big Sheep Creek - Functionally Extirpated Lookingglass- Functionally Extirpated												
	South Fork Salmon	South Fork Salmon Mainstem	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.07	0.00	0.00	0.13
		Secesh River	0.00	0.00	0.17	0.00	0.00	0.26	0.01	0.00	0.35	0.02	0.00	0.42
		East Fork S. Fork Salmon (including Johns)	0.00	0.00	0.02	0.00	0.00	0.14	0.01	0.00	0.33	0.04	0.00	0.48
		Little Salmon River (including Rapid R.)												
	Middle Fork Salmon	Big Creek	0.00	0.00	0.60	0.04	0.00	0.80	0.20	0.00	0.89	0.37	0.00	0.93
		Bear Valley/Elk Creek	0.00	0.00	0.40	0.00	0.00	0.53	0.03	0.00	0.63	0.09	0.00	0.71
		Marsh Creek	0.03	0.00	0.64	0.21	0.00	0.82	0.43	0.00	0.92	0.56	0.00	0.95
		Sulphur Creek	0.00	0.00	0.65	0.06	0.00	0.79	0.33	0.00	0.88	0.55	0.00	0.92
		Camas Creek												
		Loon Creek												
		Chamberlain Creek												
		Lower Middle Fork Salmon (below Ind. Cr.) Upper Middle Fork Salmon (above Ind. Cr.)												
	Upper Salmon	Lemhi River												
		Valley Creek	0.00	0.00	0.32	0.13	0.00	0.76	0.50	0.01	0.96	0.75	0.07	0.99
		Yankee Fork												
		Upper Salmon River (above Redfish L.)	0.00	0.00	0.37	0.00	0.00	0.53	0.00	0.00	0.64	0.00	0.00	0.71
		North Fork Salmon River												
		Lower Salmon River (below Redfish L.)	0.00	0.00	0.41	0.00	0.00	0.80	0.13	0.00	0.97	0.37	0.00	0.99
		East Fork Salmon River												
Pahsimeroi River Panther - Extirpated														

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

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Table 8.3.2-4. Changes in density-independent survival (“gaps”) necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for SR spring/summer Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=1 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0 ³	Upper 95% CI	Lower 95% CI	Survival Gap for 24 Yr Ext. Risk <5% (OET=1) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=10) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=30) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=50) ⁴	
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	1.38	2.09	0.91	1.18	5.90	0.24	1.85	8.06	0.90	1.48	2.10	1.04	0.33	0.57	0.86	1.13	
		Asotin - Functionally Extirpated																	
	Grande Ronde / Imnaha	Catherine Creek	2.30	4.45	1.19	1.40	6.40	0.31	2.55	18.17	0.54	1.42	1.85	1.09	1.28	2.18	3.07	3.88	
		Lostine/Wallowa Rivers	1.39	2.44	0.79	0.88	3.09	0.25	1.30	5.82	0.76	0.96	1.20	0.76	0.49	0.87	1.27	1.60	
		Minam River	1.25	2.13	0.73	0.80	2.50	0.26	1.09	4.67	0.86	0.92	1.12	0.75	0.27	0.50	0.79	1.06	
		Imnaha River	1.70	2.50	1.16	1.00	3.97	0.25	2.06	6.14	0.93	1.10	1.34	0.90	0.41	0.69	0.97	1.18	
		Wenaha River	1.51	2.45	0.93	0.83	2.79	0.24	1.39	7.00	0.73	0.83	1.04	0.66	0.55	0.95	1.38	1.71	
		Upper Grande Ronde	3.09	5.47	1.75								1.46	1.84	1.16	0.55	1.11	1.87	2.65
		Big Sheep Creek - Functionally Extirpated																	
		Lookingglass - Functionally Extirpated																	
	South Fork Salmon	South Fork Salmon Mainstem	1.16	1.71	0.78	0.69	2.33	0.20	1.04	3.83	0.91	0.79	0.94	0.66	0.16	0.27	0.37	0.45	
		Secesh River	0.84	1.23	0.57	0.76	2.01	0.28	0.78	2.06	0.84	0.81	0.97	0.68	0.32	0.52	0.69	0.84	
		East Fork S. Fork Salmon (including Johnson)	1.03	1.49	0.71	0.78	1.80	0.34	0.81	1.86	0.82	0.90	1.12	0.72	0.39	0.63	0.81	0.94	
		Little Salmon River (including Rapid R.)																	
	Middle Fork Salmon	Big Creek	0.83	1.51	0.46	0.67	3.09	0.15	0.67	3.09	0.71	0.93	1.29	0.66	0.42	0.96	1.84	2.70	
		Bear Valley/Elk Creek	0.74	1.21	0.45	0.63	2.84	0.14	0.63	2.84	0.80	0.79	1.08	0.59	0.27	0.53	0.90	1.26	
		Marsh Creek	1.05	1.93	0.57	0.69	3.11	0.15	0.69	3.11	0.46	0.97	1.45	0.65	0.89	1.82	3.11	4.28	
		Sulphur Creek	1.03	2.23	0.48	0.73	5.56	0.10	0.73	5.56	0.76	0.90	1.33	0.62	0.29	1.06	2.66	4.25	
		Camas Creek	1.26	2.58	0.62	0.84	5.38	0.13	0.84	5.38	1.00	1.02	1.41	0.73					
		Loon Creek	0.90	1.86	0.43	0.61	2.87	0.13	1.11	0.79	1.58	0.75	1.09	0.52					
		Chamberlain Creek																	
		Lower Middle Fork Salmon (below Ind. Cr.)																	
	Upper Middle Fork Salmon (above Ind. Cr.)																		
	Upper Salmon	Lemhi River	0.93	1.59	0.54	0.89	6.31	0.13	0.89	6.31	1.00	1.08	1.43	0.82	0.00	0.00	0.00	0.00	
		Valley Creek	0.94	1.64	0.53							0.88	1.21	0.64	0.32	1.28	3.28	5.37	
		Yankee Fork	1.65	3.52	0.77							0.82	1.23	0.54					
Upper Salmon River (above Redfish L.)		0.66	1.19	0.37	0.85	3.97	0.18	1.11	5.17	0.97	0.98	1.24	0.77	0.07	0.21	0.47	0.74		
North Fork Salmon River																			
Lower Salmon River (below Redfish L.)		0.83	1.33	0.52	0.87	3.40	0.22	0.87	3.40	0.90	0.99	1.24	0.79	0.19	0.57	1.37	2.18		
East Fork Salmon River		0.94	1.84	0.48	0.82	5.08	0.13	0.93	6.40	1.00	0.96	1.35	0.69	0.00	0.00	0.00	0.00		
Pahsimeroi River		1.97	4.59	0.85							0.00	0.00	0.00						
	Panther - Extirpated																		

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.3.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.3.2-1)^{Mean Generation Time}. Mean generation time was estimated at 4.5 years for these calculations.

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3 BRT trend survival gap is calculated as $(1.0 \div \text{base BRT slope from Table 8.3.2-1})^{\text{Mean Generation Time}}$. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt “a” value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt “a” value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

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Table 8.3.3-1. Proportional changes in average base period survival of SR spring/summer Chinook salmon expected from completed actions and current human activities that are likely to continue into the future. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

ESU	MPG	Population	Base-to-Current Adjustment (Survival Multiplier)							Total Base-to-Current Survival Multiplier ⁸
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Marine Mammal Predation ⁵	Harvest ⁶	Hatcheries ⁷	
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	1.20	1.04	1.00	1.00	0.97	1.04	1.00	1.25
		Asotin - Functionally Extirpated								
	Grande Ronde / Imnaha	Catherine Creek	1.20	1.04	1.00	1.00	0.97	1.04	1.20	1.51
		Lostine/Wallowa Rivers	1.20	1.01	1.00	1.00	0.97	1.04	1.03	1.26
		Minam River	1.20	1.00	1.00	1.00	0.97	1.04	1.22	1.47
		Imnaha River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.22
		Wenaha River	1.20	1.00	1.00	1.00	0.97	1.04	1.39	1.68
		Upper Grande Ronde	1.20	1.04	1.00	1.00	0.97	1.04	1.21	1.52
		Big Sheep Creek - Functionally Extirpated Lookingglass- Functionally Extirpated								
	South Fork Salmon	South Fork Salmon Mainstem	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Secesh River	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		East Fork S. Fork Salmon (including Johnson)	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Little Salmon River (including Rapid R.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
	Middle Fork Salmon	Big Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Bear Valley/Elk Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Marsh Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Sulphur Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Camas Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Loon Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Chamberlain Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Lower Middle Fork Salmon (below Ind. Cr.)	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Upper Middle Fork Salmon (above Ind. Cr.)	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
	Upper Salmon	Lemhi River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Valley Creek	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Yankee Fork	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Upper Salmon River (above Redfish L.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		North Fork Salmon River	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Lower Salmon River (below Redfish L.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		East Fork Salmon River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Pahsimeroi River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
Panther - Extirpated										

1 From SCA Hydro Modeling Appendix Based on differences in average base and current smolt-to-adult survival estimates.

2 From CA Chapter 5, Table 5-7.

3 From CA Appendix D, Attachment D-1, Table 6.

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4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Current 2 S/Baseline 2 S” approach, as described in Attachment F-2.

5 From SCA Marine Mammal Appendix

6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

7 From SCA Quantitative Analysis of Hatchery Actions Appendix. Additional basis is in Section 8.3.3.1. Relevant calculation methods are described in the Aggregate Analysis Appendix.

8 Total base-to-current survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

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Table 8.3.5-1. Proportional changes in survival of SR spring/summer Chinook salmon expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Survival Multiplier)								Total Base-to-Future Survival Multiplier ⁹
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Hatcheries ⁶	Non-Hydro Current-to-Future Survival Multiplier ⁷	Total Current-to-Future Survival Multiplier ⁸	
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	1.05	1.17	1.06	1.02	1.01	1.00	1.28	1.35	1.68
		Asotin - Functionally Extirpated									
	Grande Ronde / Imnaha	Catherine Creek	1.05	1.23	1.06	1.02	1.01	1.00	1.34	1.41	2.13
		Lostine/Wallowa Rivers	1.05	1.02	1.06	1.02	1.01	1.00	1.11	1.17	1.47
		Minam River	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.70
		Imnaha River	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.42
		Wenaha River	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.93
		Upper Grande Ronde	1.05	1.23	1.06	1.02	1.01	1.00	1.34	1.41	2.15
		Big Sheep Creek - Functionally Extirpated Lookingglass - Functionally Extirpated									
	South Fork Salmon	South Fork Salmon Mainstem	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		Secesh River	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		East Fork S. Fork Salmon (including Johnson)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Little Salmon River (including Rapid R.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.40
	Middle Fork Salmon	Big Creek	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		Bear Valley/Elk Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Marsh Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Sulphur Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Camas Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Loon Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Chamberlain Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Lower Middle Fork Salmon (below Ind. Cr.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Upper Middle Fork Salmon (above Ind. Cr.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Upper Salmon	Lemhi River	1.05	1.07	1.06	1.02	1.01	1.00	1.17	1.23
	Valley Creek		1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
	Yankee Fork		1.05	1.30	1.06	1.02	1.01	1.00	1.42	1.49	1.81
	Upper Salmon River (above Redfish L.)		1.05	1.14	1.06	1.02	1.01	1.00	1.25	1.31	1.59
	North Fork Salmon River		1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
	Lower Salmon River (below Redfish L.)		1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
	East Fork Salmon River		1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
	Pahsimeroi River		1.05	1.41	1.06	1.02	1.01	1.00	1.54	1.62	1.97
	Panther - Extirpated										

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates.

2 From CA Chapter 5, Table 5-9.

3 From CA Appendix D, Attachment D-1, Table 6.

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4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 No survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.

7 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

8 Same as Footnote 7, except it is calculated from all Prospective Actions, including hydro actions.

9 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.3.3-1.

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Table 8.3.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR spring/summer Chinook salmon.

ESU	MPG	Population	20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ²
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	1.22	1.08	0.98	1.03	Must be HV	All metrics >1, except lambda with HF=1	Currently Moderate Risk	Currently Moderate Risk
		Asotin - Functionally Extirpated								
								Need 1 HV and 3 V;		
	Grande Ronde / Imnaha	Catherine Creek	0.93	1.10	0.96	1.09	1 of these 2 populations must be HV or V	Lambda with HF=0 and BRT trend >1, but lambda with HF=1 and R/S <1, for both populations in this pair	Currently Moderate Risk	Currently Moderate Risk
		Upper Grande Ronde	0.70	1.13	0.97	1.09			Currently High Risk (Loss of occupancy in 1.5 MaSA and 2 MISA)	Currently Moderate Risk
		Minam River	1.36	1.18	1.10	1.15	1 of these 2 populations must be HV or V	All three metrics >1 for both populations in this pair	Currently Low Risk	Currently Moderate Risk
		Wenaha River	1.28	1.21	1.08	1.21			Currently Low Risk	Currently Moderate Risk
		Lostine/Wallowa Rivers	1.06	1.12	1.03	1.10	HV or V if needed to make 4 total for MPG	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Imnaha River	0.83	1.08	0.92	1.06	HV or V if needed to make 4 total for MPG	Lambda with HF=0 and BRT trend >1, but lambda with HF=1 and R/S <1	Currently Low Risk	Currently Moderate Risk
		Big Sheep Creek - Functionally Extirpated								
	Lookingglass - Functionally Extirpated									
								Need 1 HV and 1 V;		
	South Fork Salmon	South Fork Salmon Mainstem	1.21	1.17	1.07	1.14	HV or V (need 2 of these 3 populations)	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Secesh River	1.88	1.15	1.14	1.13	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Low Risk
		East Fork S. Fork Salmon (including Johnson)	1.35	1.14	1.13	1.10	HV or V (need 2 of these 3 populations)	All three metrics >1	Currently Low Risk	Currently Low Risk
		Little Salmon River (including Rapid R.)					HV or V (need 2 of these 3 populations)	No Data		
								Need 1 HV and 4 V;		
	Middle Fork Salmon	Big Creek	1.69	1.18	1.18	1.10	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk
		Bear Valley/Elk Creek	1.88	1.19	1.19	1.13	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		Marsh Creek	1.32	1.17	1.17	1.08	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk
		Sulphur Creek	1.35	1.15	1.15	1.10	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Camas Creek	1.10	1.12	1.12	1.07	1 of these 2 populations must be HV or V	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Loon Creek	1.55	1.20	1.20	1.15		All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Chamberlain Creek					Must be HV or V	No Data	Currently Low Risk	Currently Low Risk
		Lower Middle Fork Salmon (below Ind. Cr.)					"Maintained" Population	No Data	Currently Moderate Risk	Currently Moderate Risk
	Upper Middle Fork Salmon (above Ind. Cr.)					"Maintained" Population	No Data	Currently Moderate Risk	Currently Moderate Risk	
								Need 1 HV and 4 V;		
	Upper Salmon	Lemhi River	1.61	1.12	1.12	1.07	Must be HV or V	All three metrics >1	Currently High Risk (Loss of occupancy of 2 upstream MaSA and 1 downstream MISA)	Currently High Risk (Loss of summer-run life history)
		Valley Creek	1.51	1.15	1.15	1.11	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Yankee Fork	1.09	1.21	1.21	1.19	"Maintained" Population	All three metrics >1	Currently Moderate Risk	Currently High Risk (Out of population and out of MPG hatchery straying)
		Upper Salmon River (above Redfish L.)	2.40	1.15	1.08	1.11	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		North Fork Salmon River					"Maintained" Population	No Data	Currently Low Risk	Currently Low Risk
Lower Salmon River (below Redfish L.)		1.70	1.11	1.11	1.08	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Low Risk	
East Fork Salmon River		1.50	1.13	1.10	1.09	Must be HV or V	All three metrics >1	Currently Low Risk	Currently High Risk (Genetic diversity and legacy effects of hatchery fish)	
Pahsimeroi River		1.00				Must be HV or V	R/S>1	Currently Moderate Risk	Currently High Risk (High proportion of hatchery fish in multi-year program)	
Panther - Extirpated										

1 Calculated as the base period 20-year R/S productivity from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1.

2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

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3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

4 From ICTRT (2007a), Attachment 2

5 From Table 8.3.2-2

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Table 8.3.6.1-2. Summary of prospective estimates relevant to the survival prong of the jeopardy standard for SR spring/summer Chinook salmon. Numbers represent additional survival improvements (remaining “gaps”) to reduce 24-year extinction risk to 5% or less. Numbers less than 1.0 indicate that no additional survival changes are necessary.

ESU	MPG	Population	Extinction - Based Only On Current Adjustment - Not Influenced By RPA ¹				Extinction - Based On Current Adjustment and RPA Prospective Actions ²				ICTRT MPG Viability Scenario ³	Survival Prong Notes for Extinction Risk	
			24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50	24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50			
Snake River Spring/Summer Chinook Salmon	Lower Snake	Tucannon	0.26	0.46	0.69	0.90	0.20	0.34	0.51	0.67	Must be HV	<5% risk at QET=50	
		Asotin - Functionally Extirpated											
											Need 1 HV and 3 V:		
	Grande Ronde / Imnaha	Catherine Creek	0.85	1.45	2.04	2.57	0.60	1.02	1.44	1.82	1 of these 2 populations must be HV or V	<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.	
		Upper Grande Ronde	0.36	0.73	1.23	1.74	0.26	0.52	0.87	1.23		<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.	
		Minam River	0.18	0.34	0.54	0.72	0.16	0.29	0.47	0.63	1 of these 2 populations must be HV or V	<5% risk at QET=50 without reliance on immediate RPA actions	
		Wenaha River	0.33	0.57	0.82	1.02	0.26	0.49	0.71	0.89		≤5% risk at QET=50 if some prospective actions implemented immediately, otherwise >5% risk	
		Lostine/Wallowa Rivers	0.39	0.69	1.01	1.27	0.33	0.59	0.86	1.09	HV or V if needed to make 4 total for MPG	<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.	
		Imnaha River	0.34	0.57	0.79	0.97	0.29	0.49	0.68	0.83	HV or V if needed to make 4 total for MPG	<5% risk at QET=50 without reliance on immediate RPA actions	
		Big Sheep Creek - Functionally Extirpated Lookingglass - Functionally Extirpated											
												Need 1 HV and 1 V:	
	South Fork Salmon	South Fork Salmon Mainstem	0.13	0.22	0.31	0.37	0.11	0.19	0.26	0.32	HV or V (need 2 of these 3 populations)	<5% risk at QET=50 without reliance on immediate RPA actions	
		Secesh River	0.26	0.43	0.57	0.70	0.23	0.37	0.49	0.60	"Maintained" Population	<5% risk at QET=50 without reliance on immediate RPA actions	
		East Fork S. Fork Salmon (including Johnson)	0.32	0.52	0.67	0.78	0.28	0.45	0.58	0.68	HV or V (need 2 of these 3 populations)	<5% risk at QET=50 without reliance on immediate RPA actions. Safety-net program also reduces short-term extinction risk.	
		Little Salmon River (including Rapid R.)									HV or V (need 2 of these 3 populations)	No short-term extinction risk estimates	
												Need 1 HV and 4 V:	
	Middle Fork Salmon	Big Creek	0.35	0.79	1.52	2.23	0.30	0.68	1.31	1.92	Must be HV or V	<5% risk only expected at low QET.	
		Bear Valley/Elk Creek	0.22	0.44	0.74	1.04	0.19	0.38	0.65	0.91	Must be HV or V	<5% risk at QET=50 with some immediate RPA actions; otherwise, >5% risk	
		Marsh Creek	0.74	1.51	2.57	3.54	0.64	1.31	2.24	3.08	Must be HV or V	<5% risk only expected at low QET.	
		Sulphur Creek	0.24	0.88	2.20	3.52	0.21	0.76	1.91	3.06	"Maintained" Population	<5% risk only expected at low QET.	
		Camas Creek									1 of these 2 populations must be HV or V	No short-term extinction risk estimates	
		Loon Creek									Must be HV or V	No short-term extinction risk estimates	
		Chamberlain Creek									Must be HV or V	No short-term extinction risk estimates	
		Lower Middle Fork Salmon (below Ind. Cr.)									"Maintained" Population	No short-term extinction risk estimates	
		Upper Middle Fork Salmon (above Ind. Cr.)									"Maintained" Population	No short-term extinction risk estimates	
												Need 1 HV and 4 V:	
	Upper Salmon	Lemhi River									Must be HV or V	No short-term extinction risk estimates	
		Valley Creek	0.26	1.05	2.70	4.42	0.23	0.91	2.33	3.81	Must be HV or V	<5% risk only expected at low QET.	
		Yankee Fork									"Maintained" Population	No short-term extinction risk estimates. Captive rearing program in RPA reduces extinction risk.	
		Upper Salmon River (above Redfish L.)	0.06	0.17	0.39	0.61	0.04	0.13	0.30	0.46	Must be HV or V	<5% risk at QET=50 without reliance on immediate RPA actions	
North Fork Salmon River										"Maintained" Population	No short-term extinction risk estimates		
Lower Salmon River (below Redfish L.)		0.16	0.47	1.13	1.80	0.13	0.40	0.97	1.55	"Maintained" Population	<5% risk only expected at low QET.		
East Fork Salmon River										Must be HV or V	Safety net programs in RPA reduce extinction risk.		
Pahsimeroi River										Must be HV or V	No short-term extinction risk estimates		
Panther - Extirpated													

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1 These estimates assume that only actions that have already occurred can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.3.2-4, divided by the total base-to-current survival multiplier in Table 8.3.3-1.

2 These estimates assume that Prospective Actions to be implemented in the next 10 years can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.3.2-4, divided by the total base-to-future survival multiplier in Table 8.3.5-1.

3 From ICTRT (2007a), Attachment 2

Figure 8.3-6-1. Summary of prospective mean R/S estimates for SR spring/summer Chinook salmon under the "recent" climate assumption, including 95% confidence limits.

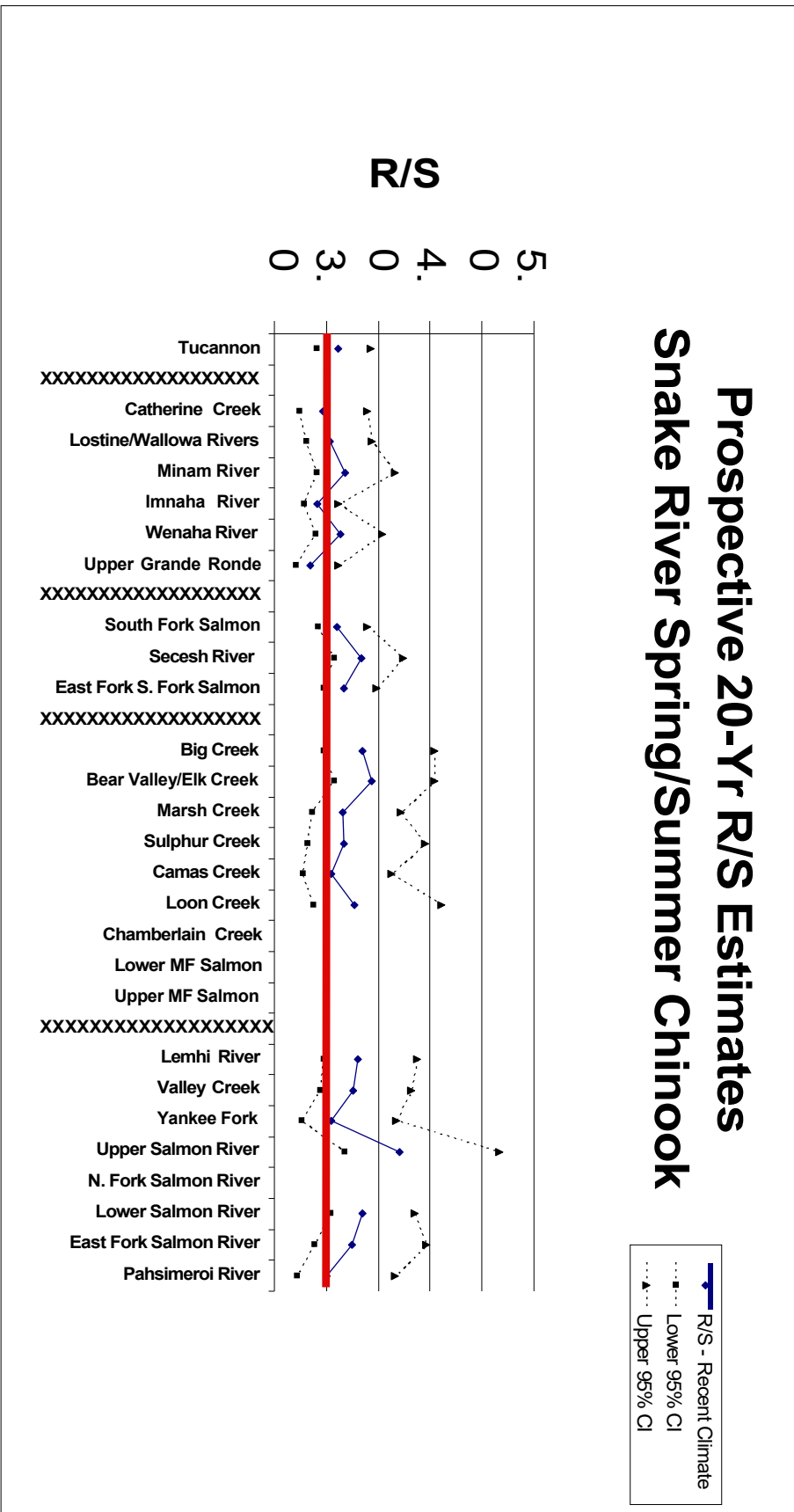


Figure 8.3-6-2. Summary of prospective mean R/S estimates for SR spring/summer Chinook salmon under three climate assumptions.

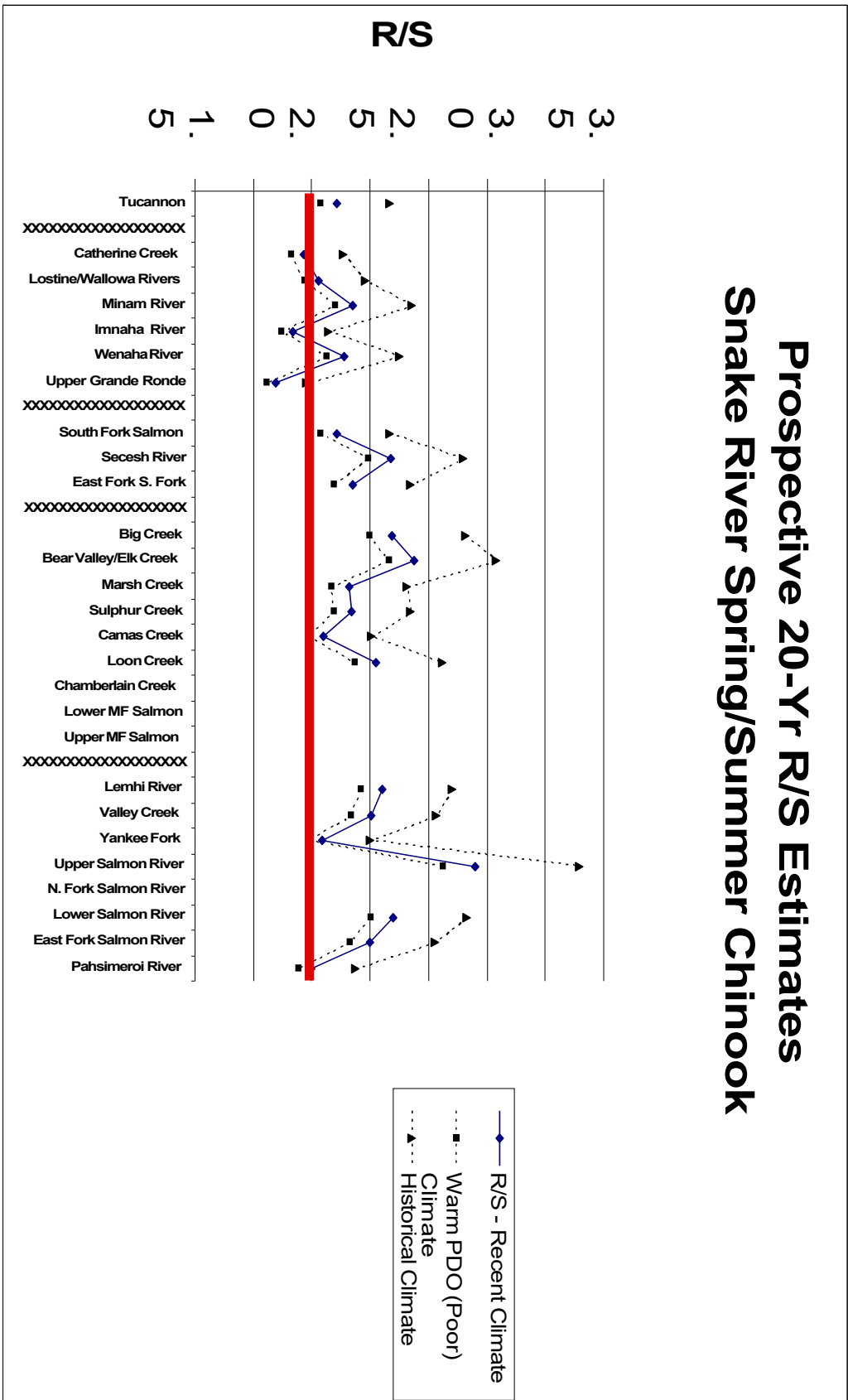


Figure 8.3.6-3. Summary of prospective 5% 24-year extinction risk gap estimates for SR spring/summer Chinook salmon under the “recent” climate assumption, showing effects of three alternative quasi-extinction thresholds (QET).

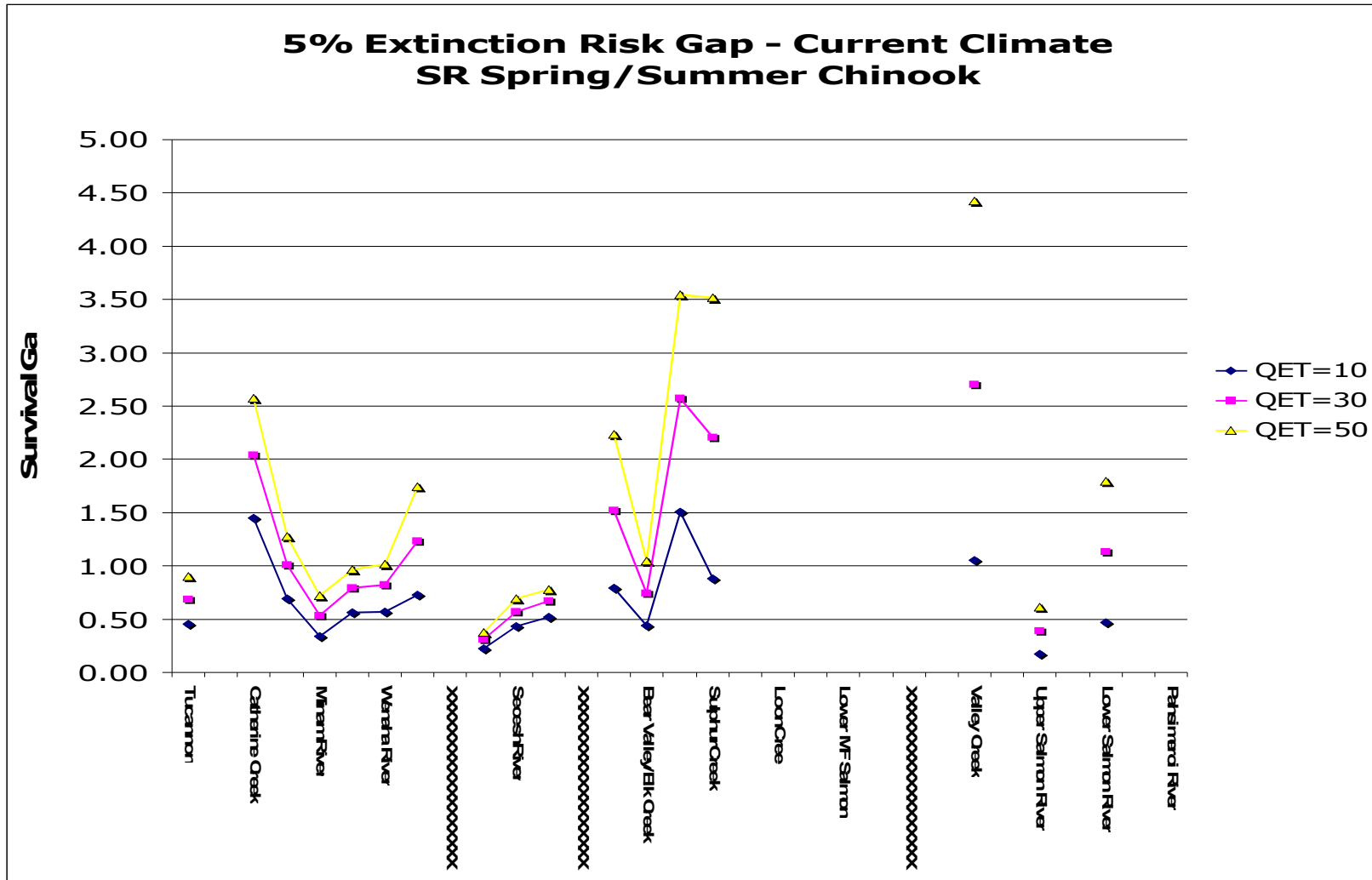
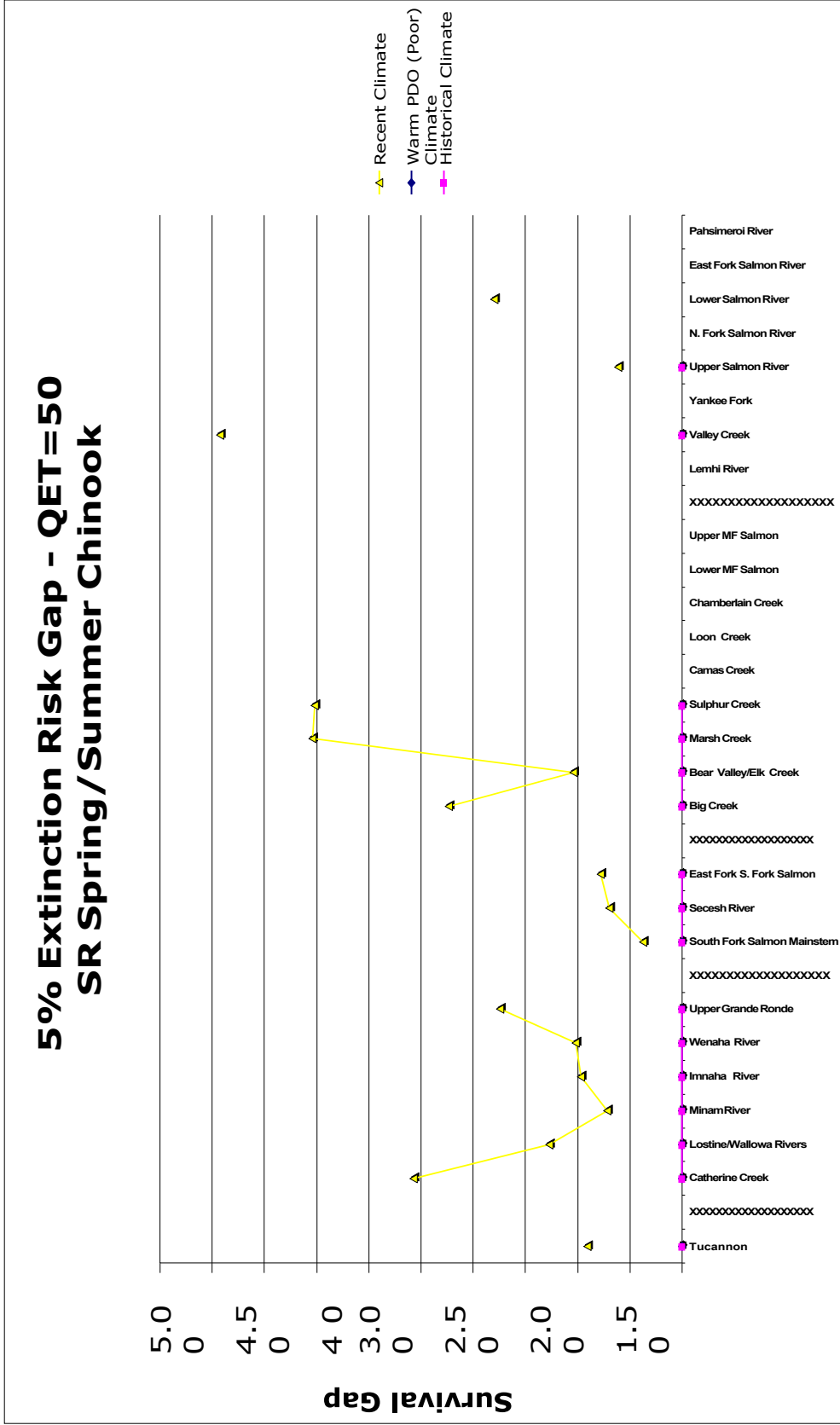
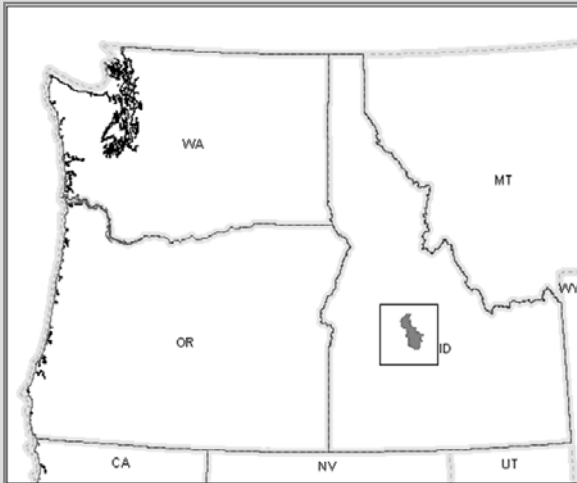


Figure 8.3.6-4. Summary of prospective 5% 24-year extinction risk gap estimates for SR spring/summer Chinook salmon under three climate assumptions.



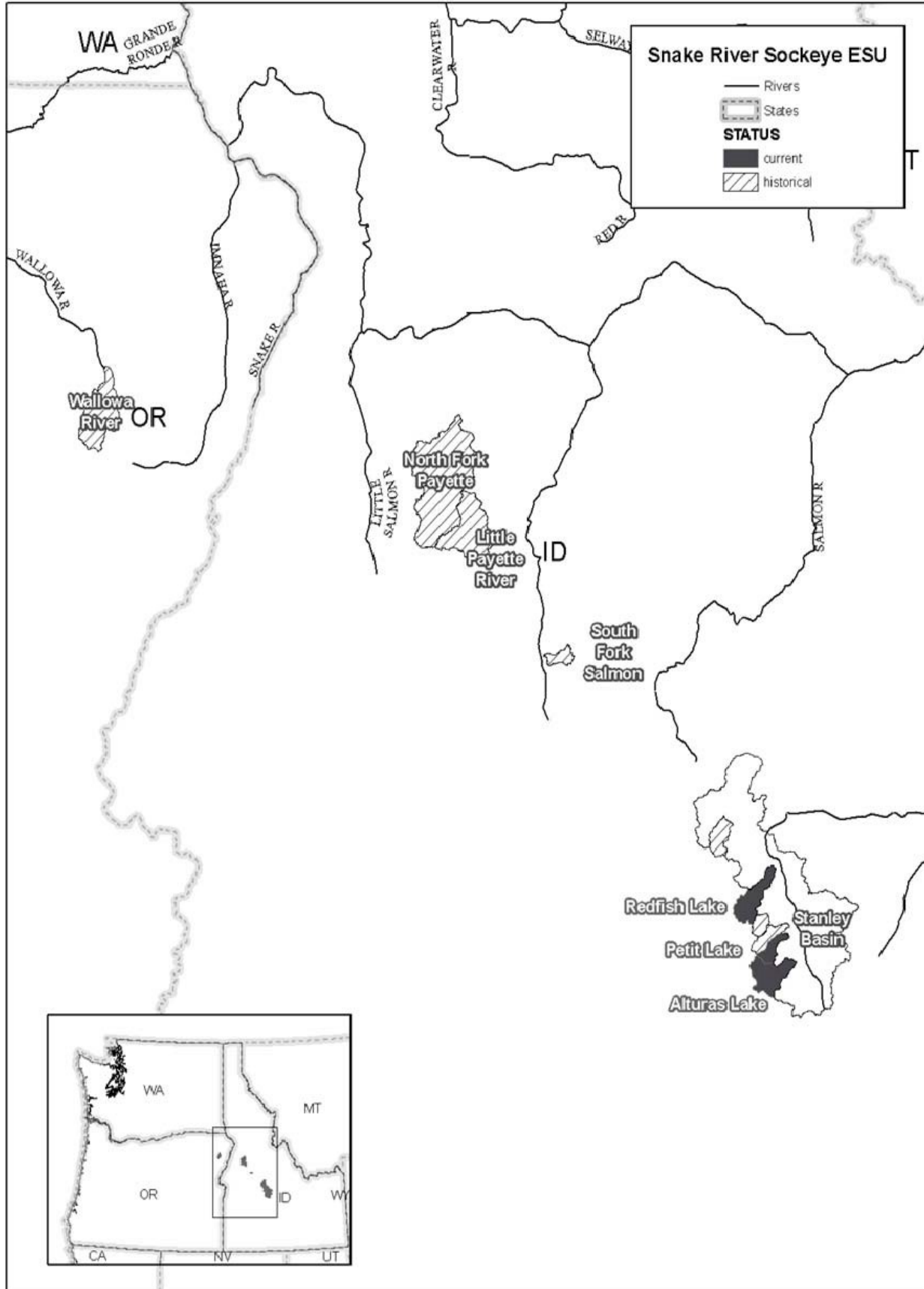
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Section 8.4 Snake River Sockeye Salmon



- 8.4.1 Species Overview
- 8.4.2 Current Rangewide Status
- 8.4.3 Environmental Baseline
- 8.4.4 Cumulative Effects
- 8.4.5 Effects of the Prospective Actions
- 8.4.6 Aggregate Effects

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Section 8.4

Snake River Sockeye Salmon

Species Overview

Background

The Snake River (SR) sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. Sockeye salmon were historically numerous in many areas of the Snake River basin prior to the European westward expansion. However, intense commercial harvest of sockeye along with other salmon species beginning in the mid-1880s; the existence of Sunbeam Dam as a migration barrier between 1910 and the early 1930s; the eradication of sockeye from Sawtooth Valley lakes in the 1950s and 1960s; the development of mainstem hydropower projects on the lower Snake and Columbia Rivers in the 1970s and 1980s; and poor ocean conditions in 1977 through the late 1990s probably combined to reduce the stock to a very small remnant population. Snake River sockeye salmon are now found predominantly in a captive broodstock program associated with Redfish and the other Sawtooth Valley lakes. At the time of listing, one, one, and zero fish had returned to Redfish Lake in the three preceding years, respectively. The Snake River sockeye ESU was listed as endangered in 1991, reaffirmed in 2005.

The designated critical habitat for SR sockeye salmon includes all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley and Lake Creek and the Salmon River.

Current Status & Recent Trends

This species has a very high risk of extinction. Between 1991 and 1998, all 16 of the natural-origin adult sockeye salmon that returned to the weir at Redfish Lake were incorporated into the captive broodstock program. The program has used multiple rearing sites to minimize chances of catastrophic loss of broodstock and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. Between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases—almost 20 times the number of wild fish that returned in the 1990s. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term. The Stanley Basin Sockeye Technical

Oversight Committee has determined that the next step toward meeting the goal of amplifying the wild population is to increase the number of smolts released.

Limiting Factors and Threats

By the time Snake River Sockeye were listed in 1991, the species had declined to the point that there was no longer a self-sustaining, naturally-spawning anadromous sockeye population. This has been the largest factor limiting the recovery of this ESU, important in terms of both risks due to catastrophic loss and potentially to genetic diversity. It is not yet clear whether the existing population retains sufficient genetic diversity to successfully adapt to the range of variable conditions that occur within its natural habitat. However, unpublished data from geneticists for the Stanley Basin Sockeye Technical Oversight Committee indicate that the captive broodstock has similar levels of haplotype diversity as other sockeye populations in the Pacific Northwest and that the program has been able to maintain rare alleles in the population over time. The broodstock program reduces the risk of domestication by using a spread-the-risk strategy, outplanting prespawning adults and fertilized eyed eggs as well as juveniles raised in the hatchery. The progeny of adults that spawn in the lakes and juveniles that hatch successfully from the eyed eggs are likely to have adapted to the lake environment rather than become “domesticated” to hatchery rearing conditions.

Recent Ocean and Mainstem Harvest

Few sockeye are caught in ocean fisheries. Ocean fishing mortality on Snake River Sockeye is assumed to be zero. Fisheries in the mainstem Columbia River that affect SR sockeye were managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007. These fisheries were limited to ensure that the incidental take of ESA-listed SR sockeye does not exceed specified rates. Non-Treaty fisheries in the lower Columbia River were limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Harvest rates have ranged from 0 to 0.95%, and 2.8 to 6.1% since 2001, respectively.

8.4.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.4.2.1 Current Rangewide Status of the Species

The Snake River (SR) sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program (Table 8.4.2.1-1). Sockeye salmon were historically numerous in many areas of the Snake River basin prior to the European westward expansion. However, intense commercial harvest of sockeye along with other salmon species beginning in the mid-1880s; the existence of Sunbeam Dam as a migration barrier between 1910 and the early 1930s; the eradication of sockeye from Sawtooth Valley lakes in the 1950s and 1960s; the development of mainstem hydropower projects on the lower Snake and Columbia Rivers in the 1970s and 1980s; and poor ocean conditions in 1977 through the late 1990s probably combined to reduce the stock to a very small remnant population. Snake River sockeye salmon are now found predominantly in a captive broodstock program associated with Redfish and the other Sawtooth Valley lakes (NMFS 1991a). At the time of listing, one, one, and zero fish had returned to Redfish Lake in the three preceding years, respectively.

Waples et al. (1997) examined the genetics of *O. nerka* from Sawtooth Valley lakes to determine whether the remnant population represented a distinct species or had been diluted by nonnative stocking during the 20th century. Sockeye salmon that returned to Redfish Lake during 1991 to 1993 were genetically distinct from Fishhook Creek kokanee, but were similar to juvenile sockeye outmigrants and a small group of “residual” sockeye salmon discovered in the lake in 1992.¹ This result supports the hypothesis that the original sockeye salmon population had not been extirpated. Populations of *O. nerka* that appear to be native have also been found in Alturas and Stanley lakes. Collectively, the native *O. nerka* from the Stanley Basin form a coherent group that is well separated genetically from all other populations of *O. nerka* in the Pacific Northwest. Therefore, although recent returns had been minimal, NOAA Fisheries' Biological Review Team recommended that the species be listed as Endangered under the ESA “to make a conservative decision in this circumstance” (Waples et al. 1991) and because the ESU might be restored using experimental hatchery programs.

Historically, adult SR sockeye salmon entered the Columbia River in June and July, migrated upstream through the Snake and Salmon rivers, and arrived at the Sawtooth Valley Lakes in August and September (Bjornn et al. 1968). Spawning in lakeshore gravels peaked in October. Fry emerged in late April and May and moved immediately to the open waters of the lake where they fed on plankton for one to three years before migrating to the ocean. Juvenile sockeye generally left the Sawtooth

¹ Residual sockeye salmon are progeny of anadromous or residual fish that remain in freshwater to mature and reproduce. They produce some anadromous offspring (Kline 1994). Residuals are genetically very similar to the anadromous form (Waples et al. 1997) and are ESA-listed along with the anadromous portion of the ESU.

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Valley Lakes from late April through May and migrated nearly 900 miles to the Pacific Ocean. While pre-dam reports indicate that sockeye salmon smolts migrated through the lower Snake River in May and June, PIT-tagged smolts from Redfish Lake recently passed Lower Granite Dam during mid-May to mid-July. Snake River sockeye spend two to three years in the ocean before returning to their natal lake to spawn.

Table 8.4.2.1-1. Snake River sockeye ESU description. (Sources: NMFS 2005a ; ICTRT 2003; McClure et al. 2005; and Flagg 2007)

ESU	
Endangered	Listed under ESA in 1991, reaffirmed in 2005
	Populatio
	Anadromous sockeye salmon in the Snake River basin and residual sockeye in Redfish Lake ²
Hatchery programs included in ESU	Captive Broodstock Program – at this time is divided between facilities at Sawtooth and Eagle ID, Burley Creek and Manchester WA, and Oxbow OR

Limiting Factors

By the time Snake River Sockeye were listed in 1991, the species had declined to the point that there was no longer a self-sustaining, naturally-spawning sockeye population. The absence of a functional natural population is the largest factor limiting the recovery of this ESU, important in terms of both risks due to catastrophic loss and potentially to genetic diversity. The population size issue will be directly addressed by the proposed action, which will result in roughly a 10-fold increase in the smolt releases from the current captive broodstock hatchery program. The captive broodstock program has succeeded in maintaining generations of sockeye that are derived from the remnants of the Redfish Lake population. It is now capable of expanding the number of fish produced in subsequent generations and the proposed action will result in the release of up to 1 million smolts per year, a level sufficient to seed Redfish Lake with natural spawners. However, even if the number of natural spawners is much larger, genetic diversity could remain as a significant limiting factor. Before intervention, Snake River Sockeye reached such low numbers that there has been concern that genetic bottlenecks have resulted. It is not yet clear whether the existing population retains sufficient genetic diversity to successfully adapt to the range of variable conditions that occur within its natural habitat. However, unpublished data from geneticists for the Stanley Basin Sockeye Technical Oversight Committee indicate that the captive broodstock has similar levels of haplotype diversity as other sockeye populations in the Pacific Northwest and that the program has been able to maintain rare alleles in the population over time (Flagg 2008). The broodstock program reduces the risk of domestication by using a spread-the-risk strategy, outplanting prespawning adults and fertilized eyed eggs as well as juveniles raised in the hatchery. The progeny of adults that spawn in the lakes and

² Progeny of Redfish Lake sockeye have been outplanted to Pettit and Alturas lakes. These fish and their descendants, including residual sockeye salmon in Pettit Lake, are also considered part of the ESU.

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juveniles that hatch successfully from the eyed eggs are likely to have adapted to the lake environment rather than become “domesticated” to hatchery rearing conditions.

Mainstem Hydro

Compared to Snake River spring/summer Chinook salmon, there is relatively little route-specific information on the survival of SR sockeye salmon through the FCRPS. Reach survival estimates are imprecise because sample sizes of migrants from the Snake River are small. Williams et al. (2005) used detections of all PIT-tagged sockeye smolts (2000-2003) to the tailrace at Lower Granite Dam for annual estimates of survival between Lower Granite and McNary dams. In 2003, the estimated survival of sockeye smolts was 72.5%, similar to that of yearling Chinook salmon, but in 2000 through 2002, sockeye survival was considerably lower (23.9% to 56.0%). The reason is unclear, but sockeye salmon juveniles appear to be prone to descaling. Williams et al. 2005 reported that between 1990 and 2001, two adults returned from 478 juveniles transported and only one adult returned from 3,925 PIT-tagged fish that migrated in-river (SARs of 0.4% vs. 0.03%, respectively). As with Chinook salmon, most untagged sockeye salmon smolts were transported to below Bonneville Dam. Nonetheless, few adult sockeye salmon returned to Lower Granite Dam in the last decade. The Prospective Action of using the hatchery to increase smolt releases will also increase sample sizes and allow better estimates of juvenile survival through the FCRPS.

Habitat

Chapman and Witty (1993) reviewed the human influences that have resulted in the low numbers of sockeye salmon. Irrigation dams extirpated the anadromous sockeye runs to Wallowa and Payette lakes. Although the residual form of sockeye remains, irrigation withdrawals from Alturas Lake Creek severely reduced the anadromous sockeye salmon population in the watershed in the early 1900s. Sunbeam Dam blocked fish passage on the upper mainstem Salmon River beginning in 1910. Though a fish ladder was built at the dam in 1919, passage remained unlikely until the early 1930s. The IDFG eliminated sockeye from Pettit, Yellow Belly, and Stanley lakes during 1955 to 1965 to manage recreational fisheries for trout. At the time of the initial listing (NMFS 1991a), the greatest habitat problem faced by the ESU was probably the lack of access to any of the lakes but Redfish. The fish barriers on Alturas and Pettit Lake creeks (an irrigation intake and a concrete rough fish barrier, respectively) were modified to facilitate passage of anadromous sockeye into these historical habitats in the early 1990s (Teuscher and Taki 1996, cited in Flag et al. 2004).

Although access to the spawning and rearing lakes is now considered functional, large portions of the migration corridor in the Salmon River (i.e., between Redfish Lake Creek and Yankee Fork Creek and between Thompson Creek and Squaw Creek) are water quality limited for temperature (IDEQ 2005), which is likely to reduce the survival of adult sockeye returning to the Stanley Basin in late July and August.

The USFS (USDA 2003) recommended the following site-specific measures to improve habitat conditions:

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- Reduce lakeshore recreation pressure, particularly in shallow areas where sockeye spawn currently or historically
- Restore or maintain native vegetation that provides naturally resilient and productive shoreline habitats, through management of lakeside recreation and other human development
- Correct causes of listing Salmon River as water-quality limited (sediment and temperature) between the confluence of Redfish Lake Creek and that of Squaw Creek with the upper Salmon River.

The natural hydrological regime in the upper mainstem Salmon has been altered by water withdrawals. The Northwest Power and Conservation Council (NPCC 2004) made the following recommendation in its Salmon Subbasin Management Plan:

- Mimic the shape and timing of the natural hydrograph in the mainstem Salmon River between the East Fork confluence and the headwaters

The NPCC emphasized that the sustainability of base flows will require, in addition to improved water delivery, adequate water storage functions such as wetlands, functional riparian areas, side channels, groundwater recharge, etc. Otherwise, attempts to restore a normative hydrograph will result in more water leaving the system during peak flows and less water available during periods that are critical to sockeye salmon.

Harvest

Few sockeye are caught in ocean fisheries. Ocean fishing mortality on SR sockeye is assumed to be zero. Fisheries in the mainstem Columbia River that affect SR sockeye are currently managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007. These fisheries are limited to ensure that the incidental take of ESA-listed SR sockeye does not exceed specified rates. Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 2%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7%, depending on the run size of upriver sockeye stocks. Actual harvest rates have ranged from 0 to 1.8%, and 2.8 to 7.0%, respectively.

Current Status of the ESU

Between 1991 and 1998, all 16 of the natural-origin adult sockeye salmon that returned to the weir at Redfish Lake were incorporated into the captive broodstock program. The program has used multiple rearing sites to minimize chances of catastrophic loss of broodstock and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. Between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases – almost 20 times the number of wild fish that returned in the 1990s (Flagg et al. 2004).³ The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term. The Stanley Basin Sockeye Technical

³ Some of these returning adults may have been anadromous progeny of residual sockeye.

Oversight Committee has determined that the next step toward meeting the goal of re-establishing and amplifying the wild population is to increase the number of smolts released.

8.4.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for SR sockeye salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley Lake Creek and the Salmon River (NMFS 1993). The lower Columbia River corridor is among the areas of high conservation value to the ESU because it connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Designated areas consist of the water, waterway bottom, and the adjacent riparian zone (defined as an area 300 feet from the normal high water line on each side of the river channel) (NMFS 1993). Designation did not involve rating the conservation value of specific watersheds as was done in subsequent designations (NMFS 2005b). The status of critical habitat is discussed further in Section 8.4.3.

8.4.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.4.3.1 Recent Hydro Operations and Configuration Improvements

Changes in hydrosystem operations and configuration that have been implemented since 1998 have improved in-river conditions for SR sockeye based on rates of descaling and mortality [see Figures B-4 and B-5 in Martinson et al. 2007]. Changes have included the installation of surface bypass structures, minimum gap turbine runners, and spill deflectors; the relocation of bypass outfalls to avoid areas where predators collect; as well as other operational and structural changes (Appendix A in Corps et al. 2007b). Changes were designed to deflect fish from turbines and attract them to safer passage routes, increase the survival of juveniles that do use the turbine passage route, and reduce dissolved gas concentrations that might otherwise limit spill operations.

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Despite these improvements, rates of descaling and mortality are still higher for sockeye than for other species (Martinson et al. 2007). The reasons for this difference are unknown. There are few empirical data on the route-specific survival and behavior of juvenile sockeye salmon under the recent operations and configuration of the FCRPS and Upper Snake Project. Studies with unlisted Upper Columbia River sockeye in the mid-Columbia reach have shown that juvenile sockeye migrate through the system faster than yearling or subyearling Chinook (Steig et al. 2006a, b, and 2007; Timko et al. 2007). In these studies, surface passage routes were similarly or slightly more effective for sockeye salmon than for yearling Chinook. However, data comparing two different surface passage configurations at Rocky Reach Dam indicated that sockeye were highly sensitive to the design and/or location of the surface passage entrance (Steig et al. 2003, 2006a). Because the design and configuration of entrances at the FERC-licensed dams in the mid-Columbia River differ from those at FCRPS projects, specific research is needed to develop strategies for safe passage through the latter.⁴

Based on data for other species of SR salmon and steelhead, recent modifications to FCRPS adult passage facilities, including increased reliability of water supply systems for fish ladders and improved ladder exit conditions to prevent injury and delay (Appendix A in Corps et al. 2007b), probably reduced mortality for this species. NOAA Fisheries estimates that the current survival rate of adult sockeye from Bonneville to Lower Granite dams is 81.1% (about 97.1% per project) based on an expansion of data for adult sockeye bound for Lake Wenatchee and the Okanogan River (SCA Adult Survival Estimates Appendix).

In addition to losses in the lower Columbia and Snake hydrosystem, both juvenile and adult sockeye are lost in the 462-mile migration corridor between Redfish Lake and Lower Granite Dam. Water withdrawals in the Upper Salmon River during juvenile migration are statistically related to decreased juvenile sockeye salmon survival through the reach (approximately a 20% reduction) (Arthaud et al. 2004). Of 614 adults that passed Lower Granite between 1999 and 2007, only 352 (57%) were recovered at Redfish Lake or the Sawtooth Hatchery weir (Kozakiewicz 2007). The factors responsible for these losses have not been established. However, the relatively large run size in 2000 provided an opportunity for a telemetry project to examine the migration behavior and survival of adult Snake River sockeye. Keefer et al. (2007) found that survival decreased as the season progressed and after July 13, none of the sockeye radio-tagged at Lower Granite Dam survived to the spawning grounds. The shift from relatively high survival of migrants that reached Lower Granite before mid-July to 100% loss coincided with the date that the Snake River at Anatone, Washington first reached 21 degrees C, indicating that elevated temperatures played an important role.

⁴ In 2007, the Chelan PUD released acoustic-tagged juvenile sockeye for evaluating the performance of its own systems. Because the ongoing passage study at McNary Dam uses the same technology, researchers obtained three-dimensional passage information (approach and passage behavior as well as fish passage and survival rates) for the fish marked by Chelan PUD. The USGS is currently working on these data and expects to publish preliminary findings by mid-summer (2008).

8.4.3.2 Recent Tributary Habitat Improvements

The Shoshone Bannock Tribes have been supplementing nitrogen and phosphorus and controlling non-native kokanee salmon competitors (i.e., for food resources) in the four Sawtooth Valley lakes (Redfish, Pettit, Alturas, and Stanley) since 1995. Based on water quality and biological sampling described in their annual reports (e.g., Kohler et al. 2007), these management strategies are increasing the carrying capacities of the lakes for rearing juvenile Snake River sockeye salmon. In part because Redfish and the other Sawtooth Valley lakes are naturally oligotrophic systems, nutrient supplementation has stimulated primary productivity and the development of a zooplankton community dominated by *Daphnia* spp. (Selbie et al. 2007). Juvenile *O. nerka* (anadromous and residualized sockeye) fed selectively on the large copepod *Daphnia* in Sawtooth Valley lakes during 2004 and 2006 (i.e., *Daphnia* made up a larger proportion of the diet than would be expected based on its availability in the water column), although the same pattern was not observed in 2005 (Kohler et al. 2005 and 2007, Taki et al. 2006). Also, limiting the number of female kokanee allowed to spawn in Redfish Lake has reduced grazing pressure on shared food resources.

8.4.3.3 Recent Estuary Habitat Improvements

For salmon that use a stream-type life-history strategy, restoration projects in the tidally influenced zone of the estuary between Bonneville Dam and approximately RM 40 are most likely to improve the functioning of the juvenile migration corridor. Projects that protect or restore riparian areas and breach or lower dikes and levees are likely to improve safe passage for this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

8.4.3.4 Recent Predator Management Improvements

Avian Predation

There are few quantitative data on rates of avian predation on SR sockeye salmon. Ryan et al. (2007) reported the numbers of PIT-tags from in-river juvenile migrants detected at Bonneville Dam and subsequently detected on estuarine bird colonies during 2006. Although the number of sockeye detected was very small compared to steelhead or Chinook, the study indicated that avian predators were consuming some Columbia basin (i.e., potentially Snake River) sockeye salmon. If so, then the Action Agencies' removal of the Caspian tern colony from Rice to East Sand Island in 1999 probably reduced predation rates on listed sockeye salmon to some small degree. PIT-tags from a few juvenile sockeye were also found on cormorant colonies in the estuary (Collis et al. 2001); this potential source of mortality has not been addressed.

Recently, Antolos et al. (2005) quantified predation on juvenile salmonids by Caspian terns nesting on Crescent Island (RM 316) in the mid-Columbia reach. Between 1,000 and 1,300 adult terns were associated with the colony during 2000 and 2001, respectively. These birds consumed approximately 465,000 juvenile salmonids in the first and approximately 679,000 in the second year. Based on PIT-tag recoveries at the colony, these were primarily steelhead from Upper Columbia River stocks. Less than 0.1% of the inriver migrating yearling Chinook from the Snake River and less than 1% of the

yearling Chinook from the Upper Columbia were consumed. Presumably, a very small number of sockeye salmon, if any, were included in the “other salmonids” (i.e., not steelhead) category in the samples.

Piscivorous Fish Predation

Although predation of juvenile sockeye undoubtedly occurs, there is little direct evidence that piscivorous fish in the Columbia River consume juvenile sockeye salmon. Presumably, Zimmerman (1999) did not differentiate sockeye from “unidentified species” in the guts of pikeminnows, smallmouth bass, or walleye in the lower Snake and lower Columbia rivers because none or very few were identified. In contrast, Chinook were 29% of the prey of northern pikeminnows in lower Columbia reservoirs, 49% in the lower Snake River, and 64% downstream of Bonneville Dam. However, these observations are likely explained, in large part, by the fact that sockeye smolts make up a very small fraction of the overall number of migrating smolts (Ferguson 2006) in any given year.

8.4.3.5 Recent Hatchery Survival Improvements

The planting of fertilized eyed eggs and the release of prespawners for natural spawning has benefited the population through the production of unmarked smolts. Between 1991 and 1997, the number of unmarked smolts emigrating from Redfish Lake declined from levels in excess of 4,000 to only 300 individuals (IDFG 2006). No unmarked smolts were observed to emigrate from Pettit Lake until 1999, but since then, estimate that 23,000 unmarked smolts have done so. Approximately 26,000 unmarked smolts have emigrated from Redfish Lake since 1998. The IDFG estimates that in migration year 2005 alone, approximately 7,870 unmarked smolts out-migrated from Redfish Lake and 7,435 from Pettit Lake. The project sponsors are conducting genetic evaluations to confirm the origins of these fish, but hypothesize that most were derived from the prespawners released into Redfish Lake and the eyed-eggs planted in Pettit Lake.

8.4.3.6 Recent Harvest Rates

Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Actual harvest rates over the last ten years have ranged from 0 to 0.9%, and 2.8 to 6.1%, respectively (TAC 2008, Table 15).

8.4.3.7 Status of Critical Habitat under the Environmental Baseline

A variety of human-caused and natural factors have contributed to the decline of SR sockeye salmon over the past century and have decreased the conservation value of essential features and PCEs of the species’ designated critical habitat. Factors affecting the conservation value of critical habitat include passage barriers (especially high summer temperatures) in the mainstem lower Snake and Salmon rivers, passage mortality at the mainstem FCRPS dams, and high sediment loads in the upper reaches of the mainstem Salmon River. Factors affecting PCEs for spawning and rearing, juvenile and adult migration corridors are described below.

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Spawning & Rearing Areas

Most of the historical spawning and rearing areas in Redfish, Pettit, and Alturas lakes lie within nearly pristine areas where habitat conditions are considered functional.

Juvenile & Adult Migration Corridors

Juvenile sockeye migrate from the Sawtooth Valley lakes during late April through May. PIT-tagged smolts from Redfish Lake recently passed Lower Granite Dam during mid-May to mid-July. Adult SR sockeye salmon entered the Columbia River in June and July and migrated upstream through the Snake and Salmon rivers, arriving at Redfish Lake in August and September. Key factors limiting the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Juvenile and adult mortality in the lower Snake River above Lower Granite Dam and in the mainstem Salmon River [*water withdrawals, temperature, and degraded riparian conditions*]

Areas for Growth & Development to Adulthood

Although SR sockeye probably spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.4.3.8 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the ESU and its designated critical habitat.

The USFS completed consultation on two projects—the Valley Road Fire (emergency consultation) and Whitebark Pine treatment in the Redfish Lake Creek watershed. The Federal Highway Administration (FHWA)/Idaho Department of Transportation (IDT) consulted on repairs at Buckhorn Bridge (Salmon River Mile Post 184).

Projects in Lower Columbia River, Estuary, and Coastal Waters

Federal agencies also completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries

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has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.14.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners

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and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

The effects of the habitat restoration projects and tar remediation in the lower Columbia River on the viability of the species will be positive. Other projects, including Whitebark Pine treatment, bridge repairs, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

The future federal projects that restore habitat in the lower river will have positive effects on water quality. The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

These actions, including those that are likely to have adverse short-term or even long-term adverse effects, were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.4.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho provided information on various ongoing and future or expected projects that NOAA Fisheries determined were reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin (see list of projects in Chapter 17 in Corps et al. 2007a). However, neither the State of Idaho nor NOAA Fisheries identified any habitat-related actions and programs by non-federal entities that were expected to benefit SR sockeye salmon.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent

past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.4.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the FCRPS and Upper Snake Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are included in the effects of the FCRPS, which is described in Section 8.4.5.1. See Chapter 10 of the FCRPS Biological Opinion for a discussion of this permit.

8.4.5.1 Effects of Hydro Operations & Configuration Prospective Actions

The Prospective Actions include a requirement that the Action Agencies assess the feasibility of using increased PIT-tagging for better estimates of juvenile smolt survival from Redfish Lake to Lower Granite Dam and through the mainstem FCRPS projects (RPA Action 52). This information is needed to optimize in-river passage and transport facilities for juvenile sockeye as well as for Chinook and steelhead. It will also help determine the specific actions that must be taken to address limiting factors in the mainstem Salmon River portion of the juvenile migration corridor.

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Until better data are developed, NOAA Fisheries uses information developed for juvenile SR spring/summer Chinook as a surrogate for estimating the effects of the Prospective Actions in the mainstem migration corridor. Based on this information, the survival of juvenile sockeye is likely to increase with the implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams in concert with training spill (amount and pattern) to provide safe egress (i.e., reduce delay and vulnerability to predators). Installing a long guide wall in The Dalles spillway tailrace will also improve egress conditions. Surface passage routes are designed to reduce juvenile travel time through the forebay of each project where predation rates are often the highest (Section 8.1.1.1). Additional benefits could pertain if faster migrating juveniles are in better condition (e.g., less stressed, greater energy reserves) upon reaching the Bonneville tailrace. Shifting the delivery of a portion of the USBR's flow augmentation water from summer to spring will slightly reduce travel time, susceptibility to predators, and stress.

Hydro Prospective Actions are likely to improve the survival of adult SR sockeye salmon between Bonneville and Lower Granite dams. These include improvements to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in section 5.3.3.1 in Corps et al. (2007a). Because temperatures in the Salmon River during late July and August are probably contributing to the loss of adult sockeye between Lower Granite Dam and the Stanley Basin (Section 8.4.3.1), the Prospective Actions also require that the Action Agencies work with appropriate parties to investigate feasibility and potentially develop a plan for ground transport of adult sockeye through this reach. If feasible, transport would provide a short-term solution while specific habitat problems are identified and addressed.

Some of the configuration changes, discussed above, correspond to ISAB recommendations to proactively address the effects of climate change. As described in Section 8.1.3, the installation of surface passage routes and other configuration improvements that reduce delay and exposure to predators also reduce exposure to warm temperatures in project forebays. The regulation of outflow temperatures at Dworshak Dam will reduce summer water temperatures at Lower Granite, and to increasingly lesser extent, at Little Goose, Lower Monumental, and Ice Harbor dams.

Effects on Species Status

The survival of both juvenile and adult SR sockeye is expected to increase under the Prospective Actions due to improvements in the mainstem migration corridor, contributing to increased adult returns to the broodstock program and to the Sawtooth Valley lakes.

Effects on Critical Habitat

The hydro Prospective Actions are expected to increase the functioning of safe passage in the juvenile and adult migration corridors. To the extent that these improvements increase the number of adults returning to spawning areas, the hydro Prospective Actions could improve water quality and forage for juveniles by increasing the return of marine derived nutrients to spawning and rearing areas (Section 8.4.3.2)

8.4.5.2 Effects of Tributary Habitat Prospective Actions

The tributary habitat Prospective Actions do not include specific projects that will improve tributary habitat used by Snake River sockeye. However, the Action Agencies will undertake a study of possible sources and locations of mortality of juvenile sockeye before they reach the Snake River as described above (Section 8.4.5.1). As sockeye smolt production increases (Section 8.4.5.5), the Action Agencies will develop habitat projects to support natural production (Appendix B.2.2 in Corps et al. 2007b).

8.4.5.3 Effects of Estuary Prospective Actions

Juvenile sockeye rear in the natal lakes for one to three years before migrating to the ocean, a stream-type life history. Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM40, restoring riparian function and access to the floodplain (see Section 5.3.3.3 in Corps et al. 2007a), are likely to improve the survival of juvenile Snake River sockeye.

Effects on Species Status

Restoration projects that are placed along the estuary corridor, with an emphasis on the upper portion of the estuary nearest to Bonneville Dam, are most likely to have a positive influence on life history diversity and spatial structure (Fresh et al 2005).

Effects on Critical Habitat

The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the conservation value of the estuary as critical habitat for this species (section 5.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time.

8.4.5.4 Effects of Predation Prospective Actions

Avian Predation

The Prospective Actions include relocating most of the Caspian terns to sites outside the Columbia basin (RPA Action 54). While this will be beneficial, the available evidence does not indicate that significant numbers of sockeye smolts have fallen prey to Caspian terns. Continued implementation and improvement of avian deterrence at mainstem dams (RPA Action 48) is also likely to increase juvenile sockeye survival by a small amount.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous Fish Predation

There is little evidence that piscivorous fish in the Columbia basin prey on juvenile sockeye salmon (see discussion in Section 8.4.3.4). The best information currently available indicates that continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) is not likely to address a limiting factor for this species. Therefore, only a small increase in survival (safe passage in the juvenile migration corridor) is likely to result from decreased predation rates.

Effects on Species Status

The predation Prospective Actions are likely to have small positive effects on the survival of juvenile sockeye salmon.

Effects on Critical Habitat

Small positive effects on survival will correspond to a small improvement in the functioning of safe passage in the juvenile migration corridor.

8.4.5.5 Effects of Hatchery Prospective Actions

The Prospective Actions include two hatchery actions that are expected to benefit Snake River sockeye:

- Continue to fund the safety-net program to achieve the interim goal of annual releases of 150,000 smolts while also continuing to implement other release strategies in nursery lakes, such as fry and parr releases, eyed-egg incubation boxes, and adult releases for volitional spawning
- Fund further expansion of the sockeye program to increase total smolt releases to between 500,000 and 1 million fish

Expanding the number of smolts released is the program's next step toward meeting the goal of amplifying the wild population. The Action Agencies will also continue to fund the other release strategies used to date, because using multiple methods increases the likelihood of success.

Effects on Species Status

The continuing and the expanded smolt releases are expected to result in an increase in the abundance and productivity of the naturally-spawning population.

Effects on Critical Habitat

The smolt releases are not expected to affect PCEs in designated critical habitat.

8.4.5.6 Effects of Harvest Prospective Actions

Management provisions for sockeye in the 2008 *U.S. v. Oregon* agreement have not changed from those in the prior agreement. Non-Indian fisheries in the lower Columbia River will be limited to a

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harvest rate of 1% and Treaty Indian fisheries to 5 to 7%, depending on the run size of upriver sockeye stocks (Table 8.4.5.6-1)

Table 8.4.5.6-1. Sockeye Harvest Rate Schedule.

River Mouth Sockeye Run Size	Treaty Harvest Rate	Non-Treaty Harvest Rate	Total Harvest Rate
< 50,000	5%	1%	6%
50,000 -75,000	7%	1%	8%
> 75,000	7% *	1%	8 % *

*If the upriver sockeye run size is projected to exceed 75,000 adults over Bonneville Dam, any party may propose harvest rates exceeding those specified in Part II.C.2. or Part II.C.3. of the 2008-2017 Management Agreement. The parties shall then prepare a revised biological assessment of proposed Columbia River fishery impacts on ESA-listed sockeye and shall submit it to NMFS for consultation under Section 7 of the ESA.

Effects on Species Status

The Prospective harvest rates will continue to have a small negative effect on the numbers of Snake River sockeye returning to the captive broodstock program and to spawn naturally in the Sawtooth Valley lakes.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas.

8.4.5.7 Research, Monitoring & Evaluation Prospective Actions

Please see Section 8.1.4 of this document.

8.4.6 Aggregate Effect of the Environmental Baseline, Prospective Actions, and Cumulative Effects on Snake River Sockeye

This section summarizes the basis for conclusions at the ESU level.

8.4.6.1 Recent Status of the Snake River Sockeye ESU & Critical Habitat

The Snake River sockeye salmon ESU is comprised of a single MPG and single population spawning and rearing in Redfish, Pettit, and Alturas lakes in the Sawtooth Valley, and includes artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. This population is

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the last remaining in a group of what were likely to have been independent populations occupying the Sawtooth Valley lakes. The Interior Columbia Basin TRT has designated this species at very high risk. The extremely low number of natural spawners and reliance on a captive Broodstock Program implemented in 1992 illustrates the high degree of risk faced by this population.

Recent annual abundances of natural-origin sockeye salmon to the Stanley Basin have been extremely low. Although residual sockeye salmon have been identified in Redfish and Pettit lakes, the abundance of the ESU is supported by adults produced through the captive propagation program. Recently, the smolt-to-adult survival of sockeye originating from the Sawtooth Valley lakes rarely has been greater than 0.3%. The current average productivity is substantially less than the productivity required for any population to be at Low (1-5%) long-term extinction risk at the minimum abundance threshold. Based on current abundance and productivity information, the Snake River sockeye salmon ESU does not meet the viability criteria for non-negligible risk of extinction over 100-year time period. Short-term extinction risk has been reduced by the captive propagation program; between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases – almost 20 times the number of wild fish that returned in the 1990s. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term.

Ocean fishing mortality on Snake River sockeye is assumed to be zero. Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Actual harvest rates over the last ten years have ranged from 0 to 0.9%, and 2.8 to 6.1%, respectively.

A draft recovery plan containing strategies to address remaining key limiting factors is expected to be completed later in 2008. Given the extremely low levels of Snake River sockeye returns, initial recovery efforts are largely focused on improving survival rates of out-migrant smolts. The Stanley Basin Sockeye Technical Oversight Committee has determined that the next step toward meeting the goal of amplifying the wild population is to increase the number of smolts released.

The major factors limiting the conservation value of critical habitat for Snake River sockeye are the effects on the migration corridor posed by the mainstem lower Snake and Columbia River hydropower system, reduced tributary stream flows and high temperatures experienced by outmigrating smolts and returning adults, and barriers to tributary migration. The Sawtooth Valley lakes lie within nearly pristine areas. The production capacity of these naturally oligotrophic systems is low, but nutrient supplementation in recent years has stimulated primary productivity and the development of a favorable zooplankton forage community. Non-native kokanee salmon directly compete for zooplankton forage in most Sawtooth Valley lakes. Ocean conditions that have affected the status of this ESU generally have been poor since 1977, improving only in the last few years.

8.4.6.2 Effects of the Prospective Actions on Snake River Sockeye & Critical Habitat

Extinction of this ESU has been prevented and the prospects for survival and recovery now depend on expanding the existing safety-net program and increasing juvenile and adult survival. The Prospective Actions are expected to result in an approximately 10-fold increase in the number of sockeye produced by the captive broodstock program, greatly increasing the number of sockeye released to the wild, and thereby increasing the likelihood of higher adult returns. The Action Agencies will continue to fund the existing broodstock program including the continued releases of 150,000 fry and parr, outplanting of eyed-egg incubation boxes, and releases of adults for volitional spawning.

The Prospective Actions include configuration changes at FCRPS dams that are likely to improve the survival of juvenile and adult sockeye salmon, although more species-specific data are needed to ensure that conditions are optimized for this species as well as Chinook and steelhead. The Prospective Actions therefore require that the Action Agencies assess the feasibility of PIT-tag marking smolts for tracking survival of this species through the FCRPS. They will also work with appropriate parties to investigate feasibility and potentially develop a plan for ground transport of adult sockeye from Lower Granite Dam to Redfish Lake to circumvent the habitat problems that are causing losses until they can be addressed.

Management provisions for sockeye in the 2008 Agreement have not changed from those in the prior *U.S. v. Oregon* Agreement. Actual harvest rates over the last ten years have ranged from 0 to 0.9% for the non-Indian and 2.8 to 6.1% for the Treaty Indian fisheries, respectively (Section 8.4.3.6).

In aggregate, the prospective actions are expected to improve the survival of juveniles and adults through the mainstem Salmon and FCRPS migration corridors (safe passage) and together with the expanded smolt release program to increase the likelihood of higher adult returns.

8.4.6.3 Cumulative Effects Relevant to the Snake River Sockeye ESU

The State of Idaho did not identify any habitat-related actions and programs in the action area by non-Federal entities that are expected to address low flows and high temperature in the mainstem Salmon River. The cumulative effects of water withdrawals and land use practices that degrade riparian conditions are likely to continue the significant adverse effects of similar past activities that contributed to the environmental baseline for this ESU.

8.4.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Sockeye Salmon ESU

The aggregate effect of the environmental baseline, the Prospective Actions, and cumulative effects will be an improvement in the viability of SR sockeye salmon. Some limiting factors will be addressed by improvements to mainstem hydrosystem passage. The installation of surface passage routes and other configuration changes that will reduce delay and exposure to predators and warm temperatures in forebays, controlling summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam, also correspond to ISAB recommendations to proactively

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address the effects of climate change (Section 8.1.3). However, based on an evaluation of future Federal actions that have completed Section 7 consultation and cumulative effects, conditions in the Salmon River portion of the juvenile and adult migration corridors are not expected to improve. If it is feasible to trap adults at Lower Granite Dam and haul them to the Sawtooth Valley, the adverse effects of low flows and high temperatures in the mainstem Salmon can be avoided, at least for this life stage. Management provisions for sockeye in the 2008 Agreement are unchanged from those in the prior *U.S. v. Oregon* Agreement and actual harvest rates are likely to be less than those allowed, as in previous years. Taking into account the obstacles faced, the Prospective Actions provide for the survival of the species with an adequate potential for recovery.

8.4.6.5 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR sockeye salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes; Alturas Lake Creek; and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. The environmental baseline within the action area, which encompasses these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR sockeye salmon. The major factors currently limiting the conservation value of critical habitat are juvenile and adult mortality at mainstem hydro projects in the lower Snake and Columbia rivers and water withdrawals, temperature, and degraded riparian conditions in the lower Snake River above Lower Granite Dam, and in the mainstem Salmon River.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Habitat work in the mainstem Salmon River and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be

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long term. The species is expected to survive until these improvements are implemented, as described in “Short-term Extinction Risk,” above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Sockeye Salmon ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Snake River Sockeye Salmon ESU nor result in the destruction or adverse modification of its designated critical habitat.

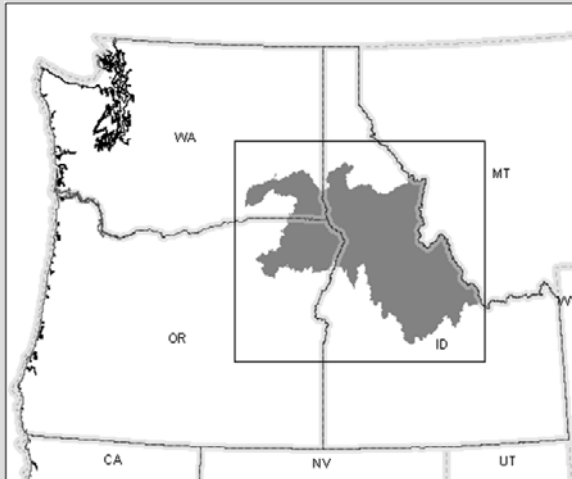
Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁵

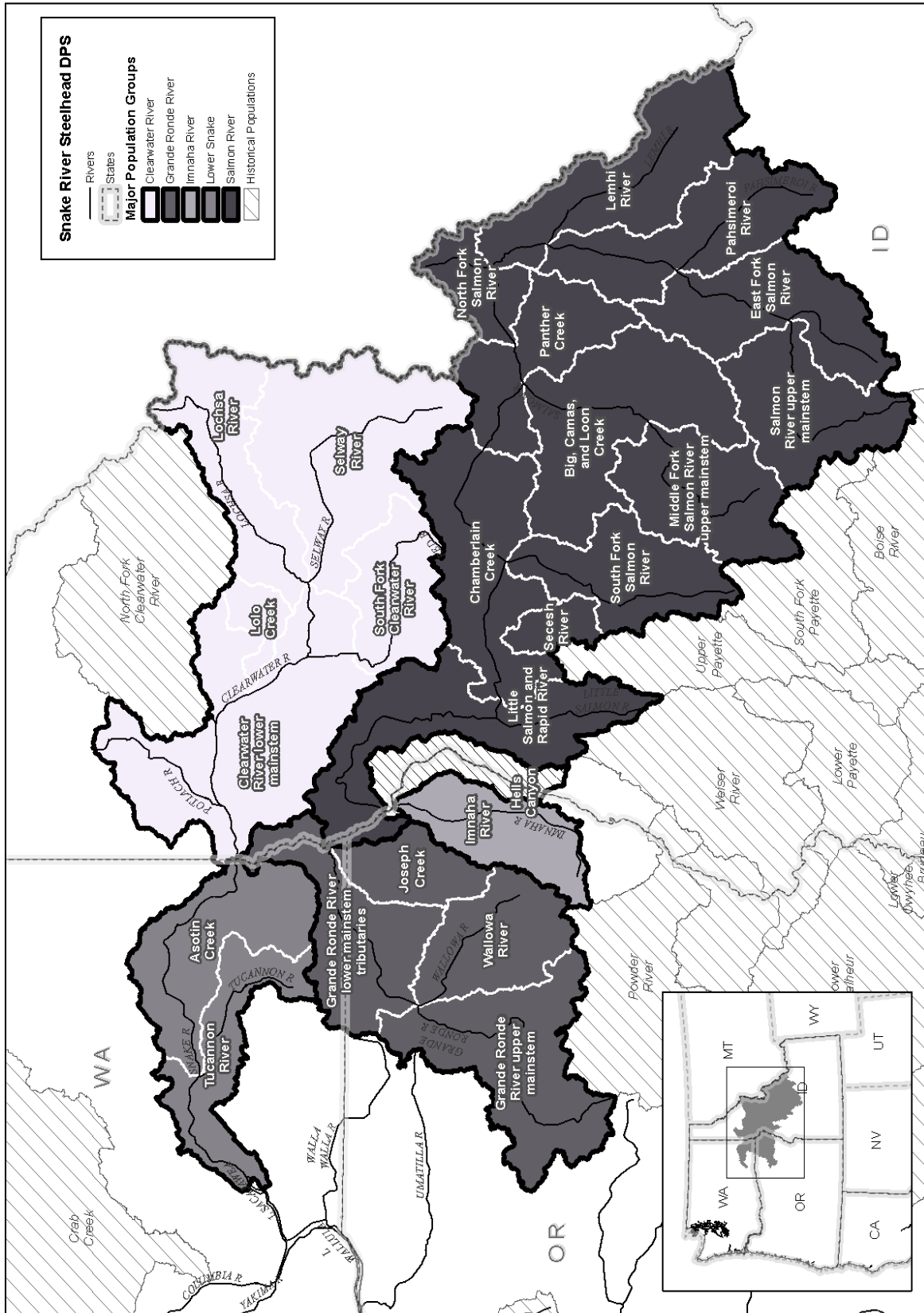
⁵ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

Section 8.5 Snake River Steelhead



- 8.5.1 Species Overview
- 8.5.2 Current Rangewide Status
- 8.5.3 Environmental Baseline
- 8.5.4 Cumulative Effects
- 8.5.5 Effects of the Prospective Actions
- 8.5.6 Aggregate Effects by MPG
- 8.5.7 Aggregate Effect on DPS

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Section 8.5

Snake River Steelhead

Species Overview

Background

The Snake River (SR) steelhead DPS includes all anadromous populations that spawn and rear in the mainstem Snake River and its tributaries between Ice Harbor and the Hells Canyon hydro complex. There are five major population groups with 24 populations. Inland steelhead in the Columbia River Basin are commonly referred to as either A-run or B-run, based on migration timing and differences in age and size at return. A-run steelhead are believed to occur throughout the steelhead streams in the Snake River Basin, and B-run are thought to produce only in the Clearwater and Salmon rivers. This DPS was listed under the ESA as threatened in 1997, reaffirmed in 2006.

Designated critical habitat for SR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

The abundance of SR steelhead has been stable or increasing for most A-run and B-run populations during the last 20 brood cycles. On average, the natural-origin components of the A-run populations have replaced themselves whereas the natural-origin components of the B-run populations have not.

Limiting Factors and Threats

Limiting factors identify the most important biological requirements of the species. Historically, the key limiting factors for the Snake River steelhead include hydropower projects, predation, harvest, hatchery effects, and tributary habitat. Ocean conditions have also affected the status of this DPS. These generally have been poor over at least the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on Snake River steelhead is assumed to be zero. Fisheries in the Columbia River were limited to ensure that the incidental take of ESA-listed Snake River steelhead does not exceed specified rates. Non-Indian fisheries were subject to a year-round 2% harvest rate limit on A-run and a 2% harvest rate limit for B-run steelhead. Treaty Indian fall season fisheries were

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subject to a 15% harvest rate limit on B-run steelhead. Incidental harvest rate limits on B-run steelhead, in particular, have reduced access to harvestable stocks in fall season fisheries. Recent harvest rates on Snake River steelhead have generally been lower than what is allowed. The recent harvest rates on A-run steelhead in non-Indian and treaty Indian fisheries range from 1.0% to 1.9%, and 4.1% to 12.4%, respectively. The recent harvest rates on B-run steelhead in non-Treaty and treaty Indian fisheries range from 1.1% to 2.0%, and 3.3% to 15.6%, respectively.

8.5.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of the species' status, which forms the basis for the listing of the species as endangered or threatened.

8.5.2.1 Current Rangewide Status of the Species

SR steelhead is a threatened species composed of 24 extant anadromous populations in five major population groups (MPG). Steelhead are anadromous form of rainbow trout, which are not listed. All populations in this DPS return in the summer and are therefore referred to as “summer-run” in contrast to “winter-run” steelhead in some other DPSs. Key statistics associated with the current status of SR steelhead are summarized in Tables 8.5.2-1 through 8.5.2-4.

Limiting Factors and Threats

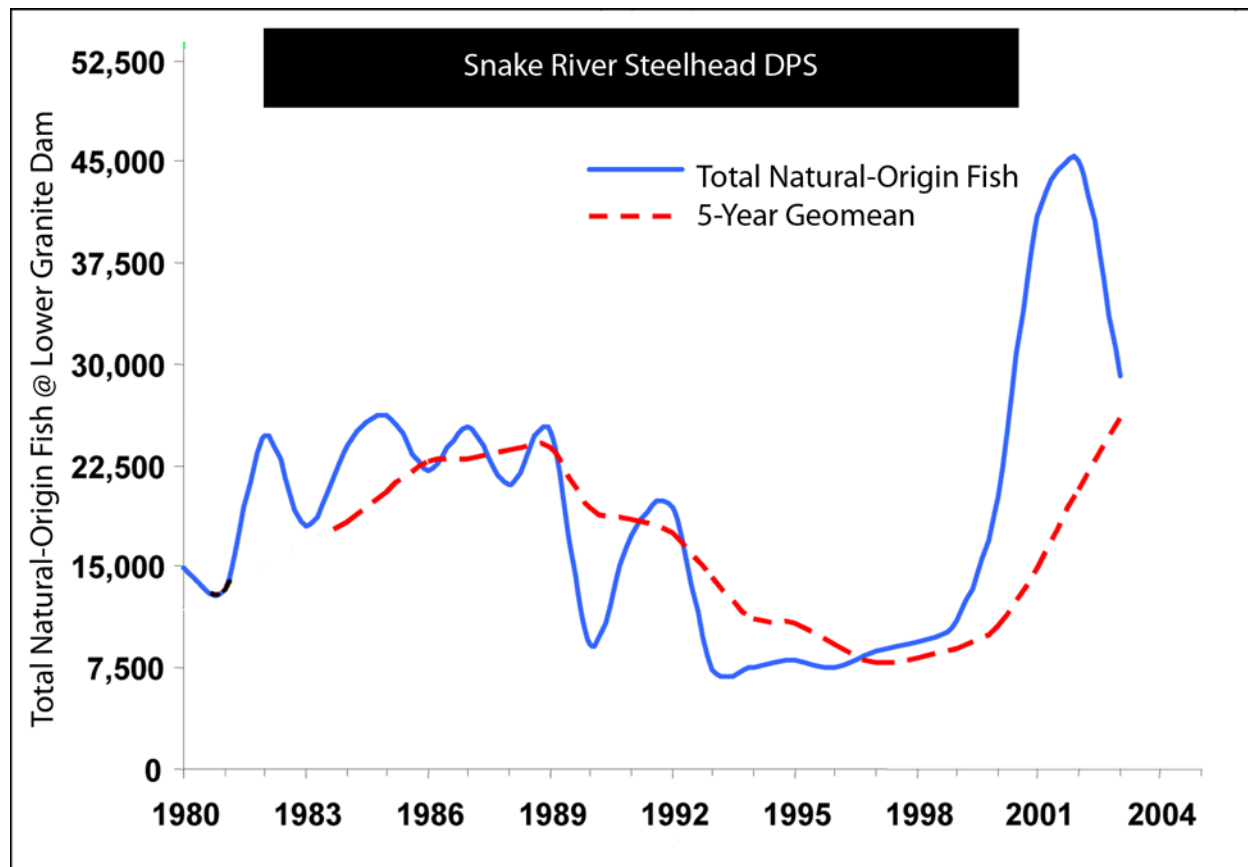
The key limiting factors and threats for Snake River steelhead include hydropower projects, predation, harvest, hatchery effects, and tributary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years (at least), improving only in the last few years. Limiting factors are discussed in more detail in the context of critical habitat in Section 8.5.3.3.

Abundance

Population-specific adult population abundance is generally not available for SR steelhead due to difficulties conducting surveys in much of their range. To supplement the few population-specific estimates, the ICTRT used Lower Granite Dam counts of A-run and B-run steelhead and apportioned those to A- and B-run populations proportional to intrinsic potential habitat (Appendix A of ICTRT 2007c). The ICTRT generated 10-year geometric mean abundance estimates for two populations in the Grande Ronde MPG and reported average A-run and average B-run abundance as an indicator for the other populations. For the two Grande Ronde MPG populations, one recent average abundance exceeds the ICTRT abundance threshold and the second is below the threshold (Table 8.5.2-1). Both the A- and B-run averages are below the average abundance thresholds that the ICTRT identifies as a minimum for low risk. Abundance for Grande Ronde populations, and the average A- and B-run populations, declined to low levels in the mid-1990s, increased to levels at or above the recovery ICTRT abundance thresholds in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.5.2.1-1, showing annual abundance of combined populations).

Figure 8.5.2.1-1 shows the 1980 to most recent abundance and 5-year geometric mean trends for the aggregate of all populations above Lower Granite Dam. The 5-year geometric mean increased from 1980, peaking in 1989 and decreasing throughout the 1990s. Aggregate abundance of natural-origin fish peaked in 2002 and the 5-year geometric mean has been increasing since 2000.

Figure 8.5.2.1-1. Snake River Steelhead DPS Abundance and 5-Year Geometric Mean (adopted from Fisher and Hinrichsen 2006)



“Base Period” Productivity

On average over the last 20 full brood year returns (~1980-1999 brood years [BY], including adult returns through ~2004), A-run SR steelhead populations replaced themselves (Table 8.5.2-1) when only natural production is considered (i.e., average R/S has been ≥ 1.0), while B-run steelhead have not. In order to ensure that the distribution of productivity estimates among MPGs is clearly stated, Table 8.5.2-1 displays the average A- and B-run SR steelhead productivities applied to each individual population. In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d], updated with Cooney [2008a]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at $\leq 5\%$ extinction risk for average A-run and average B-run populations (intrinsic productivity estimates in ICTRT 2007c). However, of the two individual Grande Ronde populations with sufficient data for estimates, one had sufficient intrinsic productivity to meet the ICTRT viability criteria (Joseph Creek) and the other (Upper Grande Ronde) did not.

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The base period trend in abundance has been stable or increasing (Table 8.5.2-1) for both A-run and B-run populations, as indicated by median population growth rate (λ) and BRT trend. The one exception is the Upper Grande Ronde population, which has λ less than 1.0 (0.99) when estimated under the assumption that effectiveness of hatchery-origin and natural-origin spawners is equal ($HF=1$).

In summary, abundance has been stable or increasing for A-run SR steelhead over the last 20 brood years, based on R/S, λ , and BRT trend estimates >1.0 . An exception is the Upper Grande Ronde population under one assumption for λ . For B-run SR steelhead populations, natural survival rates are not sufficient for spawners to replace themselves each generation, as indicated by average R/S estimates <1.0 , but abundance has been increasing, as indicated by λ and BRT trend.

Spatial Structure

The ICTRT characterizes the spatial structure risk of nearly all SR steelhead populations as “very low” or “low” (Table 8.5.2-2). Panther Creek is an exception with “high” risk because only 30% of the historical range is occupied and there is a significant geographical distance between the single major spawning area for this population and the location of the next population. This is largely a result of past mining operations, which are being addressed through other processes, including the EPA Blackbird Mine Superfund Site clean-up.

Diversity

The ICTRT characterizes the diversity risk of all SR steelhead populations as “low” or “moderate” (Table 8.5.2-2).

“Base Period” Extinction Risk

Draft ICTRT Current Status Summaries (ICTRT 2007d) characterize the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the “base period” described above for R/S productivity estimates, as “High” ($>25\%$ 100-year extinction risk) for all B-run populations and three A-run populations (Tucannon, Asotin, and Chamberlain Creek). The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses ($QET=50$). Most A-run populations are characterized as having “moderate” risk (6-25% 100-year extinction risk). One population (Joseph Creek) is characterized as having a “low” risk of long-term extinction ($<5\%$ risk).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. It is not possible to evaluate short-term extinction risk for most individual populations or for average B-run populations. Table 8.5.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for average A-run populations, average B-run populations, and two individual A-run populations in the Grande Ronde MPG with sufficient data for estimates (Upper Mainstem and Joseph Creek). Short-term extinction risk is zero for the two Grande Ronde populations, 5% for average B-run populations, and $>5\%$ for average A-run populations at

QET=50. Risk is also >5% for average A-run populations at other QETs above 1.0. In order to display the distribution of extinction risk among MPGs, Table 8.5.2-3 applies the average A- and B-run extinction risk estimates to individual A- and B-run populations. This short-term extinction risk analysis is also based on the assumption that productivity observed during the “base period” will be unchanged in the future.

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.5.2-4. Mean base period R/S survival gaps range from no needed change for average A-run populations to approximately 25% needed survival improvements for average B-run populations. It is not possible to estimate survival changes necessary to reduce short-term extinction risk to $\leq 5\%$, as described in Chapter 7.1 and the Aggregate Analysis Appendix.

8.5.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Lower Snake River, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater (NMFS 2005b). There are 289 watersheds within the range of this DPS. Fourteen watersheds received a low rating (see Chapter 4 for further detail), 44 received a medium rating, and 231 received a high rating of conservation value to the DPS. The lower Snake/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 8,225 miles of habitat areas eligible for designation, 8,049 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.5.3.3.

8.5.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.5.3.1 “Current” Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year “base period,” ending with the 1999 brood year for average A-run steelhead and 1998 brood year for average B-run steelhead. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, Table 8.5.3-1 includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7 of this document. Results are presented in Table 8.5.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately 4% higher survival for both A-run and B-run populations [SCA Quantitative Analysis of Harvest Actions Appendix, based on U.S. v. Oregon estimates]) and estuary habitat projects (less than a 1% survival change, based on CA Appendix D) result in a survival improvement for all SR steelhead populations. Tributary habitat projects result in up to 8.5% survival improvements for specific populations within the DPS (CA Chapter 7, Table 7-6). In contrast, changes in collector dam configurations and transportation timing to benefit other listed species results in a 3% reduction for FCRPS survival, (based on ICTRT base survival and COMPASS analysis of current survival in the SCA Hydro Modeling Appendix) and development of tern colonies in the estuary results in less than a 1% reduction in survival for all populations. There are 16 hatchery programs for Snake River steelhead that operate as partial mitigation for impacts from FCRPS and Hells Canyon dams (Hatchery Effects Appendix). Ten of these hatchery programs, and the vast majority all steelhead hatchery production, operate to make up for lost natural production from hydro impacts. Six steelhead hatchery programs (four A-run and two B-run) add to or supplement natural spawning. These supplementation programs preserve genetic resources, but there is no analysis to show that they have increased natural-origin fish survival.

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 0-9%, depending on the particular population (Table 8.5.3-1). This also means that the survival “gaps,” described in Table 8.5.2-4, would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.00] to [“Gap” ÷ 1.09], depending on the population).

8.5.3.2 Abundance, Spatial Structure, & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.5.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as affecting the conservation value of designated critical habitat. The condition of PCEs in spawning and rearing areas and juvenile and adult migration corridors are described below.

Spawning and Rearing Areas

This species spawns in tributaries to the Snake River in southeast Washington, northeast Oregon, and Idaho. Adults enter fresh water from June to October and spawn the following spring from March to June (Thurow 1987). Emergence occurs by early June in low elevation streams and as late as mid-July at higher elevations. Snake River steelhead usually rear in the natal tributaries for two to three years before beginning their seaward migration.

The following are the major factors that limit the functioning and thus the conservation value of habitat used by SR steelhead for these purposes (i.e., spawning and juvenile rearing areas with spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Degraded tributary channel morphology [*bank hardening for roads or other development; livestock on soft riparian soils and streambanks*]
- Physical passage barriers [*culverts; pushup dams; low flows*]
- Excess sediment in gravel [*roads; agricultural and silvicultural practices; livestock on soft riparian soils and streambanks; recreation*]
- Degraded riparian condition [*grazing*]
- Reduced tributary stream flow, which limits usable stream area and alters channel morphology by reducing the likelihood of scouring flows [*water withdrawals*]
- Degraded tributary water quality including elevated summer temperatures [*water withdrawals; groundwater depletion; degraded riparian condition*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future. These include acquiring water to increase

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streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving mainstem and channel habitat, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile and Adult Migration Corridors

Factors limiting the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]
- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Temperature barriers [*timing of adult entry into and migration through the lower Snake River in late summer and early fall is delayed because of elevated mainstem temperatures*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS corridor, the Action Agencies have improved safe passage for juvenile steelhead with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 7.3.1.1 in Corps et al. (2007a). The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For steelhead, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 7.3.1.3 in Corps et al. 2007a).

Areas for Growth and Development to Adulthood

Although SR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River (NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.5.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Lower Snake MPG

Both of the populations within this MPG were affected by several projects, as described below.

Tucannon River

The USFS consulted on one emergency fire action and two fire salvage/timber sale projects in the Upper Tucannon watershed. The Corps proposed maintenance dredging of a barge slip at the mouth of the Snake River.

Asotin Creek

The BPA consulted on replacing a wood pole transmission line. The FHWA/WSDOT consulted on a project to replace a bridge, removing a channel constriction and thereby increase safe passage.

Grande Ronde River MPG

No Section 7 consultations were completed in the subject timeframe that would affect the Wallowa River population. Projects that affected other populations in this MPG are described below.

Grande Ronde Lower Mainstem

The USFS consulted on two projects in the Grande Ronde River—Mud Creek watershed, construction of an off-highway vehicle (OHV) trail system and a fire salvage timber sale. The USFS also consulted on two habitat restoration projects that were designed to improve conditions in the Grande Ronde River—Mud Creek, Chesnimnus Creek and Upper and Lower Joseph Creek watersheds. In one project, the USFS proposed to plant vegetation in Riparian Habitat Conservation Areas, develop offsite livestock watering facilities, replace 10 culverts identified as passage barriers or unable to withstand the 100-yr flood, maintain roads, harden four vehicle crossings, harden or otherwise protect livestock watering gaps, repair or modify 36 instream structures and remove bridge abutments. These actions were expected to reduce sediment loads, improve temperatures, riparian conditions, improve passage conditions, and to increase habitat complexity. In the second project, USFS would restore riparian habitat associated with a timber sale.

The Corps consulted on construction of a new floating dock at the Port of Clarkston on the lower Snake River.

The BLM consulted on projects to treat noxious weeds and seed riparian flats with native vegetation throughout the Lower Grande Ronde watershed and to maintain ten riparian exclosures protecting five miles of riparian from grazing in the Lower Grande Ronde.

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Joseph Creek

The USFS consulted on a fuels reduction project in the Chesnimnus Creek watershed and a rangeland analysis for Joseph Creek. The USFS also consulted on two projects in the Chesnimnus Creek watershed that included habitat restoration elements: 2006 Peavine Noxious Weed Treatment and 2007 Peavine Trail Conservation.

The BLM consulted on a project to improve 100 acres of riparian along eight miles of stream in the Chesnimnus and Upper Joseph Creek watersheds.

Grande Ronde Upper Mainstem

The USFS proposed three fuel reduction projects in the Upper and Lower Catherine Creek watersheds. The USFS also proposed three grazing allotments and a rangeland analysis in the Upper Grande Ronde and Upper Grande Ronde-Five Points Creek watersheds. Additionally, the USFS consulted on a habitat restoration project in the Meadow Creek and Grande Ronde—Beaver Creek watersheds that would improve 200 acres of riparian habitat and maintain cattle exclosures.

The Corps consulted on a culvert replacement project for Oregon Highway 82 at Pierce Slough (Grande Ronde—Five Points Creek watershed). The project was expected to improve fish passage, riparian vegetation, and water quality.

Clearwater River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the North Fork Clearwater, Lolo Creek, or Lochsa River populations. Projects that affected other populations in this MPG are described below.

Lower Mainstem Clearwater

The USFS consulted on two projects, the Little Boulder Campground Hazard Tree Removal Project in the Lower Clearwater watershed and the Cottonwood Creek Bridge Repair project. The USFS also consulted on a stream crossing rehabilitation project on Webb Creek in the Lapwai Creek watershed which was designed to provide offsite water for cattle, reducing instream temperatures and improving the condition of spawning gravels.

The FHWA/IDT consulted on a road construction project in Lewiston, ID.

Selway River

The USFS consulted on a project to replace a bridge over Lookout Creek (White Cap Creek watershed).

South Fork Clearwater River

The USFS consulted on one fire salvage and timber sale project in the Red River Watershed. The USFS also proposed two fuels reduction projects that affected the Upper South Fork Clearwater River, Crooked River, and Newsome Creek watersheds which included construction of instream rock and log structures. These were designed to improve instream temperatures and forage for juvenile rearing

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habitat and increase the number of resting pools for adults. They also included rehabilitation of a portion of Newsome Creek and its floodplain area in the Johns Creek watershed, which was dredged-mined in 1937 to 1940. This project was designed to reduce sediment delivery from roads, remove fish passage impediments and culverts, and treat weeds. On the Red River in the Middle South Fork Clearwater River watershed, the USFS decommissioned 13 miles, improved 20 miles, and abandoned 3 miles of roads; restored soil on 8.5 acres of skid trails and landings; replaced one and removed eight other undersized culverts; and treated noxious weeds.

The Corps consulted on providing an in-water work permit for the Nez Perce County Fishing Pier in the Upper Clearwater River.

The BLM consulted on restoration projects in Johns Creek which would improve access in Telephone Creek and the East Fork American River, increase habitat complexity in summer and winter rearing habitat, increase shading and reduce water temperatures, improve spawning gravels, and improve forage conditions for rearing fish.

Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the South Fork Salmon River; Secesh River; Big, Camas, and Loon Creeks; and Upper or Lower Mainstem Middle Fork Salmon River populations. During the summer of 2007, wildfires burned approximately 310,000 acres of forested habitat within the range of South Fork and Middle Fork Salmon River MPGs. NOAA Fisheries expects that instream habitats will experience increased temperatures, sediment, and large woody debris delivery in the near term. Recovery times to pre-existing conditions will depend on the effects of the fire at each location, which are unknown at this time. Projects that affected other populations in this MPG are described below.

Little Salmon and Rapid Rivers

The USFS consulted on construction of the Rapid River Trailhead in the Upper Little Salmon River watershed. The USFS also proposed to install a fishway at an irrigation diversion dam, which would restore fish access to approximately three miles of Squaw Creek in the Upper Little Salmon River watershed. The project would also consolidate water rights, achieving a net increase in stream flow of 4 cfs, enough to support a low temperature thermal refuge for the Little Salmon River population.

Reclamation consulted on a culvert replacement on Squaw Creek in the Little Salmon River watershed which improved access to four miles of habitat in Squaw Creek and improved habitat complexity in Squaw and Papoose creeks.

Chamberlain Creek

The USFS consulted on a timber salvage project in the Lower South Fork Salmon River watershed and a bank protection (rip-rap) project in the Rock Creek watershed.

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Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which would result in the conversion of irrigated agricultural land to low density residential housing. The project was expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns of irrigation ditches when water was withdrawn for irrigation. The National Resource Conservation Service proposed to rehabilitate stream habitat in Iron Creek (Upper Panther Creek watershed). The BLM consulted on watershed rehabilitation activities associated with managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood.

Lemhi

The FHWA/IDT consulted on the construction of a pedestrian bridge. The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi River watershed) and two projects designed to rehabilitate stream channels and their associated riparian zones in the Middle Salmon River—Carmen Creek, Middle Salmon River—Indian Creek, and Hayden Creek watersheds. NOAA Fisheries consulted with itself on providing funds to screen a water diversion on Kenney Creek (Eighteenmile Creek watershed) and a culvert replacement in Twin Creek (North Fork Salmon River watershed). The latter project was designed to restore access and the hydraulic processes that transport sediment and large woody debris.

Pahsimeroi River

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River (disease). The BLM proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NOAA Fisheries and USFWS each consulted on projects intended to remove passage barriers by modifying water diversions in the Lower Pahsimeroi River watershed.

East Fork Salmon River

The USFS consulted on a road construction and maintenance project in the Lower East Fork Salmon River watershed, and the FHWA proposed a bridge repair/construction project over the Salmon River (Challis Creek watershed).

Imnaha River MPG

Imnaha River

The USFS consulted on an emergency fire management project in the Salmon River, a harvest/vegetation management project in the Upper Imnaha River watershed, and a bridge replacement project in the Middle Imnaha River. The USFS also consulted on granting a special use permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed which included replacing two bridges (relieving channel constrictions) and restoring local floodplain connectivity. The USFS also consulted on a culvert replacement project, also in the Upper Imnaha watershed, designed to restore access to 3.5 miles of rearing habitat.

Projects Affecting Multiple MPGs/Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.5.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration

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Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of Snake River steelhead that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and create thermal refuges. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including fire salvage timber sales, maintenance dredging, grazing, bridge repairs, whitebark pine treatment, dock/pier construction, and road construction/maintenance, will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding in any adverse modification of critical habitat.

8.5.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Little Salmon, Lolo Creek, Lower Clearwater, South Fork Clearwater, and Asotin subbasins as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.¹ Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for Snake River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing

¹ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.5.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.5.5.1 and 8.5.5.2. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvements, require that all hatchery programs operate under NOAA Fisheries' approved HGMPs, broodstock reform for the Tucannon and East Fork Salmon River hatchery programs, steelhead kelt reconditioning, hatchery safety-net planning and predator reduction actions, which are expected to be beneficial. Flow augmentation from the Upper Snake Projects will also provide benefits. These beneficial effects are described in Sections 8.5.5.3, 8.5.5.4, 8.5.5.7, and 8.5.5.9. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects, as described in Section 8.5.5.7. The harvest Prospective Action will either reduce survival (A-run steelhead and "allowable" harvest on B-run steelhead) or increase survival ("expected" harvest on B-run steelhead), as described in Section 8.5.5.5.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in Section 8.5.5.4, the Hatchery Effects Appendix of the SCA, and in this section. The Prospective Actions will ensure continuation of the beneficial effects of safety-net hatcheries and will reduce adverse impacts of other hatchery programs.

Effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit are discussed in Chapter 10 of the FCRPS Biological Opinion. The expected use of transportation under the permit is included in the effects of the FCRPS Prospective Action, which is described in Section 8.5.5.1.

8.5.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5 of this document) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3).. As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (See Section SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions are expected to increase the in-river survival (from Lower Granite to the

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Bonneville tailrace) of SR steelhead from 33.1% (Current) to 38.5% (Prospective), a relative change of 16.4% (SCA Hydro Modeling Appendix). The average proportion of juveniles destined for transportation is expected to drop from 81.7% to 77.1%. However, the proportion of juveniles transported within specific periods of time (in about 80% of the years when expected flows at Lower Granite Dam are expected to exceed 65 kcfs) will change substantially due to altered timing of spill and transportation operations (see RPA Table, Table 3) compared to past operations which did not consider within season variations in the SARs of transported and inriver migrating steelhead. The initial spill and transport operations in the >65 kcfs years will result in (1) no fish – other than what may be needed for research purposes - being collected and transported prior to April 21, (2) high levels (>95% of juveniles) being transported between May 7 and May 20), and (3) intermediate levels of juveniles being transported between April 21 and May 7 and after May 21. Unlike SR spring/summer Chinook salmon (see discussion in Section 8.3.5.1), the smolt-to-adult returns (BON to LGR) of transported SR steelhead are usually equal to, or higher than that of in-river migrating juveniles that survived to below Bonneville Dam throughout the smolt migration period.² The Prospective Actions are expected to result in a slight positive (+0.01%) increase in overall LGR to LGR SAR estimates for steelhead even though transport rates are decreasing by about 5.7% (relative to current operations). During the lowest flow years (about 20% of years when spring flows are predicted to be <65 kcfs at Lower Granite Dam), about 90% (71% to 98%) of juvenile steelhead are likely to be transported to below Bonneville Dam.³

Implementation of the Prospective Actions addressing hydro operations is expected to slightly reduce the average total system survival (the total percentage of fish arriving at Lower Granite Dam expected to survive to below Bonneville Dam via in-river migration and transportation) from 92.3% to 90.9% (a reduction of about 1.5%). The COMPASS model further estimates that Lower Granite Dam to Lower Granite Dam Smolt to Adult Returns (LGR-to-LGR SARs) will be reduced from about 1.82% to 1.75% (a relative decrease of 3.8%) as a result of the hydro Prospective Actions that govern spill and transport operations and their effect on migration timing to below Bonneville Dam (see discussion above and in Section 8.1).⁴

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult SR steelhead migrating from Bonneville Dam

² These differences do not include the substantial losses of fish migrating inriver to reach the Bonneville Dam tailrace. Including these losses would lower the expected SARs of inriver migrating fish compared to those transported. This is, and will continue to be,

³ Only three of the 13 years (out of 70) when flows were less than 65 kcfs at Lower Granite Dam had estimated transport rates less than 90%. Closer inspection of these years indicated that the “forecasts” (used to determine the operation to be implemented for a given year in the model) were for flows > 65 kcfs (which would not trigger the “maximum” transport operation). This is a realistic situation that is faced by managers (Regional Forum, Technical Management Team) that must make operational choices based on the forecast information is available at the time.

⁴ NOTE: The COMPASS model estimates SARs for in-river and transported migrants separately before combining them (with the estimated percentage of in-river and transported juveniles surviving to below Bonneville Dam) to provide an overall LGR to LGR SAR. Thus, the COMPASS model SAR estimates include (through the transport SAR estimate) the increased stray rates that are often observed for adult fish transported as juveniles (compared to stray rates of those that migrated in-river as juveniles) – a negative effect of transportation.

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upstream to Lower Granite Dam. The current PIT tag based survival estimate, taking account of harvest and “natural” stray rates within this reach, is 90.1% (about 98.5% per project). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to Lower Granite Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Hydro Actions are also likely to positively affect the survival of SR steelhead in ways that are not included in the quantitative analysis. NOAA Fisheries considers these expected benefits qualitatively in the remainder of this Section.

The Prospective Actions requiring implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects. This is likely to result in survival improvements in the forebays of these projects, where predation rates are currently often the highest. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating steelhead in tailraces where juvenile mortality rates are relatively high.

Continuing efforts under the NPMP, the program to remove fish predators, and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from Lower Granite Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem’s effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 38.5%. A portion of the 61.5% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of juvenile Snake River steelhead in a hypothetical unimpounded Columbia River would be 82%. Therefore, approximately 29% ($=18/61.5$) of the mortality experienced by in-river migrating juvenile steelhead is probably due to natural factors.

The direct survival rate of adults migrating through the FCRPS is already quite high. The prospective actions include additional passage improvements (to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in Corps et al. 2007a). Adult steelhead survival from Bonneville to Lower Granite Dam will be approximately 90.1% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will benefit the juvenile migrants by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address

conditions that have altered channel margin habitat, identified as a limiting factor and threat in the lower Columbia River below Bonneville Dam (Section 8.3.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Lochsa and South Fork Clearwater populations by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2007 a, b).

8.5.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival for all populations, except the Lower Middle Fork Tributaries population, are listed in CA Chapter 7, Table 7-8, p. 7-16. Although CA Table 7-8 indicates that the Prospective Actions will improve habitat quality for the Lower Middle Fork Tributaries population by 7%, a more realistic estimate is a 2% improvement (Table 8.5.5-1). This is because the Prospective Actions target actions only in the Big Creek watershed, which affect only a subpopulation of the entire Lower Middle Fork Tributary population. The Big Creek Watershed encompasses approximately 29% of the intrinsic potential for the Lower Middle Fork Tributaries Population. Therefore, the actions in Big Creek will result in a lower survival increase when spread over the entire population, or approximately 2% ($7\% \times 0.291 = 2\%$). In summary, for targeted populations in this DPS, the effect is a <1 - 16% expected increase in egg-smolt survival, depending on population. This is a result of implementing tributary habitat projects that improve habitat function quality by addressing limiting factors and threats.⁵ For example, roads in the Sesech and South Fork Salmon watersheds contribute fine sediment to stream gravels and inadequate culverts at stream crossings create passage barriers. As part of their implementation of the RPA (Action 34), the Action Agencies will address this limiting factor by providing funds for decommissioning and/or improving roads and for removing and/or replacing culverts on Forest Service lands to the Nez Perce Tribe.

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access. Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts

⁵ The Action Agencies identify the projects that will improve these PCEs and that they will fund by 2009 in Tables 3b; 4a; and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.5.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Snake River steelhead (stream-type life history) associated with the specific actions to be implemented from 2007-2010 is 1.4%. The survival benefit for Snake River steelhead (stream-type life history), associated with actions to be implemented from 2010 through 2018, is 4.3%. The total survival benefit for Snake River steelhead, as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats, is approximately 5.7% (Corps et al. 2007a Chapt.7.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will address factors that have limited the functioning of PCEs used by juvenile steelhead migrants from the Snake River. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 7.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs needed by juvenile steelhead from the Snake River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction (Section 8.5.5.2) are expected to be minor, occur only at the project scale, and persist for a short time.

8.5.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Hatchery programs preserve genetic resources in the Tucannon, North Fork Clearwater, Pahsimeroi, and East Fork Salmon. On the other hand, hatchery programs in the Little Salmon River, mainstem Salmon River, Lemhi River, Upper Salmon River, Wallowa River, Lower Grande Ronde River, and Hells Canyon pose risks to the diversity and productivity of many populations in the DPS (SCA Hatchery Effects Appendix).

Prospective Actions include continued funding of hatcheries and the adoption of programmatic criteria, or Best Management Practices (BMPs), for operating salmon and steelhead hatchery programs. More than thirty hatchery programs in the Snake River Basin require ESA consultation and NOAA Fisheries has scheduled these consultations to follow scientific reviews by the congressionally mandated Hatchery Scientific Review Group and the United States Fish and Wildlife Service Hatchery Review Team. Hatchery reforms will be implemented in new ESA consultations informed by new science, new Hatchery and Genetic Management Plans for each program, and NOAA Fisheries guidance (see Artificial Propagation for Pacific Salmon Appendix) has established a schedule for completing new ESA consultations on more than thirty hatchery programs in the Snake River Basin and will consult on the operation of existing or new programs when Hatchery and Genetic

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Management Plans (HGMPs) for each program are updated. The Action Agencies intend to adopt these programmatic criteria. Site-specific application of BMPs will be defined in HGMPs, and consultations with NOAA Fisheries will be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, Corps et al. 2007b, Page 2-44). Consultation with the Action Agencies will be initiated by February of 2010 and completed by August of 2010.

Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.5.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stock groups of summer steelhead used for harvest management including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. SR steelhead populations are designated as both A-run and B-run.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are subject to a 2% harvest rate limit on wild steelhead from each steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS. The total annual harvest rate limit for A-run steelhead, for example, is 4%. This is consistent with the ESA-related management constraints that have been in place in recent years. The expected harvest impacts on non-Treaty fisheries are less than those proposed (TAC 2008). The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.5.5.5-1). Harvest rates for non-Treaty fisheries are not expected to change over the course of this Agreement (TAC 2008).

The harvest rate on A-run steelhead in tribal spring season fisheries has averaged 0.2% since 1985 (Table 8.5.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.5.2.1.1-1). The harvest rate in fall season fisheries averaged 9.6% since 1985 and 4.2% since 1998 (Table 8.5.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are similar to the 1998-2006 average of 4.2%.

With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2%, since 1985 (Table 8.5.5.5-1).

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No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Snake River steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA.). Summer Chinook were chronically depressed for decades until returns began to increase in 2001. Higher runs provided more fishing opportunity as of 2002. However, there is no evidence of an associated increase in the catch of listed steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001 and 10.9% from 2002 to 2006 (TAC 2008). During those same years, the harvest rate of steelhead averaged 2.3% and 2.4% (Table 8.5.5.5-1). As with the spring fisheries, no further changes in future fisheries are expected, as a result of the Prospective Action, that would lead to changes in the expected catch of steelhead. However, there is recent information regarding adult conversion rates from analysis of PIT-tag data, indicating that more UCR steelhead than SR steelhead are lost in upstream passage. These greater losses may be due to differential harvest rates that are not currently detectable. The losses may also be due to timing differences, passage conditions, or another combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

Prospective treaty-Indian fall season fisheries will be managed using the abundance based harvest rate schedule for B-run steelhead, as contained in the 2008 Agreement (Table 8.5.5.5-2). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance based harvest rate schedule, harvest may vary up or down from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts to B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide greater opportunity for the tribes to satisfy their treaty right, to harvest 50% of the harvestable surplus of fall Chinook, in years when conditions are generally favorable. Even with these provisions, it is unlikely that the treaty right for Chinook or steelhead can be fully satisfied. The harvest rate in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate would remain fixed at 2%.

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Table 8.5.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Treaty Indian					Non-Indian			
Year	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				

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Treaty Indian					Non-			
Year	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1998-06 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

Table 8.5.5.5-2. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	River Mouth URB Run Size	Treaty Total B Harvest Rate	Non-Treaty wild B Harvest Rate	Total Harvest Rate
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries and are thus the indicator stock used for management purposes. Generally, the status of B-run steelhead is worse than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead generally are also higher because their timing coincides with the return of fall Chinook, the primary target of this fishery. A-run steelhead typically return a few weeks earlier and thus are less susceptible to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.2% and ranged from 5.4 to 12.4% (Table 8.5.5.5-1).

The abundance based harvest rate schedule allows the tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size, a determination can be made as to how often fisheries would be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years, and 20% 10 out of 22 years. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.5.5.5-3).

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Table 8.5.5.5-3. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries.

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.10%

Although the prospective harvest rate schedule will allow for harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty-Indian fisheries have generally been lower than allowed. Since 1998, fall season fisheries have been subject to a combined 17% harvest rate limit for B-run steelhead. From 1998 to 2006 the observed harvest rate averaged 12.7% (TAC 2008).

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For fall season fisheries it is also necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.5.5.5-3). This represents a 14% increase over the current harvest rate limit of 15% ($17.1/15.0 = 1.14$). The harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.5.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998, when the current ESA limits were applied, fall season harvest rate averaged 4.2%, while the total harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% ($0.042 * 1.140 = 0.48$) and 7.2%.

The net result for A-run populations of SR steelhead will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on US v Oregon memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for A-run populations.

The net result for B-run populations of SR steelhead ranges from a 3% reduction in survival, based on the allowable harvest rate, to a 2% increase in survival, based on the expected harvest rate. Therefore, a 0.97-1.02 current-to-future survival adjustment is applied to the prospective harvest action for B-run populations.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. This was identified as a limiting factor for the Lochsa and South Fork Clearwater populations by the remand collaboration Habitat Workgroup (Habitat Technical Subgroup 2007a, b).

8.5.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River steelhead from reduction in Caspian tern nesting habitat on East Sand Island and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4% (Corps et al. 2007a Attachment F-2, Table 4).

Compensatory mortality may occur but based on the discussion in Section 8.3.5.6 it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA, Corps et al. 2007a Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Implementation and further improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery implementation and further improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.5.5.7 Effects of Research and Monitoring Prospective Actions

See Section 8.1.4 of this document.

8.5.5.8 Effects of Kelt Reconditioning

Effects on Species Status

Prospective Actions implementing passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, are likely to also benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times, which lead to a reduction in total travel time, may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interactions between improved surface passage and improved kelt survival and return rates are not fully known. However, some improvement is likely.

The Prospective Actions implementing reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks where they are fed and medicated to enhance survival. Current programs either hold kelts for 3-5 weeks and release them below Bonneville or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning

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efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Transportation of kelts involves capturing kelts, transporting them to a point downstream of Bonneville dam, and releasing them. Kelt transportation studies in the Snake River found that there was not only an improvement in FCRPS survival from 4-33% to approximately 98% in transported kelts, but transported kelts returned to Lower Granite dam at a rate of 1.7% versus in-river migrating kelts which returned at a rate of 0.5% (Boggs and Peery, 2004).

Both transportation and reconditioning of kelts require capture of downstream migrating kelts. Given kelt preference for surface passage and the potential for future implementation of surface passage routes, the number of kelts that can be collected is limited. Upper and Mid-Columbia DPSs present significant challenges to successfully collecting kelts. Existing bypass systems and transportation facilities on the Snake River dams make successful collection of Snake River steelhead more likely. An analysis by Dygert (2007) estimated that 7% (during spill) to 22% (no spill) of the upstream steelhead run could be captured at LGR as downstream migrating kelts. The Prospective Actions would employ collection at both LGR and LGS. Our analysis of the Prospective Actions (SCA Hydro Modeling Appendix) suggests that employing a combination of transportation, reconditioning, and in-stream passage improvements could increase kelt returns enough to increase the number of Snake River B-run steelhead spawners by about 6% (SCA steelhead Kelt Appendix). If logistical difficulties associated with capture of upper Columbia River steelhead kelts can be overcome, similar benefits could be expected for that DPS as well.

Effects on Critical Habitat

NOAA Fisheries will analyze any effects of the kelt reconditioning action on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.5.5.9 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.5.5.1 through 8.5.5.9 and are summarized in Table 8.5.5-1. Estuary habitat improvement projects, kelt reconditioning, and further reductions in bird and fish predation are

expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are expected to increase survival for selected populations. The net effect, which varies by population, is 10-39% increased survival, compared to the “current” condition, and 11-40% increased survival, compared to the “base” condition.

8.5.5.10 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.5.6-1 and 8.5.6-2 and in Figures 8.5.6-1 and 8.5.6-2. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Also, because quantitative short-term extinction risk gaps cannot be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.5.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized by Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared with the importance of each population to MPG and DPS viability. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Lower Snake River MPG

This MPG consists of two extant populations (Tucannon and Asotin), one of which must be viable and the other highly viable to achieve the ICTRT’s suggested MPG viability scenario. Both are A-run populations. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run population estimates, coupled with Prospective Actions that are specific to each population. The estimated productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 for both populations (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions survival is expected to be sufficient for these populations to grow and for the abundance of spawners to trend upward. There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) and the application of average A-run estimates to these specific populations. This suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for estuarine survival, as well as in both tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These actions address limiting factors and threats. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity greater than 1.0 for these populations are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity sufficiently increase to levels exceeding minimum thresholds.
- The productivity estimates described above are based on mean results of analyses that assume future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both “Warm PDO” (poor) and “historical” ocean scenarios both populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2).
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.
- Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival

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changes necessary to reduce short-term extinction risk to 5% cannot be estimated for this species. Base-to-current survival improvements range from 7 to 9%, depending on the population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 14 to 16% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). This suggests that other qualitative information should also be considered:

- There is no safety-net hatchery program for these populations. There is a hatchery supplementation program for the Tucannon that preserves genetic resources and reduces extinction risk in the short-term.
- The recent 10-year geometric mean abundance is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is well above the 50 fish QET (Table 8.5.2-1). No years in the average A-Run data set are below 50 fish (Cooney 2008b).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Clearwater MPG

This MPG consists of five extant populations. The ICTRT recommends that four of these populations be viable or highly viable for this MPG. Key populations within this MPG include the Lower Clearwater (the only extant “large” population), Lolo Creek (the only population with both the A-run and B-run life histories), and the Selway, Lochsa, and South Fork Clearwater populations (all of which are “intermediate” sized populations). The Lower Clearwater is an A-run population, Lolo Creek has both A-run and B-run life histories, and the other extant populations are B-run. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Estimated productivity (based on R/S) is expected to be greater than 1.0 for 3-4 populations and less than 1.0 for 1-2 populations, depending upon assumption for prospective harvest, with implementation of the Prospective Actions (Table 8.5.6-1). The Selway River population is expected to be less than 1.0 under both harvest assumptions while the Lolo Creek results depend upon prospective harvest

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assumption (0.99 with allowable harvest and 1.04 with expected harvest). This means that with implementation of the Prospective Actions, survival for 3-4 of the five populations is expected to be sufficient for them to grow. Lambda and the BRT abundance trend are expected to be greater than 1.0 for all five populations. This means that all populations in this MPG are expected to increase in abundance.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These actions address limiting factors and threats. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not solely determined by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- The productivity estimates described above are based on mean results of analyses that assume future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” (poor) climate scenario, the results are nearly identical to results under recent climate conditions.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased

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hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

- Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. Base period B-run extinction risk is estimated to be 5% at QET=50 and less than 5% at lower QET levels.
- These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 1-3%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10-39% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). This suggests that other qualitative information should also be considered:

- There is no safety-net hatchery program for these populations.
- The recent 10-year geometric mean abundance for these populations is unknown. However, the ICTRT estimated average A-run abundance (applicable to the Lower Clearwater population) at 456 fish and average B-run abundance at 272 fish (Table 8.5.2-1), both of which are well above the 50 fish QET. No years in either the average A-Run or average B-run data sets are below 50 fish (Cooney 2008b).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Grande Ronde MPG

This MPG consists of four extant populations. The ICTRT recommends that two of these populations be viable or highly viable for MPG viability. Key populations within this MPG include the Grande Ronde Upper Mainstem (essential, since it is the only “large” population in this MPG), Joseph Creek (least influenced by hatcheries and contributes to spatial structure in the lower portion of the MPG), and the Lower Grande Ronde Mainstem (also contributes to spatial structure in the lower portion of the MPG). The ICTRT suggests a choice among Joseph Creek and the Lower Mainstem. All four populations are A-run. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Population-specific productivity estimates are available for the Upper Grande Ronde, Wallowa, and Joseph Creek populations. Population-specific estimates are not available for the Lower Grande Ronde population, so productivity and extinction risk are inferred from average A-run population estimates, coupled with Prospective Actions that are specific to this population. The estimated productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for three of the four populations (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions survival is expected to be sufficient for these populations to grow and for the abundance of spawners to trend upward. For the Upper Mainstem populations, all metrics except lambda, calculated with the assumption that hatchery-origin and natural-origin spawners are equally effective (HF=1), are greater than 1.0. The lambda HF=1 estimate for the Upper Mainstem is 0.99.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.6.6-1). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not solely driven by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). As long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds, the MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors.
- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). Under the ICTRT “Warm PDO” (poor) climate scenario, the results are nearly identical to results under recent climate conditions.

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- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period short-term extinction risk indicate 21% risk at QET=50 for average A-run populations (indicative of the Lower Mainstem and Wallowa populations) and 0% extinction risk for the Joseph Creek and Upper Mainstem populations, which were estimated directly (Table 8.5.2-3).

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs (Table 8.5.2-3). These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 1-2%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 11-14% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk for the populations in this MPG.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to 50% for these populations; Table 8.5.2-3). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for these populations.
- The recent 10-year geometric mean abundance is 1226 spawners for the Upper Mainstem and 2132 spawners for Joseph Creek, both of which are far above the 50 fish QET (Table 8.5.2-1).

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Abundance of the Lower Mainstem and Wallowa populations is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is above the 50 fish QET. No years in the average A-Run data set are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Imnaha River MPG

This MPG consists of one population (Imnaha River), which must be highly viable to achieve the ICTRT suggested MPG viability scenario. The Imnaha population exhibits the A-run life history pattern. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Population-specific productivity estimates are available for this population. Estimated productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the Imnaha population (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions, survival is expected to be sufficient for this population to grow and for the abundance of spawners to trend upward.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.5.6-1). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in the Imnaha River as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under “historical” and “Warm PDO” (poor) ocean

scenarios this population is expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Population-specific extinction risk is not available for the Imnaha population, so it is inferred from average A-run population estimates, coupled with Prospective Actions that are specific to this population. Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs (Table 8.5.2-3). These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% cannot be estimated for this species. Base-to-current survival improvements are estimated to be 1% for this population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10% current-to-prospective survival change for this population). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to 50% for average A-run populations; Table 8.5.2-3; Figure 8.5.6-1). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for this population, but a supplementation hatchery program does preserve genetic resources.

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- The recent 10-year geometric mean abundance for the Imnaha population is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is above the 50 fish QET (Table 8.5.2-1). No years in the average A-Run data set are below 50 fish (Cooney 2008b).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Salmon River MPG

This MPG consists of 12 extant populations. The ICTRT recommends that six of these populations be viable or highly viable for MPG viability. Eight of the populations are A-run and four of the populations are B-run. Key populations within this MPG include the South Fork Salmon (only “intermediate”-sized B-run population), the Upper Middle Fork Salmon (one of two “large” B-run populations; no history of hatchery influence), and Chamberlain Creek (“basic” sized A-run population with no history of hatchery influence). The ICTRT also suggests that two of the remaining six “intermediate”-sized populations be viable or highly viable (Lower Middle Fork, Little Salmon/Rapid River, Lemhi, Pahsimeroi, East Fork Salmon, and Upper Mainstem). Additionally, the ICTRT recommends that one additional population of any size be viable or highly viable. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Estimated productivity (based on R/S) is expected to be greater than 1.0 for 8-9 populations, depending on prospective harvest assumptions (Table 8.5.6-1; Figure 8.5.6-1). This means that survival for 8-9 populations will be sufficient for the populations to grow. The Upper Middle Fork, Lower Middle Fork, South Fork, and (under one harvest assumption) the Secesh populations are expected to have R/S <1.0. All four of these populations are B-run and it would be necessary for two of them to be viable to achieve the TRT viability scenario. All 12 populations are expected to have lambda and BRT trend greater than 1.0, meaning that abundance of spawners is expected to increase.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.5.6-1). This suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle

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should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT, for all but one population (the Pahsimeroi; Table 8.5.2-2). For the remaining populations, the MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- The Pahsimeroi population currently has a “high” risk, as defined by the ICTRT, for spatial structure. This risk is due to the population occupying only 30% of its historical range and because of the geographic distance between its single major spawning area and the nearest adjacent population.
- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” (poor) climate assumption, results are nearly identical to those based on recent climate conditions.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Population-specific extinction risk is not available for the populations in this MPG, so it is inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Quantitative estimates of *base period* extinction risk indicate 21% risk

at QET=50 for average A-run populations and 5% for average B-run populations (Table 8.5.2.3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 0-7%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10-27% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for any of these populations, except the East Fork Salmon A-run population. This program increases the number of natural spawners and reduces extinction risk in the short-term.
- The recent 10-year geometric mean abundance for these populations is unknown. However, the ICTRT estimated average A-run abundance at 456 fish and average B-run abundance at 272 fish (Table 8.5.2-1), both of which are above the 50 fish QET. No years in either the average A-Run or average B-run data set are below 50 fish (Cooney 2008b).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.5.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.5.7.1 Potential For Recovery

The future status of all populations and MPGs of SR steelhead will be improved compared to their current status through the implementation of Prospective Actions with beneficial effects, as described in Sections 8.5.5, 8.5.6, and 8.5.7.2. These actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning of B-run steelhead, and tributary habitat

improvements for most populations. These beneficial actions also completely offset the slightly decreased A-run population survival associated with the harvest Prospective Action. For B-run populations, the harvest Prospective Action may represent decreased survival, which is offset by the beneficial actions if the “allowable” harvest rate is implemented. Conversely, it may represent increased B-run steelhead survival if the “expected” harvest rate is implemented (Section 8.5.5.5). Hydro actions are expected to remain at current survival levels. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This conclusion takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.5.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.5.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatchery programs, and degradation of tributary and estuary habitat. The high spatial structure risk for the Panther Creek population is largely a result of past mining operations, which are being addressed through other processes including the EPA Blackbird Mine Superfund Site cleanup. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects and also address limiting factors and threats. The ICTRT has indicated that the longer some hatchery programs continue, the more likely their effects will limit recovery potential. As described in Section 8.5.5.4, several ongoing hatchery programs that affect this DPS pose risks to diversity and natural productivity. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized.

The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat, which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Some of the problems limiting recovery of SR steelhead, such as genetic diversity concerns, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

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Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the SR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion. However, quantitative information is extremely limited for the Snake River steelhead DPS because of the difficulty of counting redds or fish during the spring and early summer spawning period. The ICTRT was able to estimate trends for only four populations in the Grande Ronde and Imnaha MPGs and abundance for only two populations. All other population estimates are inferred from average A-run and B-run estimates of base productivity, which are derived from dam counts and assumptions about the distribution of spawners within the DPS. These average base period estimates were then coupled with population-specific improvements in the Prospective Actions to derive population-specific estimates of prospective effects.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, 11 of which are described in Section 8.5.5.4, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.5.6, with implementation of the Prospective Actions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 for three of the four of the populations in the Imnaha and Grande Ronde MPGs for which the ICTRT developed population-specific base period estimates (Table 8.5.6-1 and Figure 8.5.6-1). For the fourth population, Grande Ronde Upper Mainstem, estimates were either greater than 1.0 or were very close (0.99). A-run populations and 2-4 of the eight B-run populations (depending on prospective harvest assumptions) are expected to have R/S greater than 1.0, based on average A- and B-run base productivity. This equates to R/S greater than 1.0 for 18-20 of the 24 populations with estimates. The 4-6 populations with estimates less than 1.0 are all composed of B-run steelhead and are components of the Clearwater and Salmon River MPGs. R/S is expected to be greater than 1.0 for all of the important populations identified by the ICTRT in the other three MPGs in this DPS.

Populations for which R/S is expected to be greater than 1.0 generally have estimates that are considerably greater than 1.0 (mean approximately 1.20). By providing additional benefits to stronger populations, the Prospective Actions help offset problems with poorly performing populations, supporting the viability of the DPS as a whole.

Some important caveats that apply to all three quantitative estimates are as follows:

- As described above, population-specific productivity is available for only four populations in the MPG – the remaining population estimates are extrapolations of average A- and B-run estimates from the ICTRT.
- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over longer than a 10-year period), so quantitative estimates of prospective R/S and BRT trend may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). Under the ICTRT “Warm PDO” (poor) climate assumption, results are nearly identical to the results under the recent climate assumption.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.
- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S and the BRT trend are expected to be greater than 1.0 at the upper 95% confidence limits for all populations and R/S and the BRT trend are expected to be less than 1.0 for all populations at the lower 95% confidence limits (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors discussed above indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. All populations are expected to increase in abundance in the future, based on lambda and BRT trends. NOAA Fisheries cannot demonstrate quantitatively by $R/S > 1.0$, that all populations (including important populations in two MPGs) will have natural productivity sufficient to replace themselves and grow as a result of the actions considered in the aggregate analysis. However, the great majority of populations are likely to increase in abundance and enough populations are likely to be increasing to conclude that the DPS as a whole will be trending toward recovery.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.5.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through net survival improvements resulting from the Prospective Actions and a continuation of other current management actions, as described above and in Sections 8.5.3 and 8.5.5.

As described above and in Section 8.5.6, abundance is expected to be increasing for all populations and natural productivity (R/S) is expected to be sufficient for most populations to grow (Table 8.5.6-1). Recent abundance levels for average A-run and B-run populations are estimated to be 456 and 272 spawners, respectively, which is well above the QET levels under consideration (Table 8.5.2-1). These factors also indicate a decreasing risk of extinction.

Hatchery supplementation programs preserve genetic resources and reduce short-term extinction risk by increasing abundance of four A-run and two B-run populations in the Tucannon, North Fork Clearwater, Pahsimeroi, and East Fork Salmon rivers. These programs insure that the affected populations will not go extinct in the short-term, although as described above they would increase diversity risk to the DPS if continued over a long time period.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24-year) extinction risk also support this conclusion.

As described in Section 8.2.6, short-term extinction risk derived from performance during the base period is 0% at QET=50 for the two populations in this DPS for which population-specific estimates are available (Upper Grande Ronde and Joseph Creek; Table 8.5.2-3). For all other A-run populations,

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base period-derived short-term extinction risk is based on the A-run average: 21% at QET=50 and 5% at QET=1. As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. B-run base extinction risk was estimated to be 5% at QET=50. These estimates assume no continued supplementation.

It was not possible to determine the survival improvements needed to reduce extinction risk to 5% or less for any populations except those already below 5% during recent years. Base-to-current survival improvements range from 0-9%, depending on population. Some additional improvements will also accrue from Prospective Actions that are likely to be implemented immediately (an unknown proportion of the 10-39% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to 50% for average A-run populations (Table 8.5.2-3). This uncertainty indicates that it is important also to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that all populations or all MPGs will have a low risk, primarily because of data limitations and significant uncertainty in the estimates for base period performance. However, the combination of recent abundance estimates for average populations, expected survival improvements, expected positive trends for most populations, and supplementation programs that reduce short-term risk for some populations, indicate that enough populations are likely to have a low enough risk to conclude that the DPS, as a whole, will have a low risk of short-term extinction.

8.5.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in the following subbasins: Hells Canyon, Imnaha River, Lower

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Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Lower Snake River, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators), will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Snake River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

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Several of the analyses presented above are projections of DPS health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in DPS health demonstrated above have been accompanied by regional efforts to protect and restore this DPS, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this DPS.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this DPS will continue to improve.⁶

⁶ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.5.2-1. Status of SR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY). Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend			
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: 20-yr non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0) ³	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current ⁴	Lower 95% CI	Upper 95% CI	
Snake River Steelhead		Average "A-Run" Populations (only 14 years)	456	1995-2004	1000	1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22	
		Average "B-Run" Populations (only 13 years)	272	1995-2004	1000	0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10	
	Lower Snake	Tucannon (A, but below LGR)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22	
		Asotin (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22	
	Imnaha River	Imnaha R. (A)			1000	1.45	0.94	2.24	1.06	0.82	1.37	1.06	0.82	1.37	1.03	0.99	1.14	
	Grande Ronde		Upper Mainstem (A)	1226	1997-2006	1500	0.93	0.65	1.33	0.99	0.83	1.17	0.96	0.81	1.13	0.99	0.95	1.07
			Lower Mainstem (A)			1000	1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Joseph Cr. (A)	2132	1996-2005	500	1.26	0.84	1.89	1.05	0.82	1.35	1.05	0.82	1.35	1.01	0.97	1.11
			Wallowa R. (A)			1000	1.28	0.94	1.75	1.05	0.82	1.34	1.04	0.81	1.34	1.03	0.99	1.20
	Clearwater River		Lower Mainstem (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Lolo Creek (A & B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			Lochsa River (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			Selway River (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			South Fork (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			North Fork - (Extirpated)															
	Salmon River		Little Salmon/Rapid (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Chamberlain Cr. (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Secesh River (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			South Fork Salmon (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			Panther Creek (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Lower Middle Fork Tribs (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			Upper Middle Fork Tribs (B)				0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
			North Fork (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Lemhi River (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Pahsimeroi River (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			East Fork Salmon (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
			Upper Mainstem (A)				1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22

1 Most recent year for 10-year geometric mean abundance is 2003-2005, depending upon the population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from the ICTRT (2007c).

2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years (Upper Grande Ronde, Imnaha River, Wallowa River, and Joseph Creek) or 13-14 years (average A- and B-run), as described in Cooney (2008a).

3 Median population growth rate (lambda) during the most recent period of approximately 20 years from Cooney (2008b). Actual years in estimates vary by population.

4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008b).

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Table 8.5.2-2. Status of SR steelhead with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure ¹	ICTRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²	
Snake River Steelhead	Average "A-Run" Populations (only 14 years)					
	Average "B-Run" Populations (only 13 years)					
	Lower Snake	Tucannon (A, but below LGR)		Currently Low Risk	Currently Moderate Risk	
		Asotin (A)		Currently Low Risk	Currently Moderate Risk	
	Imnaha River	Imnaha R. (A)		Currently Very Low Risk	Currently Moderate Risk	1.00
	Grande Ronde	Upper Mainstem (A)		Currently Very Low Risk	Currently Moderate Risk	0.86
		Lower Mainstem (A)		N/A	N/A	
		Joseph Cr. (A)		Currently Very Low Risk	Currently Low Risk	1.00
		Wallowa R. (A)		Currently Very Low Risk	Currently Low Risk	1.00
	Clearwater River	Lower Mainstem (A)		Currently Very Low Risk	Currently Low Risk	
		Lolo Creek (A & B)		Currently Low Risk	Currently Moderate Risk	
		Lochsa River (B)		Currently Very Low Risk	Currently Low Risk	
		Selway River (B)		Currently Very Low Risk	Currently Low Risk	
		South Fork (B)		Currently Low Risk	Currently Moderate Risk	
		North Fork - (Extirpated)				
	Salmon River	Little Salmon/Rapid (A)		Currently Very Low Risk	Currently Low Risk	
		Chamberlain Cr. (A)		Currently Low Risk	Currently Low Risk	
		Secesh River (B)		Currently Very Low Risk	Currently Low Risk	
		South Fork Salmon (B)		Currently Low Risk	Currently Low Risk	
			Panther Creek (A)	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk	
			Lower Middle Fork Tribs (B)	Currently Low Risk	Currently Moderate Risk	
			Upper Middle Fork Tribs (B)	Currently Very Low Risk	Currently Low Risk	
			North Fork (A)	Currently Low Risk	Currently Moderate Risk	
			Lemhi River (A)	Currently Low Risk	Currently Moderate Risk	
			Pahsimeroi River (A)	Currently Moderate Risk	Currently Moderate Risk	
			East Fork Salmon (A)	Currently Very Low Risk	Currently Moderate Risk	
		Upper Mainstem (A)	Currently Very Low Risk	Currently Moderate Risk		

1 ICTRT conclusions for Snake River steelhead are from draft versions of ICTRT Current Status Summaries (ICTRT 2007d)

2 Average fractions of natural-origin natural spawners are from the ICTRT (2007c).

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Table 8.5.2-3. Status of SR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the “base period” of the approximately 20 most recent brood years. Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

ESU	MPG	Population	24-Year Extinction Risk											
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Steelhead	Average "A-Run" Populations (only 14 years)		0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Average "B-Run" Populations (only 13 years)		0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
	Lower Snake	Tucannon (A, but below LGR)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Asotin (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Imnaha River	Imnaha R. (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Grande Ronde	Upper Mainstem (A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		Lower Mainstem (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Joseph Cr. (A)	0.00	0.00	0.03	0.00	0.00	0.10	0.00	0.00	0.15	0.00	0.00	0.19
		Wallowa R. (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Clearwater River	Lower Mainstem (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lolo Creek (A & B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Lochsa River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Selway River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		South Fork (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		North Fork - (Extirpated)												
	Salmon River	Little Salmon/Rapid (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Chamberlain Cr. (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Secesh River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		South Fork Salmon (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Panther Creek (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lower Middle Fork Tribs (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Upper Middle Fork Tribs (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		North Fork (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lemhi River (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Pahsimeroi River (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		East Fork Salmon (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
Upper Mainstem (A)		0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49	

¹ Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

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Table 8.5.2-4. Changes in density-independent survival of SR steelhead (“gaps”) necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for SR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%. Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 20 yr lambda = 1.0 @ HF=1 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0 ³	Upper 95% CI	Lower 95% CI	Survival Gap for 24 Yr Ext. Risk <5% (OET=1) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=10) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=30) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=50) ⁴	
Snake River Steelhead	Average "A-Run" Populations (only 14 years)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41					
	Average "B-Run" Populations (only 13 years)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66					
	Lower Snake	Tucannon (A, but below LGR)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Asotin (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
	Innaha River	Innaha R. (A)		0.69	1.07	0.45	0.77	2.50	0.24	0.77	2.50	0.24	0.89	1.07	0.56				
	Grande Ronde	Upper Mainstem (A)		1.08	1.55	0.75	1.07	2.28	0.50	1.23	2.65	0.57	1.07	1.24	0.75				
		Lower Mainstem (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Joseph Cr. (A)		0.79	1.19	0.53	0.81	2.50	0.26	0.81	2.50	0.26	0.94	1.12	0.62				
		Wallowa R. (A)		0.78	1.07	0.57	0.82	2.46	0.27	0.83	2.54	0.27	0.89	1.04	0.44				
	Clearwater River	Lower Mainstem (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Lolo Creek (A & B)-assume B		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		Lochsa River (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		Selway River (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		South Fork (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		North Fork - (Extirpated)																	
	Salmon River	Little Salmon/Rapid (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Chamberlain Cr. (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Secesh River (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		South Fork Salmon (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		Panther Creek (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Lower Middle Fork Tribs (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		Upper Middle Fork Tribs (B)		1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
		North Fork (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Lemhi River (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Pahsimeroi River (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		East Fork Salmon (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Upper Mainstem (A)		0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.5.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.5.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.5.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap could not be calculated for this species.

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Table 8.5.3-1. Proportional changes in SR steelhead average base period survival expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

ESU	MPG	Population	Base-to-Current Adjustment (Divisor)							Total ⁸
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Marine Mammal Predation ⁵	Harvest ⁶	Hatcheries ⁷	
Snake River Steelhead	Average "A-Run" Populations (only 14 years)									
	Average "B-Run" Populations (only 13 years)									
	Lower Snake	Tucannon (A, but below LGR)	0.966	1.065	1.003	0.996	1.000	1.041	1.00	1.07
		Asotin (A)	0.966	1.085	1.003	0.996	1.000	1.041	1.00	1.09
	Imnaha River	Imnaha R. (A)	0.966	1.001	1.003	0.996	1.000	1.041	1.00	1.01
	Grande Ronde	Upper Mainstem (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
		Lower Mainstem (A)	0.966	1.001	1.003	0.996	1.000	1.041	1.00	1.01
		Joseph Cr. (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
		Wallowa R. (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
	Clearwater River	Lower Mainstem (A)	0.966	1.025	1.003	0.996	1.000	1.041	1.00	1.03
		Lolo Creek (A & B)	0.966	1.005	1.003	0.996	1.000	1.040	1.00	1.01
		Lochsa River (B)	0.966	1.005	1.003	0.996	1.000	1.040	1.00	1.01
		Selway River (B)	0.966	1.007	1.003	0.996	1.000	1.040	1.00	1.01
		South Fork (B)	0.966	1.015	1.003	0.996	1.000	1.040	1.00	1.02
		North Fork - (Extirpated)								
	Salmon River	Little Salmon/Rapid (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01
		Chamberlain Cr. (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Secesh River (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		South Fork Salmon (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		Panther Creek (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Lower Middle Fork Tribs (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		Upper Middle Fork Tribs (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		North Fork (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Lemhi River (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01
Pahsimeroi River (A)		0.966	1.065	1.003	0.996	1.000	1.041	1.00	1.07	
East Fork Salmon (A)		0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01	
Upper Mainstem (A)		0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01	

1 From SCA Hydro Modeling Appendix Based on differences in average base and current smolt-to-adult survival estimates.

2 From CA Chapter 7, Table 7-6.

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3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Current 2 S/Baseline 2 S” approach, as described in Attachment F-2.

5 From SCA Marine Mammal Appendix. No populations in this DPS are winter-run.

6 From SCA Quantitative Analysis of Harvest Actions Appendix). Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup, modified to reflect the current maximum harvest rate for B-run steelhead.

7 Hatchery changes are discussed qualitatively.

8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

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Table 8.5.5-1. Proportional changes in SR steelhead survival expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)										
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Kelt Reconditioning ⁶	Marine Mammal ⁷	Allowable Harvest ⁸	Expected Harvest ⁹	Hatcheries ⁹	
Snake River Steelhead	Average "A-Run" Populations (only 14 years)												
	Average "B-Run" Populations (only 13 years)												
	Lower Snake	Tucannon (A, but below LGR)	1.00	1.05	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Asotin (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
	Innaha River	Innaha R. (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
	Grande Ronde	Upper Mainstem (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Lower Mainstem (A)	1.00	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Joseph Cr. (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Wallowa R. (A)	1.00	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
	Clearwater River	Lower Mainstem (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Lolo Creek (A & B)	1.00	1.08	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		Lochsa River (B)	1.00	1.16	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		Selway River (B)	1.00	1.01	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		South Fork (B)	1.00	1.14	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		North Fork - (Extirpated)											
	Salmon River	Little Salmon/Rapid (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Chamberlain Cr. (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Secesh River (B)	1.00	1.06	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		South Fork Salmon (B)	1.00	1.01	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		Panther Creek (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
		Lower Middle Fork Tribs (B)	1.00	1.02	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		Upper Middle Fork Tribs (B)	1.00	1.00	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00	
		North Fork (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00	
Lemhi River (A)		1.00	1.03	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00		
Pahsimeroi River (A)		1.00	1.09	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00		
East Fork Salmon (A)		1.00	1.02	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00		
Upper Mainstem (A)		1.00	1.06	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00		

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Table 8.5.5-1. Continued.

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)				High	Low	
			Non-Hydro With Allowable Harvest ¹⁰	Non-Hydro With Expected Harvest ¹⁰	Total (Allowable Harvest) ¹¹	Total (Expected Harvest) ¹¹	Total Base-Current and Current-Future ¹²	Total Base-Current and Current-Future ¹²	
Snake River Steelhead	Average "A-Run" Populations (only 14 years)								
	Average "B-Run" Populations (only 13 years)								
	Lower Snake	Tucannon (A, but below LGR)		1.15	1.15	1.16	1.16	1.24	1.24
		Asotin (A)		1.14	1.14	1.14	1.14	1.25	1.25
	Imnaha River	Imnaha R. (A)		1.10	1.10	1.10	1.10	1.11	1.11
	Grande Ronde	Upper Mainstem (A)		1.14	1.14	1.14	1.14	1.17	1.17
		Lower Mainstem (A)		1.11	1.11	1.11	1.11	1.12	1.12
		Joseph Cr. (A)		1.14	1.14	1.14	1.14	1.17	1.17
		Wallowa R. (A)		1.11	1.11	1.11	1.11	1.13	1.13
	Clearwater River	Lower Mainstem (A)		1.10	1.10	1.10	1.10	1.13	1.13
		Lolo Creek (A & B)		1.23	1.29	1.23	1.29	1.24	1.30
		Lochsa River (B)		1.32	1.39	1.32	1.39	1.33	1.40
		Selway River (B)		1.15	1.21	1.15	1.21	1.16	1.22
		South Fork (B)		1.30	1.36	1.30	1.36	1.32	1.39
		North Fork - (Extirpated)							
	Salmon River	Little Salmon/Rapid (A)		1.10	1.10	1.10	1.10	1.11	1.11
		Chamberlain Cr. (A)		1.10	1.10	1.10	1.10	1.11	1.11
		Secesh River (B)		1.21	1.27	1.21	1.27	1.21	1.27
		South Fork Salmon (B)		1.14	1.20	1.15	1.20	1.15	1.21
		Panther Creek (A)		1.10	1.10	1.10	1.10	1.11	1.11
		Lower Middle Fork Tribs (B)		1.16	1.22	1.16	1.22	1.17	1.23
		Upper Middle Fork Tribs (B)		1.14	1.20	1.14	1.20	1.14	1.20
		North Fork (A)		1.10	1.10	1.10	1.10	1.11	1.11
		Lemhi River (A)		1.13	1.13	1.13	1.13	1.14	1.14
		Pahsimeroi River (A)		1.20	1.20	1.20	1.20	1.28	1.28
		East Fork Salmon (A)		1.12	1.12	1.12	1.12	1.13	1.13
		Upper Mainstem (A)		1.17	1.17	1.17	1.17	1.18	1.18

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates.

2 From CA Chapter 7, Table 7-6.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Prospective 2 S/Current 2 S" approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 From SCA Steelhead Kelt Appendix

7 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. No populations in this DPS are winter-run.

8 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

9No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.

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10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

11 Same as Footnote 8, except it is calculated from all Prospective Actions, including hydro actions.

12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.8.3-1.

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Table 8.5.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR steelhead.

Expected Harvest Assumption:										
ESU	MPG	Population	20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980 Current BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ⁵
		Average "A-Run" Populations (only 14 years)								
		Average "B-Run" Populations (only 13 years)								
							Need 1 HV and 1 V:			
Lower Snake		Tucannon (A, but below LGR)	1.34	1.10	1.10	1.25	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Asotin (A)	1.36	1.11	1.11	1.27	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
Innaha River		Innaha R. (A)	1.60	1.08	1.08	1.14	Must be HV	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
							Need 1 HV and 1 V:			
Grande Ronde		Upper Mainstem (A)	1.09	1.02	0.99	1.16	Must be HV or V	Three metrics >1, but lambda with HF=1 assumption is 0.99.	Currently Very Low Risk	Currently Moderate Risk
		Lower Mainstem (A)	1.22	1.08	1.08	1.13	1 of these 2 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Both populations in this group meet criteria.	N/A	N/A
		Joseph Cr. (A)	1.48	1.09	1.09	1.19		All three metrics >1. Both populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Wallowa R. (A)	1.45	1.07	1.07	1.16	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk
							Need 1 HV and 3 V:			
Clearwater River		Lower Mainstem (A)	1.23	1.08	1.08	1.15	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Lolo Creek (A & B)	1.04	1.06	1.06	1.25	Must be HV or V	All three metrics >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Moderate Risk
		Lochsa River (B)	1.12	1.08	1.08	1.34	2 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Saiway River (B)	0.98	1.05	1.05	1.17		R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		South Fork (B)	1.11	1.08	1.08	1.33		All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
	North Fork - (Extirpated)									
							Need 1 HV and 5 V:			
Snake River Steelhead		Upper Middle Fork Tribs (B)	0.96	1.04	1.04	1.15	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Chamberlain Cr. (A)	1.20	1.08	1.08	1.12	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Low Risk
		South Fork Salmon (B)	0.97	1.04	1.04	1.16	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Low Risk
		Panther Creek (A)	1.20	1.08	1.08	1.12	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. All three populations in this group meet criteria.	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk
		Secesh River (B)	1.02	1.06	1.06	1.22		All three metrics >1. Estimates assume average B-run base productivity. All three populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		North Fork (A)	1.20	1.08	1.08	1.12		All three metrics >1. Estimates assume average A-run base productivity. All three populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
		Lower Middle Fork Tribs (B)	0.98	1.05	1.05	1.17	2 of these 6 populations must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Little Salmon/Rapid (A)	1.21	1.08	1.08	1.13		All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Lemhi River (A)	1.24	1.09	1.09	1.16		All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
		Pahsimeroi River (A)	1.40	1.11	1.11	1.30		All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Moderate Risk	Currently Moderate Risk
		East Fork Salmon (A)	1.23	1.08	1.08	1.15		All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
		Upper Mainstem (A)	1.28	1.09	1.09	1.19		All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk

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Table 8.5.6.1-1. Continued.

Allowable Harvest Assumption:										
ESU	MPG	Population	20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ²
		Average "A-Run" Populations (only 14 years)								
		Average "B-Run" Populations (only 13 years)								
							Need 1 HV and 1 V:			
Lower Snake		Tucannon (A, but below LGR)	1.34	1.10	1.10	1.25	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Asotin (A)	1.36	1.11	1.11	1.27	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
Imnaha River		Imnaha R. (A)	1.60	1.08	1.08	1.14	Must be HV	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
							Need 1 HV and 1 V:			
Grande Ronde		Upper Mainstem (A)	1.09	1.02	0.99	1.16	Must be HV or V	Three metrics >1, but lambda with HF=1 assumption is 0.99	Currently Very Low Risk	Currently Moderate Risk
		Lower Mainstem (A)	1.22	1.08	1.08	1.13	1 of these 2 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Both populations in this group meet criteria.	N/A	N/A
		Joseph Cr. (A)	1.48	1.09	1.09	1.19		All three metrics >1. Both populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Wallowa R. (A)	1.45	1.07	1.07	1.16	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk
							Need 1 HV and 3 V:			
Cleanwater River		Lower Mainstem (A)	1.23	1.08	1.08	1.15	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Lolo Creek (A & B)	0.99	1.05	1.05	1.19	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Lochsa River (B)	1.07	1.07	1.07	1.28		All three metrics >1. Estimates assume average B-run base productivity. One of two populations in this group to meet criteria.	Currently Very Low Risk	Currently Low Risk
		Selway River (B)	0.93	1.03	1.03	1.11	2 of these 3 populations must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		South Fork (B)	1.06	1.06	1.06	1.27		All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
Snake River Steelhead		North Fork - (Extirpated)								
							Need 1 HV and 5 V:			
Salmon River		Upper Middle Fork Tribs (B)	0.91	1.03	1.03	1.10	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Chamberlain Cr. (A)	1.20	1.08	1.08	1.12	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Low Risk
		South Fork Salmon (B)	0.92	1.03	1.03	1.10	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Low Risk
		Panther Creek (A)	1.20	1.08	1.08	1.12	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Two of three populations in this group to meet criteria.	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk
		Sacash River (B)	0.97	1.04	1.04	1.16		R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		North Fork (A)	1.20	1.08	1.08	1.12		All three metrics >1. Estimates assume average A-run base productivity. Two of three populations in this group to meet criteria.	Currently Low Risk	Currently Moderate Risk
		Lower Middle Fork Tribs (B)	0.93	1.03	1.03	1.12		R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Little Salmon/Rapid (A)	1.21	1.08	1.08	1.13		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Lemhi River (A)	1.24	1.09	1.09	1.16	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
		Pahsimeroi River (A)	1.40	1.11	1.11	1.30		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Moderate Risk	Currently Moderate Risk
		East Fork Salmon (A)	1.23	1.08	1.08	1.15		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
		Upper Mainstem (A)	1.28	1.09	1.09	1.19		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk

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- 1 Calculated as the base period 20-year R/S productivity from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1.
- 2 Calculated as the base period 20-year mean population growth rate (λ) from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1, raised to the power of $(1/\text{mean generation time})$. Mean generation time was estimated to be 4.5 years.
- 3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1, raised to the power of $(1/\text{mean generation time})$. Mean generation time was estimated to be 4.5 years.
- 4 From ICTRT (2007c), Attachment 2
- 5 From Table 8.5.2-2.

Figure 8.5.6-1. Summary of prospective mean R/S estimates for SR steelhead under the “recent” climate assumption, including 95% confidence limits.

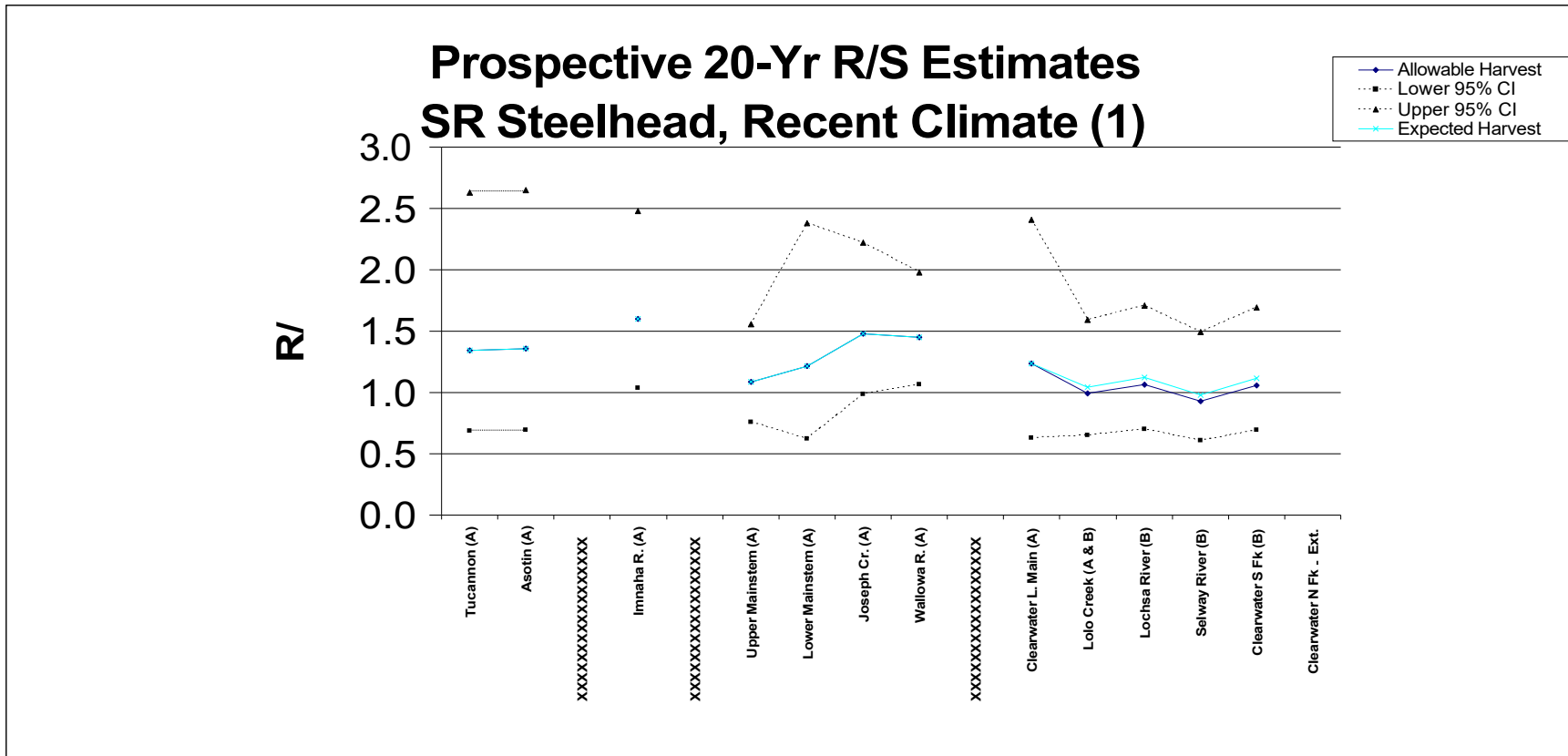


Figure 8.5.6-1. Continued.

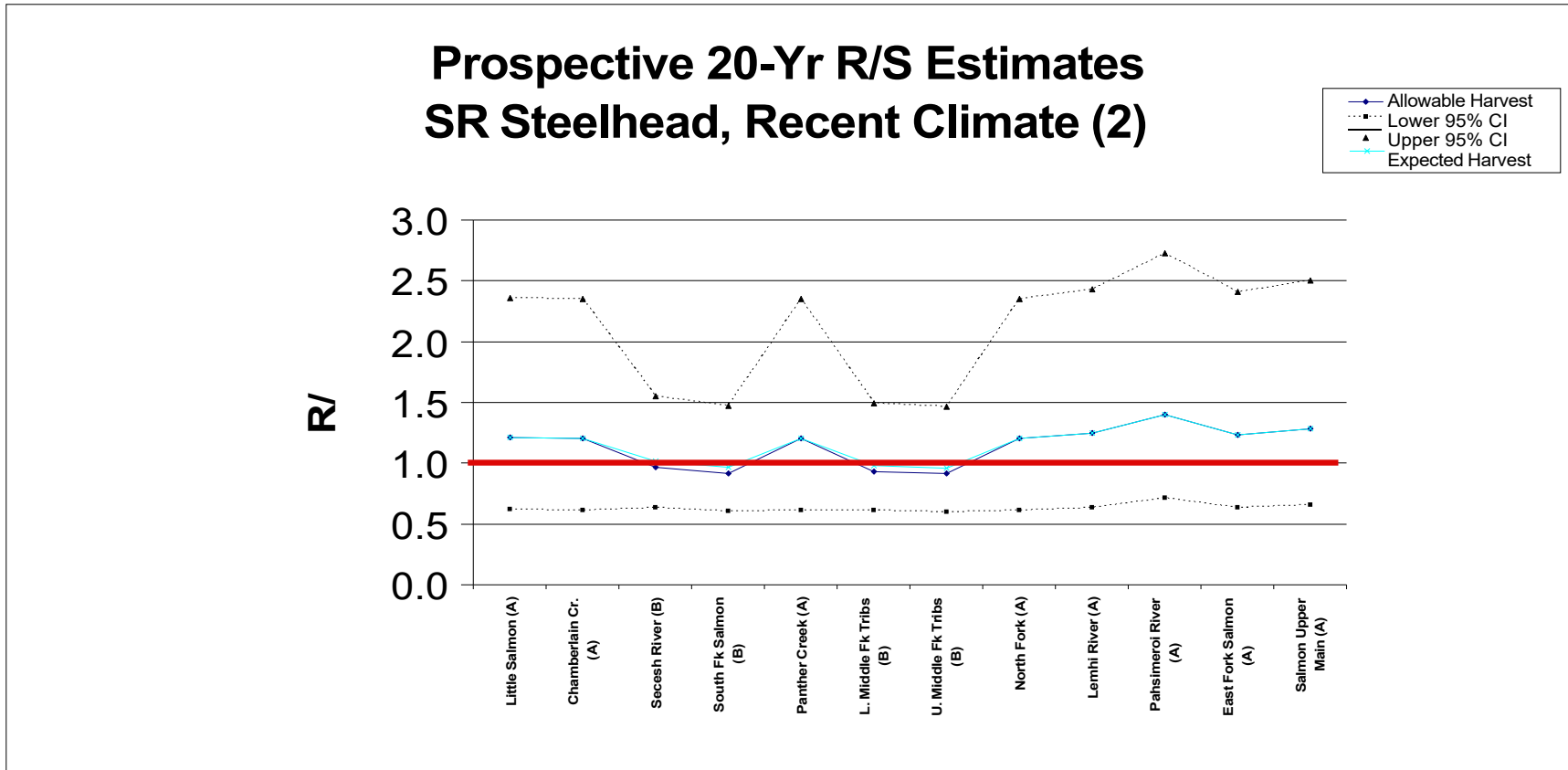


Figure 8.5.6-2. Summary of prospective mean R/S estimates for SR steelhead under three climate assumptions.

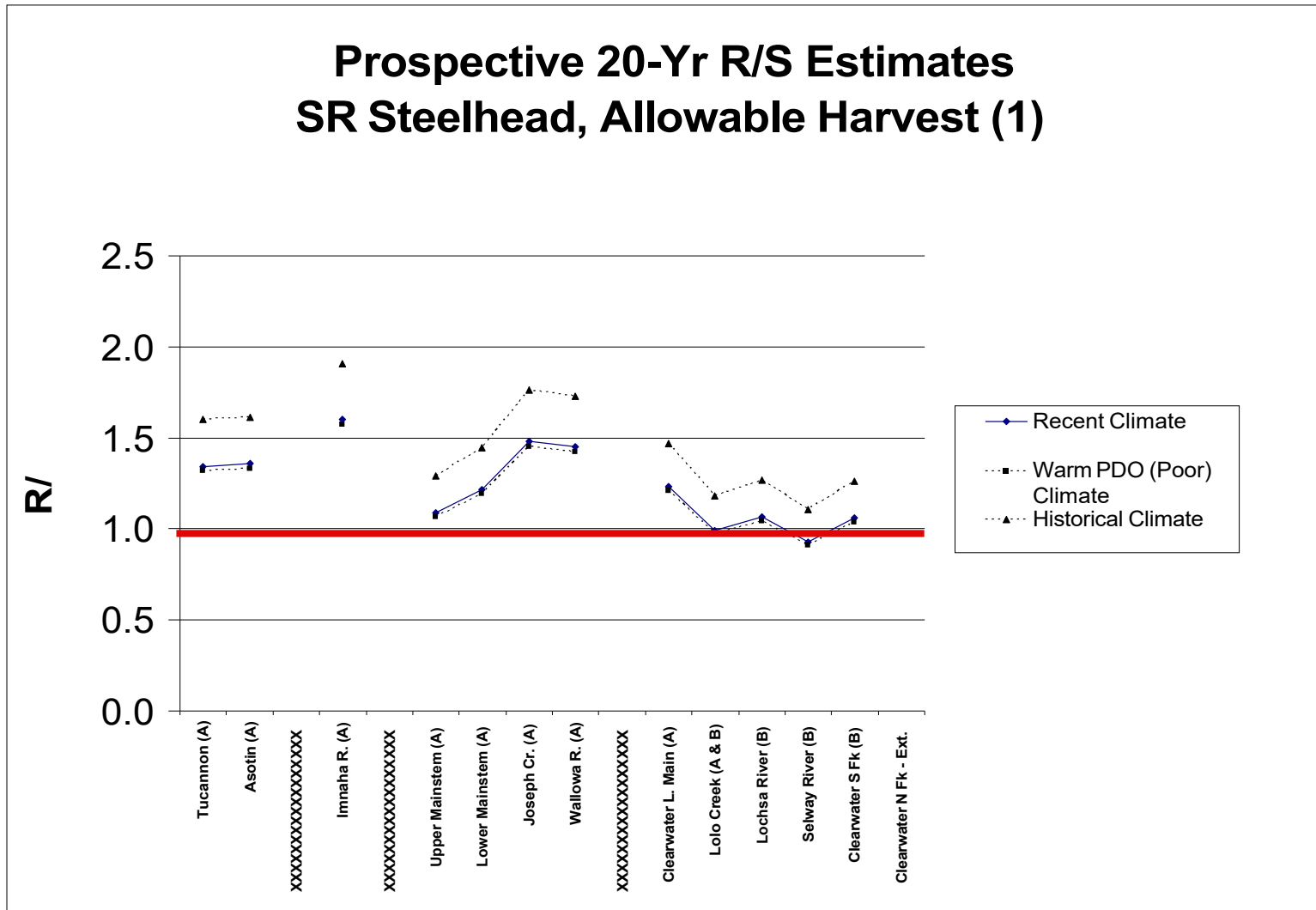
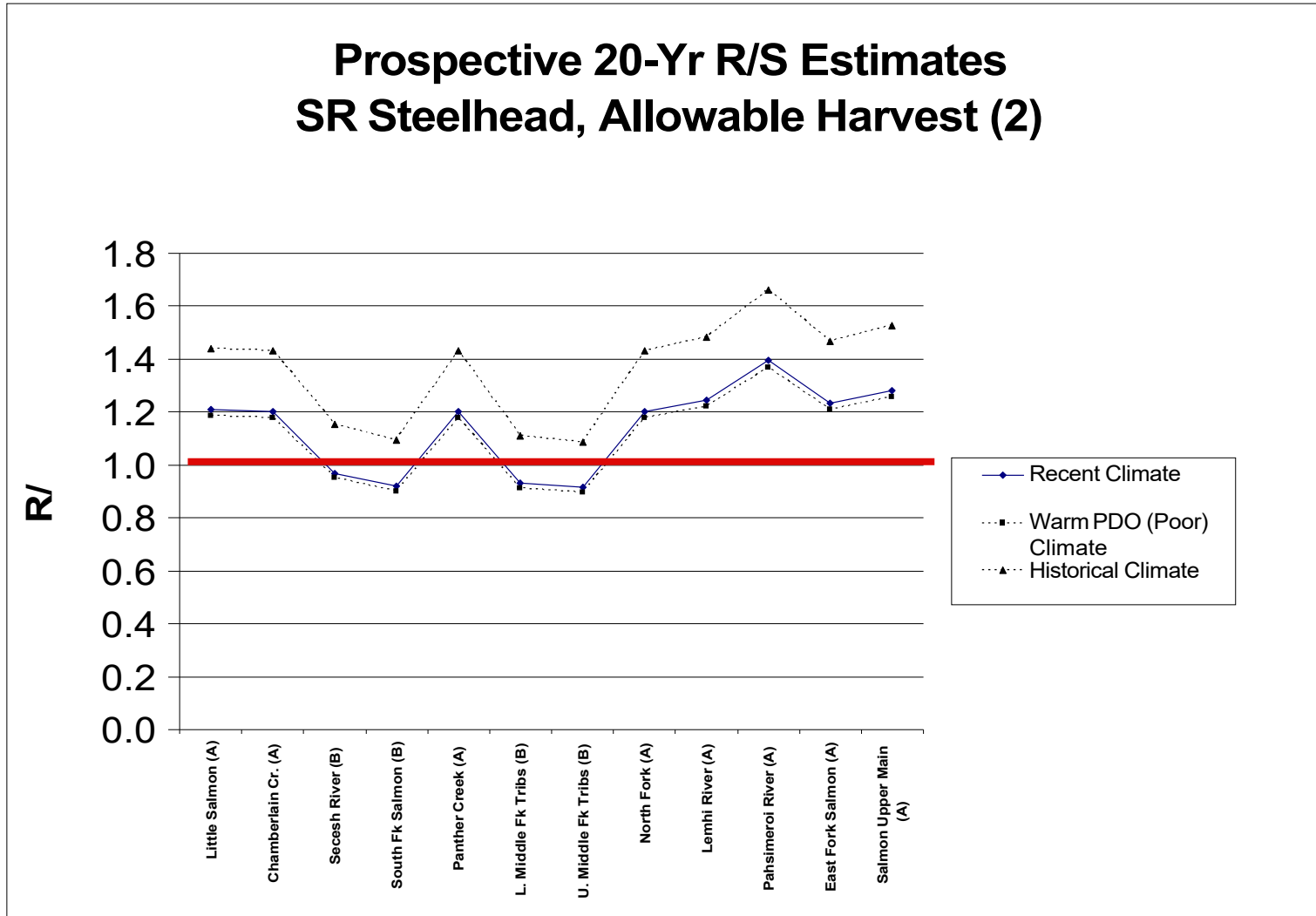
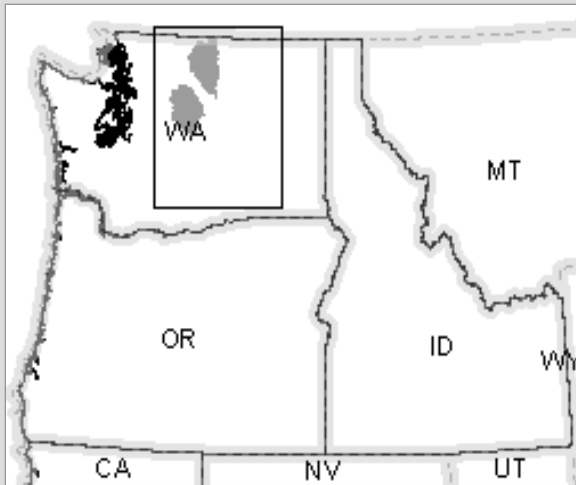


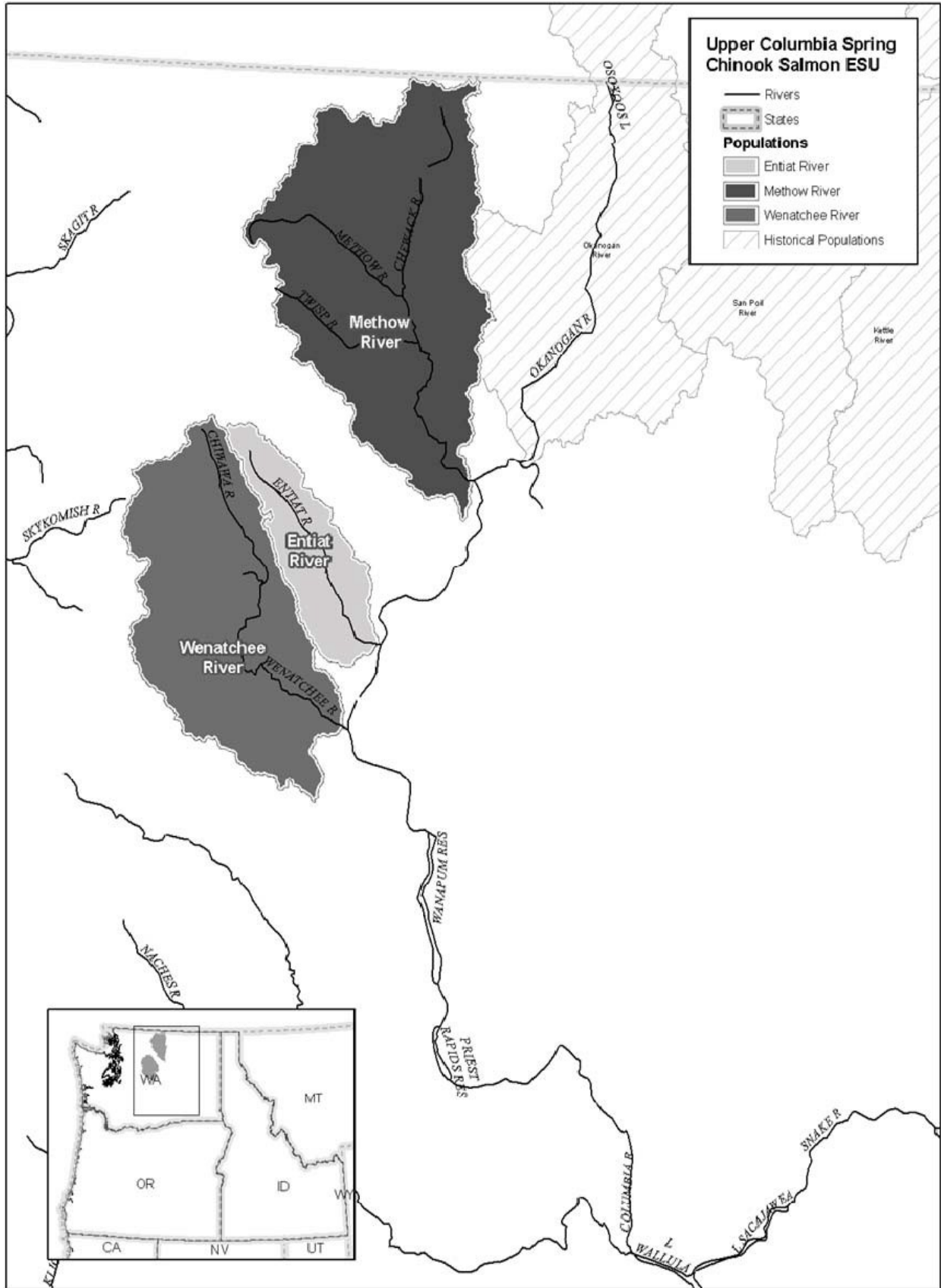
Figure 8.5.6-2. Continued.



Section 8.6 Upper Columbia River Spring Chinook Salmon



- 8.6.1 Species Overview
- 8.6.2 Current Rangewide Status
- 8.6.3 Environmental Baseline
- 8.6.4 Cumulative Effects
- 8.6.5 Effects of the Prospective Actions
- 8.6.6 Aggregate Effects by MPG
- 8.6.7 Aggregate Effect on ESU



Section 8.6

Upper Columbia River Spring Chinook Salmon

Species Overview

Background

The Upper Columbia River (UCR) spring Chinook salmon ESU consists of one major population group (MPG) composed of three existing and one extinct population. These fish spawn and rear in the mainstem Columbia River and its tributaries between Rock Island and Chief Joseph dams. The latter, completed in 1961, now blocks the upriver migration of this species. For 20 years prior to that, migration was blocked by Grand Coulee Dam. Upper Columbia River spring Chinook were listed as endangered under the ESA in 1999, reaffirmed in 2005.

Designated critical habitat for UCR spring Chinook includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam and several tributary subbasins.

Current Status & Recent Trends

Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above (Wenatchee and Methow) or near (Entiat) the recovery abundance thresholds in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s. Jack counts in 2007, an indicator of future adult returns, were at the highest level since 1977.

Limiting Factors and Threats

The key limiting factors and threats for the UCR spring Chinook include hydropower projects, predation, harvest, hatchery effects, degraded estuary habitat, and degraded tributary habitat. Ocean conditions, which have also affected the status of this ESU generally have been poor over the last 20 years, improving only recently.

Recent Ocean and Mainstem Harvest

The ocean fishery mortality affecting Upper Columbia River spring Chinook is low, and for practical purposes, assumed to be zero. Incidental take occurs in spring season fisheries in the mainstem Columbia River, which are intended to target harvestable hatchery and natural-origin stocks. The fisheries were limited to assure that incidental take does not exceed a rate of 5.5 to 17%. The average take in recent years, however, has been 10.7%.

8.6.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is with the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.6.2.1 Current Rangewide Status of the Species

UCR spring Chinook is an endangered species composed of three extant populations in one major population group (MPG). All three populations must be viable to achieve the delisting criteria in the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007). Key statistics associated with the current status of UCR spring Chinook salmon are summarized in Tables 8.6.2-1 through 8.6.2-4.

Limiting Factors & Threats

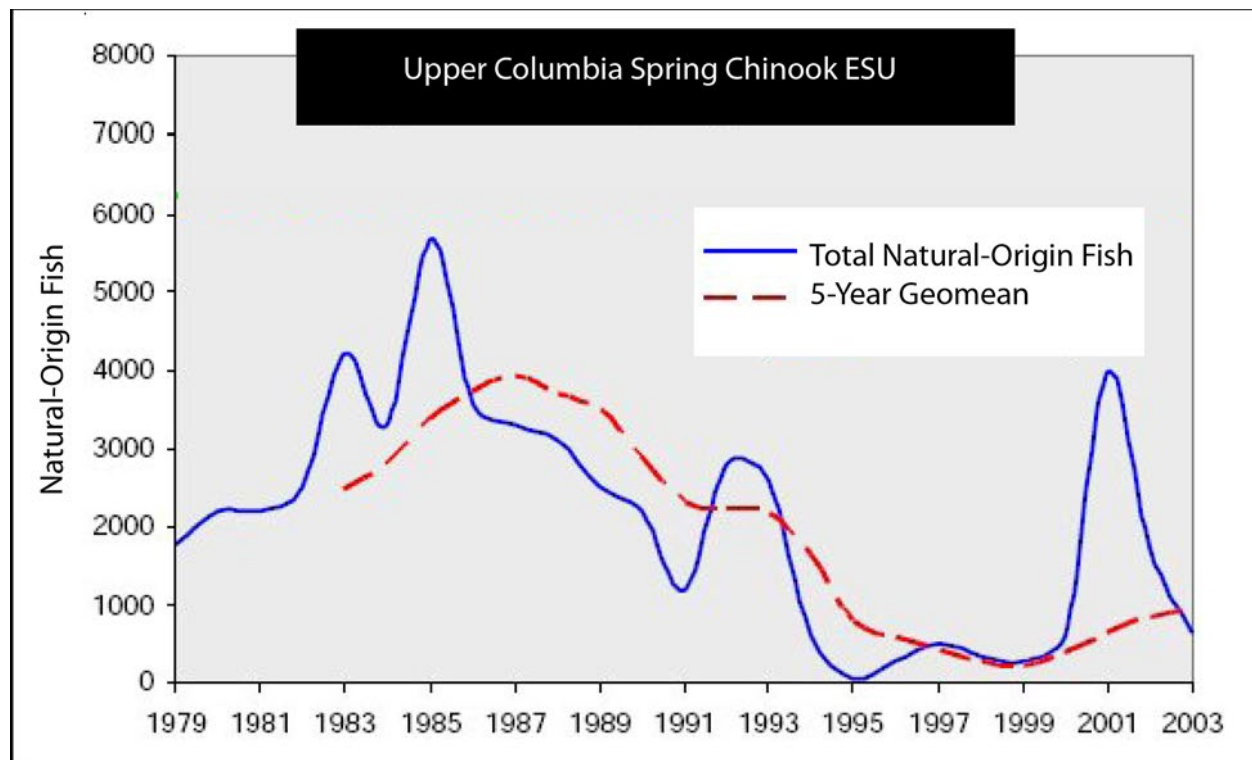
The key limiting factors and threats for the UCR spring Chinook include hydropower projects, predation, harvest, hatchery effects, degraded estuary habitat, and degraded tributary habitat. Ocean conditions have also affected the status of this ESU and generally have been poor for this ESU over the last 20 years, improving only in the last few years. Limiting factors are discussed in detail in the context of the conservation value of critical habitat in Section 8.6.3.3.

Abundance

For all populations, average abundance over the recent 10-year period is below the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.6.2-1).¹ Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above (Wenatchee and Methow) or near (Entiat) the recovery abundance thresholds in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.6.1.1-1), which shows annual abundance of combined populations. The 5y-year geometric mean peaked in 1987, and continuously decreased until 1999 (Figure 8.6.1.1-1). The 5-year geometric mean remains low as of 2003 (Figure 8.6.1.1-1). Recently, 2007 UCR spring Chinook jack counts, an indicator of future adult returns, have increased to their highest level since 1977.

¹ BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for “no jeopardy” determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.6.1.1-1. Upper Columbia River Spring Chinook Abundance Trends (Corps et al. 2007a, Chapter 8, Figure 8.2 showing annual abundance of combined populations).



“Base Period” Productivity

On average over the last 20 full brood year returns (1979-1998 brood years [BY], including adult returns through 2003), UCR spring Chinook populations have not replaced themselves (Table 8.6.2-1). This is true when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d], updated with Cooney [2007b]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at $\leq 5\%$ extinction risk (ICTRT 2007c).

The BRT trend in abundance and median population growth rate (λ) calculated with HF=1 also indicates a decline during this period for all three populations (Table 8.6.2-1). λ , when calculated with the HF=0 assumption, does indicate an increasing trend for the Methow population, but not for the Wenatchee and Entiat populations (Table 8.6.2-1). The HF=1 and the HF=0 λ calculation assumptions are alternatives regarding the effectiveness of hatchery-origin natural spawners, relative to natural-origin natural spawners, as discussed in Section 7.1.1.2.

Spatial Structure

The ICTRT characterizes the spatial structure risk to UCR spring Chinook populations as “low” or “moderate” (Table 8.6.2-2).

Diversity

The ICTRT characterizes the diversity risk to all UCR spring Chinook populations as “high” (Table 8.6.2-2). The high risk is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939-1943. In recent years, straying hatchery fish, compositing fish for broodstock, low proportion of natural-origin fish in some broodstocks and a high proportion of hatchery fish on the spawning grounds have contributed to the high genetic diversity risk. Discontinuation of the Entiat hatchery program in 2007 addresses a major limiting factor and is expected to benefit Entiat Chinook productivity and diversity.

“Base Period” Extinction Risk

The ICTRT Current Status Summaries (ICTRT 2007d) characterizes the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the “base period” described above for R/S productivity estimates, as “High” (>25% 100-year extinction risk) for all three UCR spring Chinook populations. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.6.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for the Wenatchee and Entiat populations. It is not possible to estimate short-term extinction risk for the Methow population using the methods employed in this analysis. This short-term extinction risk analysis is based also on the assumption that productivity observed during the “base period” will be unchanged in the future. At QET=50, the Wenatchee population has approximately a 2% risk while the Entiat population has greater than a 5% risk of extinction. Confidence limits on these estimates are extremely high, ranging from 0 to over 80% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET levels below 50 spawners, the results are more optimistic. The Entiat population has less than 5% risk of short-term extinction when QET=10 or less.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. When hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, short-term extinction risk is lower as evidenced by

analyses for SR spring/summer Chinook, SR fall Chinook, and UCR steelhead (Hinrichsen 2008, included as Attachment 1 in the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival (See Table 7.4.1) necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.6.2-4. Mean base period R/S survival gaps range from 34-40%, lambda survival gaps range from no needed change to 54% needed survival improvement, and BRT trend survival gaps range from 37-69%. Because short-term extinction risk is <5% for the Wenatchee population, there is no extinction risk gap at QET=50. However, survival would have to improve approximately 47% for the Entiat population to have <5% risk at QET=50 and survival would have to improve 4% at QET=30.

8.6.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for UCR spring Chinook includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Methow, Upper Columbia/Entiat, and Wenatchee (NMFS 2005b). There are 31 watersheds within the range of this ESU. Five watersheds received a medium rating and 26 received a high rating of conservation value to the ESU (see Chapter 4 for more detail). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 1,002 miles of habitat areas eligible for designation, 974 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.6.3.3.

8.6.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.6.3.1 “Current” Productivity & Extinction Risk under the Environmental Baseline

Because the action area as described in Chapter 5 encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year “base period,” ending with the 1998 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone

Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, and since 1998, the Comprehensive Analysis includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7 of this document. Results are presented in this document, in Table 8.6.3-1.

Briefly, reduction in the average base period harvest rate (estimated to result in a 4% survival increase [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in both FCRPS and Public Utility District (PUD) dam configuration and operation (approximately a 24-43% survival increase, based on ICTRT base survival and COMPASS analysis of current survival in SCA Hydro Modeling Appendix), and estuary habitat projects (a less than 1% survival change, based on CA Appendix D) result in a survival improvement for all UCR spring Chinook populations. Tributary habitat projects and changes in hatchery operations result in approximately a 2% survival improvement for all three populations (Corps et al. 2007a Chapter 8, Table 8-5). In contrast, the development of tern colonies in the estuary in recent years results in less than 1% reduction in survival for all populations. Additionally, increased adult Chinook predation by marine mammals (primarily California sea lions) in the Columbia River immediately downstream of Bonneville Dam has resulted in approximately a 3% reduction in survival for UCR spring Chinook salmon populations (SCA Marine Mammal Appendix).

Hatchery programs have been operated in each of the three ESU populations, but their effect on the base-to-current status of each of these populations has varied. For more information, see the Salmonid Hatchery Inventory and Effects Evaluation Report (NMFS 2004b). Over the base period, hatchery programs in the Wenatchee have reduced short-term extinction risk on the one hand and have imposed hybridization and the loss of genetic variation on the other. In the Entiat, genetic studies have shown that the natural population has been subject to outbreeding depression because the Entiat National Fish Hatchery (NFH) used Carson stock fish for broodstock. This program was discontinued in 2007 and adult returns from the last juvenile releases in 2006 will cease after 2010. For the Methow, the threat of outbreeding depression has been reduced since the phasing-out of Carson broodstock beginning in 2001. The PUD-funded hatchery program in the Methow basin started in 1992, using local fish for broodstock. Over the base period, this program has reduced short-term extinction risk while it has imposed hybridization and the loss of genetic variation.

The CA (Corps et al. 2007a) assumes a 1% survival change for the Methow population, based on the Winthrop NFH transition from Carson stock to a local Methow stock. Although this is an improvement, it fails to fully complete the transition in broodstock practices for two reasons. First, both the NFH and the PUD programs still rely on a high percentage of hatchery-origin fish for

broodstock, and second, they use a composite stock (i.e., a combination of Methow and Chewuch River fish). This practice homogenizes Methow Chinook, breaking down genetic differentiation and posing a continued risk to the fitness of the natural population. Therefore, the 1% survival benefit assumed in the CA/BA is not anticipated in the SCA.

The net result of all base-to-current changes is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 28-47%, depending on the particular population (Table 8.6.3-1). This also implies that the survival “gaps” described in Table 8.6.2-4 would be reduced proportionally by this amount (i.e., [“Gap” ÷ 1.28] to [“Gap” ÷ 1.47], depending on the population).

8.6.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section. For further detail please see the Rangewide Status section of this Chapter.

8.6.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as reducing the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by UCR spring Chinook salmon. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

UCR spring Chinook spawn and rear in the major tributaries to the Columbia River between Rock Island and Chief Joseph dams. Adults reach the spawning areas from April through July and hold in tributaries until late summer. Spawning peaks in mid- to late-August (UCSRB 2007). The majority of juvenile spring Chinook rear in their natal tributaries, although a significant proportion (30-40%) emigrate downstream to the Wenatchee mainstem to complete freshwater rearing (ICTRT 2007d). Juvenile spring Chinook spend a year in freshwater before migrating to salt water in the spring of their second year of life. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by UCR spring Chinook salmon for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Physical passage barriers [*mortality at hydroelectric projects in the mainstem Columbia River; water withdrawals and unscreened diversions*]

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- Excess sediment in spawning gravels and in substrates that support forage organisms [*land and water management activities*]
- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures [*degraded riparian and channel function*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors for this ESU in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile spring Chinook migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]
- Juvenile and adult passage mortality [*hydropower projects in the mainstem Columbia River*]
- Pinniped predation on adults due to habitat changes in the lower river [*existence and operation of Bonneville Dam*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for yearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 5.3.1.1 in Corps et al. (2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the absolute survival of spring-run Chinook by 5.5%. Thus, the continuing negative impact of sea lions will likely be approximately a 3% reduction from base period survival for spring Chinook populations.

The safe passage of yearling Chinook through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant

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colony has grown since that time. For these salmon, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 8.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although UCR spring Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.6.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Mainstem Mid-Columbia Hydroelectric Projects

NOAA Fisheries completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County Public Utility Districts in support of the proposed Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91% combined adult and juvenile survival standard for each salmon and steelhead ESU migrating through each project. In addition, compensation for up to 9% unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7% mortality provided through hatchery programs and compensation for up to 2% provided through tributary habitat improvement programs.

In May 2004, NOAA Fisheries also completed an ESA Section 7 consultation on FERC's proposed amendment to the existing license for the Grant County PUD's Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NOAA Fisheries expects that project-related mortalities (i.e., direct, indirect, and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 24.5% for juvenile UCR spring Chinook salmon. NOAA Fisheries also expects that implementation of the interim protection plan will result in mortality rates of no more than 2% per project or 4% combined for adult UCR spring Chinook salmon.

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Thus, NOAA Fisheries expects the cumulative mortality through the mid-Columbia reach of juvenile UCR spring Chinook to be 18% for the Wenatchee population; 24% for the Entiat population; and 27% for the Methow population. The total mortality rates (natural and project-related) of adult UCR spring Chinook salmon are expected to be 2% for adult spring Chinook returning to the Wenatchee and Entiat rivers and 3% for fish returning to the Methow.

Wenatchee River

A number of forest management activities relevant to this consultation have also undergone consultation and are included in the baseline. The USFS proposed fuels reduction projects in the White River – Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, and a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River – Nason Creek and Chiwawa River watersheds). The USFS' project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River – Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The FHWA/WSDOT consulted on a road construction project in the Wenatchee River – Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River – Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NOAA Fisheries consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the Corps consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

As part of the Grant PUD interim protection plan, NOAA Fisheries consulted with itself on the issuance of an ESA Section 10 permit issued jointly to Grant PUD, WDFW, and The Confederated Tribes and Bands of the Yakama Nation on the implementation of an artificial propagation (hatchery) program to supplement the spring Chinook salmon spawning aggregate in the White River.²

² Five major spawning areas contribute to the Wenatchee spring Chinook population. These are the White River, Chiwawa River, Nason Creek, Little Wenatchee River, and upper Wenatchee River spawning aggregates.

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As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the spawning aggregate in the Chiwawa River. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon and sockeye salmon and endangered steelhead in the Wenatchee basin, which could have effects on natural-origin spring Chinook, resulting in issuance of an ESA Section 10 permits. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Wenatchee basin.

The USFW consulted on the implementation of a hatchery program rearing out-of-ESU Carson stock spring Chinook salmon at Leavenworth NFH to provide fish for terminal-area harvest. The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce coho salmon to the Wenatchee basin. BPA underwent a separate consultation on the operation of a juvenile fish trap to monitor all salmonid species in Nason Creek.

Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NOAA Fisheries consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into seven miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to nine miles of habitat in a wilderness area (Middle Methow River watershed). The USFS completed two projects during 2007 under its programmatic consultation with NOAA Fisheries (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp

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River/North Creek Trail to improve five acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to four miles of stream.

Reclamation consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The FERC consulted on a license amendment for the Wells hydroelectric project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens.

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the spawning aggregates in the Methow, Chewuch, and Twisp Rivers. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon, and endangered steelhead in the Methow basin, which could have effects on natural-origin spring Chinook. These consultations resulted in the issuance of an ESA Section 10 permit. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Methow basin.

The USFWS consulted on the implementation of a supplementation hatchery program rearing listed spring Chinook salmon at Winthrop NFH. They also consulted on the implementation of a hatchery program rearing listed UCR steelhead at Winthrop NFH.

The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce Coho salmon to the Methow basin. Reintroduction could effect the natural population of spring Chinook salmon in the basin.

Projects Affecting Multiple Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries

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has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.6.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical

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merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of UCR spring Chinook salmon that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects such as hydroelectric generation (including the FERC-licensed hydro projects in the mid-Columbia River), forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.6.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect one or more of

the listed species or associated critical habitat in the Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Entiat, Methow, and Wenatchee populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.³ Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for Upper Columbia River spring Chinook. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

³ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

8.6.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.6.5.1, 8.6.5.2, and 8.6.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions, which are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in this section. There are no Federal safety-net hatchery programs for UCR spring Chinook salmon.

8.6.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the Prospective Actions effects in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.1.1.3)

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (McNary to the Bonneville tailrace) of UCR spring Chinook salmon from 66.7% (Current) to 72.6% (Prospective), a relative change of 8.8% (SCA Hydro Modeling Appendix).⁴ Transportation at McNary Dam is only expected to occur in 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs. In this unlikely circumstance, about 70.6% of the juveniles arriving at McNary Dam would be transported (see Table 11.7 of the FCRPS Biological Opinion). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller benefit, would exist from transportation at McNary Dam.

The COMPASS model estimates, combined with in-river migrant survivals through the non-Federal mainstem projects and smolt-to-adult returns (McNary Dam to the ocean and back to Rock Island Dam (assuming SR spring/summer Chinook salmon post-Bonneville survival relationships as a surrogate) will likely increase from about 0.58 to 0.63% (a relative improvement of 8.5%) for

⁴ For UCR spring Chinook salmon, the in-river survival estimate and total system survival estimate are virtually identical because fish are not likely to be transported in 69 out of 70 years (>98% of the time) in the 70-year water record.

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Wenatchee River fish; 0.53 to 0.58% (a relative improvement of 9.6%) for Entiat River fish; and 0.51 to 0.56% (a relative improvement of 9.7%) for Methow and Okanogan River fish. These increases are a result of the Prospective Actions and mid-Columbia PUD actions being implemented.

This improvement, combined with the expected survival improvements resulting from actions being implemented as a result of the completed biological opinions on the existence and operation of the five mid-Columbia mainstem projects (NMFS 2006e and SCA Hydro Modeling Appendix,) are expected to increase the relative survival of in-river migrants to the Bonneville tailrace by 8.8% (Wenatchee population) and 10.0% (Entiat, Methow, and Okanogan populations).

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult UCR spring Chinook salmon migrating from Bonneville Dam upstream to McNary Dam. The current PIT tag based survival estimate, taking account of harvest and “natural” stray rates within this reach, is 90.1% (about 96.6% per project) (BA Table 2.1). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Hydro Actions are also likely to positively affect the survival of UCR spring Chinook salmon, as a result of the construction of gas abatement structures at Chief Joseph Dam (reduction of future total dissolved gas levels), in ways that are not included in the quantitative analysis. NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects. This is likely to result in survival improvements in the forebays of these projects, where predation rates often are currently the highest (see Section 8.1.1). Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem’s effects on water quality, water quantity, water velocity, project injury and mortality, and predation, will increase to 72.6%. A portion of the 27.4% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling UCR spring Chinook in a hypothetical, unimpounded Columbia River from McNary Dam to Bonneville Dam would be 89.5%. Therefore, approximately 38.3% (10.5%/27.4%) of the mortality experienced by in-river migrating juvenile Chinook salmon is probably due to natural factors.

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The direct survival rate of adults through the FCRPS is already relatively high. The prospective actions include additional passage improvements (to the ladders at John Day and McNary dams and other improvements. Adult spring Chinook survival from Bonneville to Priest Rapids Dam will be approximately 90.1% under the Prospective Actions.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. Shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit the yearling migrants in the lower Columbia River, reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.6.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the functioning of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Wenatchee population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.6.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Chapter 8, Table 8-7, p. 8-12. For targeted populations in this ESU the effect is a 3 to 22% expected increase in low density egg-smolt survival, depending on population, as a result of implementing tributary habitat Prospective Actions that improve habitat function by addressing significant limiting factors and threats.⁵ For example, the Action Agencies will address limiting factors by replacing barrier culverts and screen irrigation pumps in the Wenatchee, Entiat, and Methow subbasins (Table 1-b in Attachment B.2.2-2 to Corps et al. 2007b). These passage projects in many instances will enable juvenile spring-run Chinook to access rearing habitat in tributaries that are too small to support spawning, but are generally more productive per unit area for rearing than are mainstem settings. The Action Agencies will also fund channel complexity projects and restore streamflows. Channel complexity projects include reconnecting oxbows that were isolated by highway and railroad construction in the Upper Wenatchee (Nason Creek in particular) and reconnecting small side channel habitats in the Methow and Entiat that have been stranded as a consequence of mainstem channel incision.

⁵ The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 1a and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.6.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Upper Columbia River Spring-run Chinook (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007-2010 is 1.4%. The survival benefit for Upper Columbia River Spring-run Chinook (stream-type life history) associated with actions to be implemented from 2010 through 2018 is 4.3%. The total survival benefit for Upper Columbia River Spring-run Chinook as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (Chapter 8.3.3.3 in Corps et al. 2007a). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats needed by yearling Chinook migrants from the upper Columbia River to increase life history diversity and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the conservation value of the estuary as habitat for this species (Section 8.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by yearling Chinook from the upper Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.6.5.2).

8.6.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

A qualitative assessment of the Prospective Actions was provided in Section 8.3.3.5, page 8-15, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as reforms to current federally funded programs that will be identified in future ESA consultations (see Tier 2 actions in the BA).

The Prospective Actions require the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs (see Appendix E of Corps et al. 2007a and SCA Artificial Propagation for Pacific Salmon Appendix) NOAA Fisheries cannot consult on the operation of existing or new programs until Hatchery and Genetic Management Plans are updated and consultation is initiated (consultations will be initiated and submitted to NOAA Fisheries by January 2009 and completed by July 2009). The FCRPS Action Agencies intend to adopt this programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs, and site specific application of BMPs, will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the FCRPS Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44). Available information, principles, and guidance for operating hatchery programs are described in Appendix E of the CA and Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives; 2) preserve genetic resources; and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.6.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of UCR spring Chinook will vary from year-to-year depending on an abundance-based harvest rate schedule (Table 8.6.5.5-1). Harvest will depend on the total abundance of upriver spring, natural-origin SR spring/summer Chinook, and may be further limited by natural-origin Upper Columbia River spring Chinook (see Table 8.6.5.5-1 footnote 4). The allowable harvest rate will range from 5.5 to 17%. As indicated in Table 8.6.5.5-1, most of the prospective harvest will occur in treaty Indian fisheries.

Table 8.6.5.1-1. Abundance-based harvest rate schedule for upriver spring Chinook and Snake River spring/summer Chinook in spring management period fisheries (TAC 2008).

Harvest Rate Schedule for Chinook in Spring Management Period					
Total Upriver Spring and Snake River Summer Chinook Run Size	Snake River Natural Spring/Summer Chinook Run Size¹	Treaty Zone 6 Total Harvest Rate²	Non-Treaty Natural Harvest Rate³	Total Natural Harvest Rate	Non-Treaty Natural Limited Harvest Rate
<27,000	<2,700	5.0%	<0.5%	<5.5%	0.5%
27,000	2,700	5.0%	0.5%	5.5%	0.5%
33,000	3,300	5.0%	1.0%	6.0%	0.5%
44,000	4,400	6.0%	1.0%	7.0%	0.5%
55,000	5,500	7.0%	1.5%	8.5%	1.0%
82,000	8,200	7.4%	1.6%	9.0%	1.5%
109,000	10,900	8.3%	1.7%	10.0%	
141,000	14,100	9.1%	1.9%	11.0%	
217,000	21,700	10.0%	2.0%	12.0%	
271,000	27,100	10.8%	2.2%	13.0%	
326,000	32,600	11.7%	2.3%	14.0%	
380,000	38,000	12.5%	2.5%	15.0%	
434,000	43,400	13.4%	2.6%	16.0%	
488,000	48,800	14.3%	2.7%	17.0%	

1. If the Snake River natural spring/summer forecast is less than 10% of the total upriver run size, the allowable mortality rate will be based on the Snake River natural spring/summer Chinook run size. In the event the total forecast is less than 27,000 or the Snake River natural spring/summer forecast is less than 2,700, Oregon and Washington would keep their mortality rate below 0.5% and attempt to keep actual mortalities as close to zero as possible while maintaining minimal fisheries targeting other harvestable runs.

2. Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from January 1-June 15. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.

3. Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the Hwy 395 Bridge in the Tri-Cities and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from January 1-June 15; Wanapum tribal fisheries, and Snake River mainstem recreational fisheries upstream to the Washington-Idaho border from April through June. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.

4. If the Upper Columbia River natural spring Chinook forecast is less than 1,000, then the total allowable mortality for treaty and non-treaty fisheries combined would be restricted to 9% or less. Whenever Upper Columbia River natural fish restrict the total allowable mortality rate to 9% or less, then non-treaty fisheries would transfer 0.5% harvest rate to treaty fisheries. In no event would non-treaty fisheries go below 0.5%

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harvest rate.

5. The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

The prospective harvest schedule is similar to that used in 2001, as well as in the most recent 2005 to 2007 Agreement. Since 2001, the allowable harvest rates ranged from 5.5 to 17%. The 2001 schedule did not include SR summer Chinook as part of the abundance indicator. The 2005 schedule was modified to include SR summer Chinook, but the abundance levels were adjusted accordingly to provide a comparable level of harvest for the adjusted run size. The harvest rate schedule proposed for use in 2008 and beyond differs from the 2005 schedule only in that it adjusts the allocations between the treaty-Indian and non-treaty fisheries.

Harvest rates under the Prospective Actions will be the same as they have been in recent years. Therefore, no additional current-to-future survival adjustment is necessary for the prospective harvest action for this species.

It is also pertinent to consider the potential effects of conservative management. Fisheries directed at upriver spring Chinook can be managed with relative precision. Catch is tracked on a daily basis, and runsize estimates can be adjusted in-season using counts at Bonneville dam. Since 2001, actual harvest rates have ranged between 1.1 and 2.6% less than those allowed (Table 8.3.5.5-2). Any analysis that assumes that the allowed harvest rates will always be fully used would therefore be conservative.

Table 8.6.5.5-2. Actual harvest rate on UCR spring Chinook, and those allowed under the applicable abundance based harvest rate schedule (Actual HR from TAC 2008).

Year	Actual HR (%)	Allowed HR (%)	Difference (%)
2001	14.6	16.0	1.4
2002	12.7	14.0	1.3
2003	9.4	12.0	2.6
2004	10.8	12.0	1.2
2005	7.9	9.0	1.1
2006	8.0	10.0	2.0

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and

forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, identified as a limiting factor for the Wenatchee population (Habitat Technical Subgroup 2006b).

8.6.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Upper Columbia River spring-run Chinook from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 2.1% (CA Attachment F-2, Table 4). Compensatory mortality may occur, but based on the discussion in 8.3.5.6, it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (Corps et al. 2007a Appendix F). Continued implementation and improvement of avian deterrence at all lower Columbia River dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island will further reduce predation on yearling Chinook, improving the status of safe passage in the juvenile migration corridor. These fish migrate over the deep water channel adjacent to the East Sand Island colony, which has made them especially vulnerable to predation. The benefit of this action will be long term.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.6.5.7 Effects of Research & Monitoring Prospective Actions

See Section 8.1.4 of this document.

8.6.5.8 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to the estimation of base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the action are described in Sections 8.6.5.1 through 8.6.5.8 and are summarized in Table 8.6.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the ESU. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 22-46% increased survival, compared to the “current” condition, and 56-99% increased survival, compared to the “base” condition.

8.6.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.6.6-1 and 8.6.6-2 and in Figures 8.6.6-1 through 8.6.6-4. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and ESU level.

8.6.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized by Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Eastern Cascades MPG is the only MPG within the Upper Columbia River Spring Chinook ESU. Because there is only one MPG, Section 8.6.7 applies to both the Eastern Cascades MPG and the entire Upper Columbia River Spring Chinook ESU. As described in Section 8.6.2.1, all three populations must be viable to achieve the delisting criteria in the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007).

8.6.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Upper Columbia River Spring Chinook ESU

This section summarizes the basis for conclusions at the ESU level.

8.6.7.1 Potential for Recovery

It is likely that the Upper Columbia River Chinook ESU will trend toward recovery.

The future status of all three extant populations and the single MPG of UCR Chinook will be improved compared to their current status. This will be done through a reduction of adverse effects of the FCRPS and Upper Snake projects, as well as the implementation of Prospective Actions with beneficial effects, as described in Sections 8.6.5, 8.6.6, and 8.6.7.2. These beneficial actions include reduction of avian and fish predation, estuary habitat improvements, hatchery reform and tributary habitat improvements for each population. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.6.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.6.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatcheries, and degradation of tributary and estuary habitat. The ICTRT has indicated concerns for all three populations relative to high diversity risk, including legacy effects of historical hatchery practices. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to result in no change from the current harvest rates in the environmental baseline.

Some of the problems limiting recovery of UCR Chinook, such as the effects of legacy hatchery practices, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as

hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

In sum, these qualitative considerations suggest that the UCR Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of some of the metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, such as those affecting all three extant UCR Chinook populations (Section 8.6.5.4), but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S calculations incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

R/S is expected to be greater than 1.0 for all three UCR Chinook populations after implementation of the Prospective Actions (Table 8.6.6.1-1, Figure 8.6.6-1).

Population growth rate (lambda) and BRT trend estimates are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. All three populations in this ESU are expected to have lambda greater than 1.0 and two of three populations are expected to have a BRT trend greater than 1.0 (Table 8.6.6-1). This indicates that in general these populations are expected to continue to increase in abundance in the

future. In contrast to R/S estimates, the lambda and BRT trend estimates are at least partially explained by second generation hatchery progeny (F₂ generation) spawning naturally.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate and its effects on early ocean survival will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” scenario, all three metrics are expected to be greater than 1.0 for all three populations (SCA Aggregate Analysis Appendix; Figure 8.6.6-2). With the “Warm PDO” (poor) ocean scenario, all three populations are expected to have R/S greater than 1.0, two of three populations are expected to have BRT trend and lambda (HF=0) greater than 1.0, and no populations are expected to have lambda greater than 1.0 if hatchery-origin spawners are assumed equally as effective as natural-origin spawners.
- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, all three metrics are expected to be less than 1.0 at the lower 95% confidence limit and greater than 1.0 at the upper 95% confidence limit for all populations (SCA Aggregate Analysis Appendix; Figure 8.6.6-1). These results suggest that it also is important to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements.

Quantitative estimates indicate that all UCR Chinook populations will be increasing (indicated by R/S) as a result of the actions considered in the aggregate analysis. It is also likely that abundance will increase given the aggregate effects, including a continuing supplementation program (indicated by BRT trend and lambda).

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.6.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Action and a continuation of other current management actions, as described above and in Section 8.6.5.

As described above and in Section 8.6.7.1, abundance is expected to be stable or increasing and populations are expected to grow as indicated by R/S, lambda, and two of three BRT trend estimates. Recent abundance levels are estimated between 59 and 222 spawners, depending on population, which is above the QET levels under consideration (Table 8.6.2-1). These factors also indicate a decreasing risk of extinction.

Continuing hatchery reforms will likely contribute to reduced risk and improving viability for all three Chinook populations in this ESU through hatchery reform generally will be analyzed in future consultations, as described above. However, some important changes are already taking place (e.g., discontinued use of Carson stock in the Entiat). For the Wenatchee population, the White River spawning area is one of the only locations with any evidence of genetic differentiation from other areas in the entire Upper Columbia ESU (ICTRT 2007b), and investments in the White River program are expected to decrease extinction risks associated with spatial distribution and diversity and buffer the Wenatchee population against environmental variability. For the Entiat, the hatchery program using incompatible Carson stock fish was discontinued in 2007. This was identified as a major limiting factor for Entiat spring Chinook. Adult returns from juvenile releases prior to 2007 should cease after 2010 and the fitness of Entiat spring Chinook is expected to improve as hatchery returns and outbreeding depression declines. For the Methow, the threat of outbreeding depression and reduced fitness is declining since the phasing-out of Carson broodstock beginning in 2001. Additional reforms would reduce threats to genetic diversity within the Methow population that can buffer the population from fluctuations in environmental conditions and to fitness reductions when a high proportion of the natural spawners are of hatchery-origin. New ESA consultations for Action Agency funded hatchery programs leading to the implementation of more hatchery reform are to be completed by June 2009 and NOAA Fisheries guidance (Artificial Propagation for Pacific Salmon Appendix) is expected to help shape those consultations.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of

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possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

Quantitative estimates of extinction risk indicate <5% risk at QET=50 for the Wenatchee population, regardless of the schedule for implementing the Prospective Actions (Table 8.6.1-2; Figure 8.6.6-3). No quantitative estimates are available for the Methow population, but because its abundance and trend are similar to that of the Wenatchee population, it is likely to have similar extinction risk. For the Entiat, estimated short-term extinction risk is <5% at QET=50, if all Prospective Actions are assumed to occur immediately, and >5% if no Prospective Actions occur immediately (Table 8.6.6.1-2). An additional 8% survival change is needed to reduce extinction risk to <5% under the latter assumption. Implementation of all Prospective Actions is expected to result in an additional 46% survival improvement for this population (Table 8.6.5-1).

These estimates assume no continued supplementation and assume that the population will be extinct if it falls below 50 fish for four years in a row (QET=50). It is likely that short-term extinction risk is lower than that calculated above when continued supplementation is considered (see, for example, the UCR steelhead analysis in Section 8.7.7 and Hinrichsen 2008, which is Attachment 1 to the Aggregate Analysis Appendix), but such an analysis was not conducted for this ESU. Similarly, as discussed in Section 7.1.1, QET levels less than 50 may be relevant to short-term extinction risk, particularly for smaller populations like the Entiat. Short-term extinction risk for the Entiat under continuing current management conditions is expected to be less than 5% at QET levels of 30 spawners or less (Table 8.6.5-1; Figure 8.6.6-3).

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While NOAA Fisheries does not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to approximately 80% at QET=50 (Table 8.6.2-3). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

This summary of quantitative extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario both

populations are expected to have $\leq 5\%$ risk at QET=50 (Aggregate Analysis Appendix; Figure 8.6.6-4). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, the results are very similar to those under the “recent” climate scenario, as described above.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

Taken together, the combination of all the factors above indicates that the ESU as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered, along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in a lower short-term extinction risk than in recent years. Quantitative estimates available for two populations indicate that UCR Chinook from the Wenatchee population will have a low risk even without implementation of any Prospective Actions, while some improvements would need to occur quickly for the Entiat population to have low risk at QET=50. Only about one-sixth of the survival improvement expected from the Prospective Action would need to occur quickly, which is a reasonable expectation given the nature of several of the actions. No Prospective Actions would be needed for low short-term risk of the Entiat population at QET=30. Because of similar abundance and trends, the Methow population likely has similar extinction risk as the Wenatchee population. Additionally, it is likely that short-term extinction risk in the Methow and Wenatchee is low given continuation of current supplementation programs. The combination of recent abundance estimates, expected survival improvements, expected positive trends for these populations, and supplementation programs that reduce short-term risk indicate the three populations in this ESU are likely to have a low enough risk of extinction to conclude that the ESU as a whole will have a low risk of short-term extinction.

8.6.7.3 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for UCR spring Chinook salmon including all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Methow, Upper Columbia/Entiat, and Wenatchee. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for UCR spring Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, and excess sediment in gravel in tributary spawning and rearing areas.

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Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams, in concert with training spill to provide safe egress provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat spring Chinook in the tailrace of Bonneville Dam will do the same for adults. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Upper Columbia River Spring Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Upper Columbia River Spring Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat.

Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.

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- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁶

⁶ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.6.2-1. Status of UCR spring Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: 20-yr non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current ⁴	Lower 95% CI	Upper 95% CI
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	222	1994-2003	2000	0.75	0.46	1.22	0.96	0.61	1.51	0.91	0.61	1.36	0.89	0.83	0.95
		Methow R.	180	1994-2003	2000	0.73	0.42	1.27	1.02	0.59	1.78	0.94	0.58	1.53	0.90	0.80	1.01
		Entiat R.	59	1994-2003	500	0.72	0.49	1.05	0.97	0.72	1.31	0.92	0.71	1.21	0.93	0.89	0.98
		Okanogan R. (extirpated)															

1 Most recent year for 10-year geometric mean abundance is 2003. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c).

2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 brood years in Cooney (2007). Actual years in average vary by population.

3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008c).

4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008c).

Table 8.6.2-2. Status of UCR spring Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure ¹	ICTRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.62
		Methow R.	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.52
		Entiat R.	Currently Moderate Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.69
		Okanogan R. (extirpated)			

1 ICTRT conclusions for UCR spring Chinook are from ICTRT Current Status Summaries (ICTRT 2007d)

2 Average fractions of natural-origin natural spawners are from ICTRT (2007c).

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Table 8.6.2-3. Status of UCR spring Chinook salmon with respect to extinction risk. Extinction risk is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	24-Year Extinction Risk												
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI	
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	0.00	0.00	0.42	0.00	0.00	0.64	0.01	0.00	0.78	0.02	0.00	0.82	
		Methow R.													
		Entiat R.	0.00	0.00	0.18	0.01	0.00	0.42	0.07	0.00	0.69	0.19	0.00	0.82	
		Okanogan R. (extirpated)													

¹ Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

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Table 8.6.2-4. Changes in density-independent survival (“gaps”) necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for UCR spring Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=1 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0 ³	Upper 95% CI	Lower 95% CI	Survival Gap for 24 Yr Ext. Risk <5% (OET=1) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=10) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=30) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=50) ⁴
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.34	2.17	0.82	1.23	9.60	0.16	1.54	9.53	0.87	1.69	2.28	1.26	0.13	0.29	0.49	0.65
		Methow R.	1.37	2.40	0.79	0.90	10.91	0.07	1.30	11.34	1.00	1.63	2.75	0.96				
		Entiat R.	1.40	2.05	0.95	1.13	4.33	0.30	1.43	4.73	0.90	1.37	1.72	1.10	0.32	0.63	1.04	1.47
		Okanogan R. (extirpated)																

1 R/S survival gap is calculated as $1.0 \div \text{base R/S}$ from Table 8.6.2-1.

2 Lambda survival gap is calculated as $(1.0 \div \text{base lambda from Table 8.6.2-1})^{\text{Mean Generation Time}}$. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as $(1.0 \div \text{base BRT slope from Table 8.6.2-1})^{\text{Mean Generation Time}}$. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt “a” value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt “a” value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

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Table 8.6.3-1. Proportional changes in average base period survival of UCR Chinook salmon expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

ESU	MPG	Population	Base-to-Current Adjustment (Survival Multiplier)							Total Base-to-Current Survival Multiplier ⁸
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Marine Mammal Predation ⁵	Harvest ⁶	Hatcheries ⁷	
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.25	1.02	1.00	1.00	0.97	1.04	1.00	1.28
		Methow R.	1.43	1.02	1.00	1.00	0.97	1.04	1.00	1.47
		Entiat R.	1.32	1.02	1.00	1.00	0.97	1.04	1.00	1.36
		Okanogan R. (extirpated)								

1 From SCA Hydro Appendix. Based on differences in average base and current smolt-to-adult survival estimates for both FCRPS and PUD dams.

2 From CA Chapter 8, Table 8-7.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Current 2 S/Baseline 2 S” approach, as described in Attachment F-2.

5 From SCA Marine Mammal Appendix

6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

7 No quantitative hatchery effects.

8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

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Table 8.6.5-1. Proportional changes in survival of UCR spring Chinook salmon expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Survival Multiplier)								Total Base-to-Future Survival Multiplier ⁹
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Hatcheries ⁶	Non-Hydro Current-to-Future Survival Multiplier ⁷	Total Current-to-Future Survival Multiplier ⁸	
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.09	1.03	1.06	1.02	1.01	1.00	1.13	1.22	1.56
		Methow R.	1.10	1.06	1.06	1.02	1.01	1.00	1.16	1.27	1.86
		Entiat R.	1.10	1.22	1.06	1.02	1.01	1.00	1.33	1.46	1.99
		Okanogan R. (extirpated)									

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates for both FCRPS and PUD dams.

2 From CA Chapter 8, Table 8-9.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.

7 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

8 Same as Footnote 7, except it is calculated from all Prospective Actions, including hydro actions.

9 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.6.3-1.

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Table 8.6.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for UCR spring Chinook.

ESU	MPG	Population	20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ⁵
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.17	1.05	1.00	0.98	Must be HV or V	R/S and lambda >1; BRT trend <1	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying, high proportion hatchery fish)
		Methow R.	1.36	1.17	1.08	1.03	Must be HV or V	All three metrics >1	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying, high proportion hatchery fish)
		Entiat R.	1.42	1.13	1.08	1.09	Must be HV or V	All three metrics >1	Currently Moderate Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying, high proportion hatchery fish)
		Okanogan R. (extirpated)								

1 Calculated as the base period 20-year R/S productivity from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1.

2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

4 From ICTRT (2007a), Attachment 2

5 From Table 8.6.2-2

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Table 8.6.6.1-2. Summary of prospective estimates relevant to the survival prong of the jeopardy standard for UCR spring Chinook. Numbers represent additional survival improvements (remaining “gaps”) to reduce 24-year extinction risk to 5% or less. Numbers less than 1.0 indicate that no additional survival changes are necessary.

ESU	MPG	Population	Extinction - Based Only On Current Adjustment - Not Influenced By RPA ¹				Extinction - Based On Current Adjustment and RPA Prospective Actions ²				ICTRT MPG Viability Scenario	Survival Prong Notes for Extinction Risk
			24-yr Extinction Risk Gap for ≤5% at OET=1	24-yr Extinction Risk Gap for ≤5% at OET=10	24-yr Extinction Risk Gap for ≤5% at OET=30	24-yr Extinction Risk Gap for ≤5% at OET=50	24-yr Extinction Risk Gap for ≤5% at OET=1	24-yr Extinction Risk Gap for ≤5% at OET=10	24-yr Extinction Risk Gap for ≤5% at OET=30	24-yr Extinction Risk Gap for ≤5% at OET=50		
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	0.10	0.23	0.38	0.51	0.08	0.19	0.31	0.42	Must be HV or V	<5% risk at OET=50 without reliance on immediate RPA actions
		Methow R.									Must be HV or V	No short-term extinction risk estimates
		Entiat R.	0.24	0.46	0.76	1.08	0.16	0.32	0.52	0.74	Must be HV or V	<5% risk at OET=50 if some Prospective Actions implemented immediately; otherwise, >5% risk
		Okanogan R. (extirpated)										

1 These estimates assume that only actions that have already occurred can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.6.2-4, divided by the total base-to-current survival multiplier in Table 8.6.3-1.

2 These estimates assume that the Prospective Actions to be implemented in the next 10 years can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.6.2-4, divided by the total base-to-future survival multiplier in Table 8.6.5-1.

3 From ICTRT (2007a), Attachment 2

Figure 8.6.6-1. Summary of prospective mean R/S estimates for UCR spring Chinook salmon under the “recent” climate assumption, including 95% confidence limits.

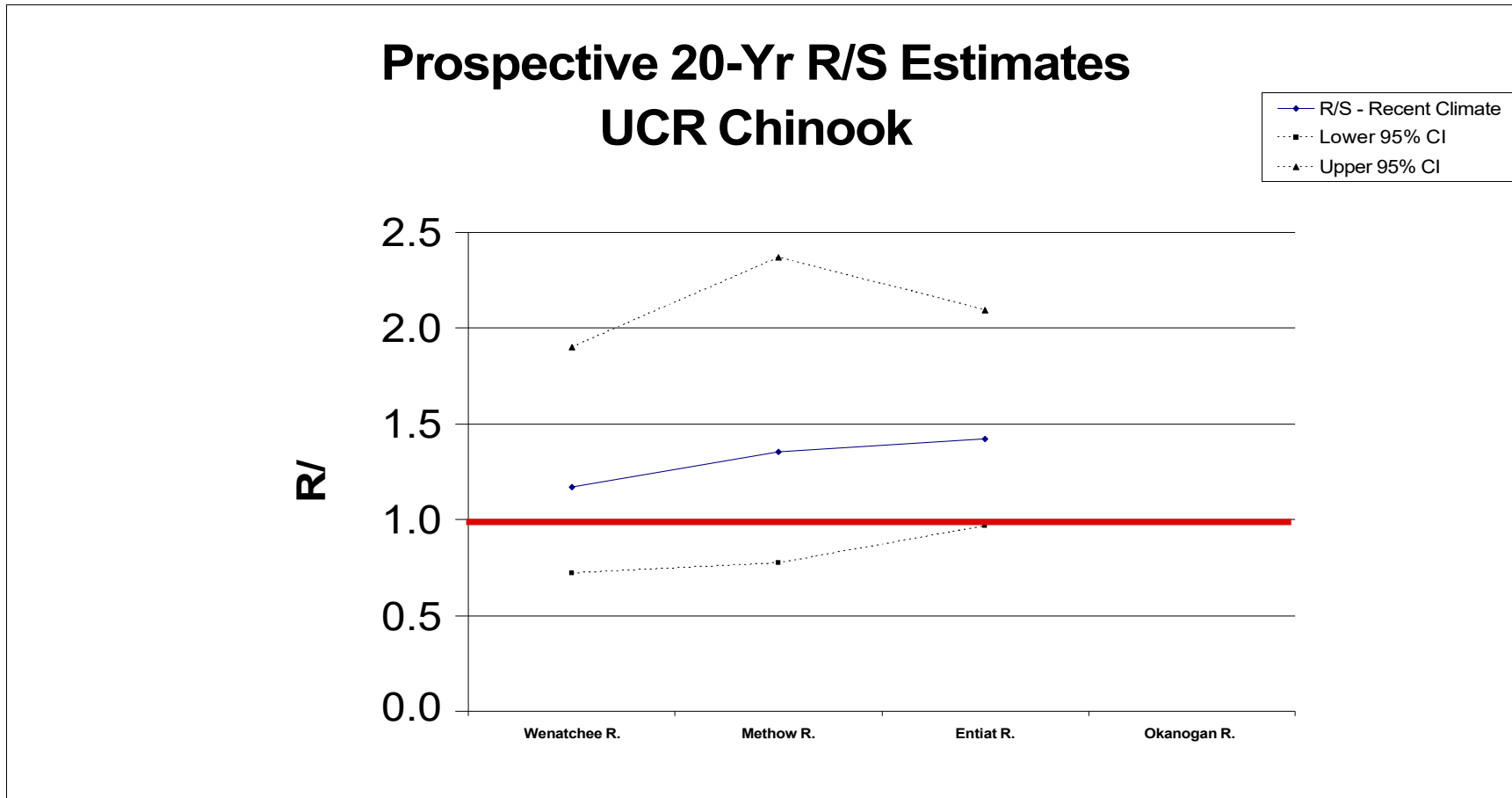


Figure 8.6.6-2. Summary of prospective mean R/S estimates for UCR Spring Chinook salmon under three climate assumptions.

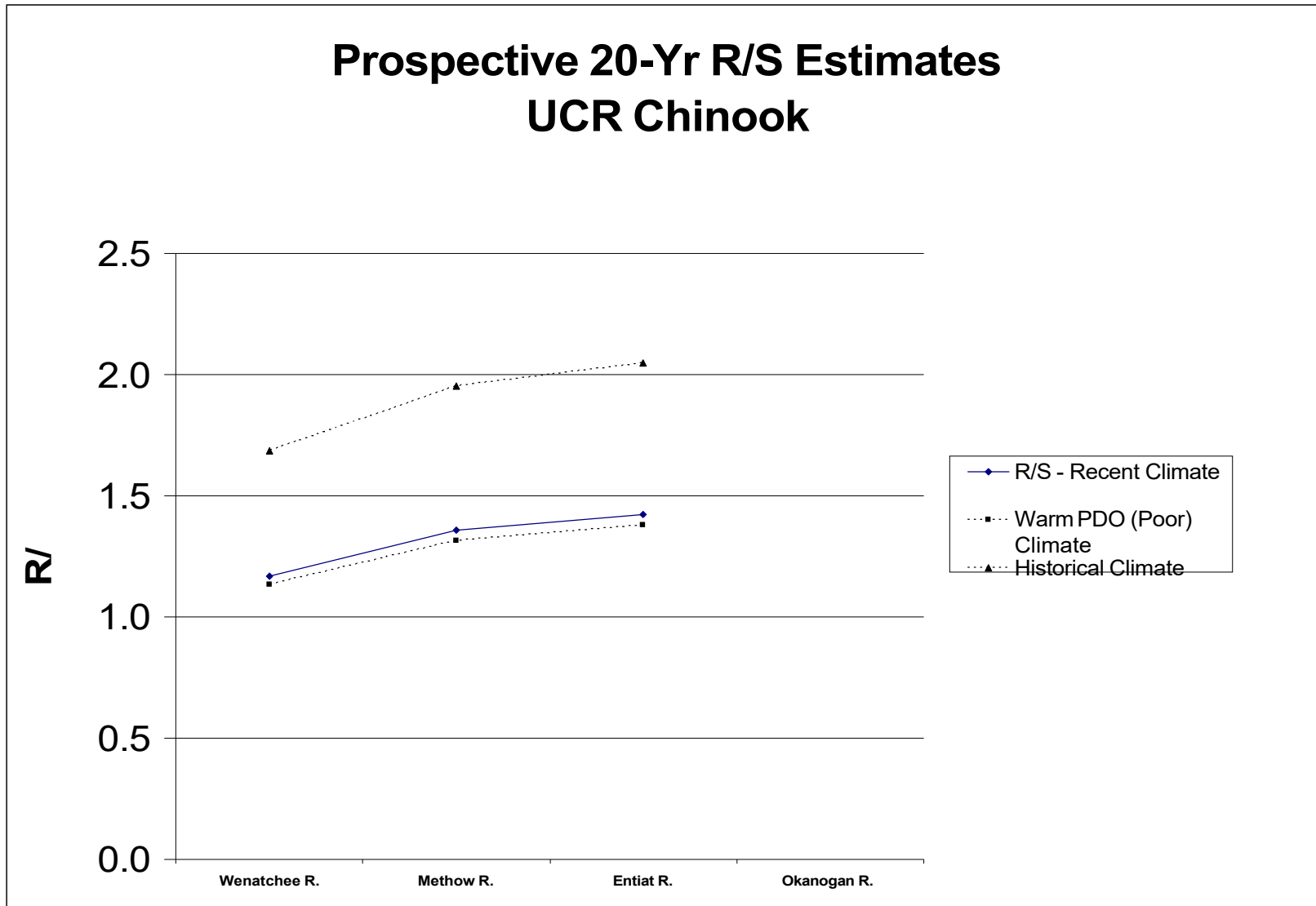


Figure 8.6.6-3. Summary of prospective 5% 24-year extinction risk gap estimates for UCR spring Chinook salmon under the “recent” climate assumption, showing effects of three alternative quasi-extinction thresholds (QET).

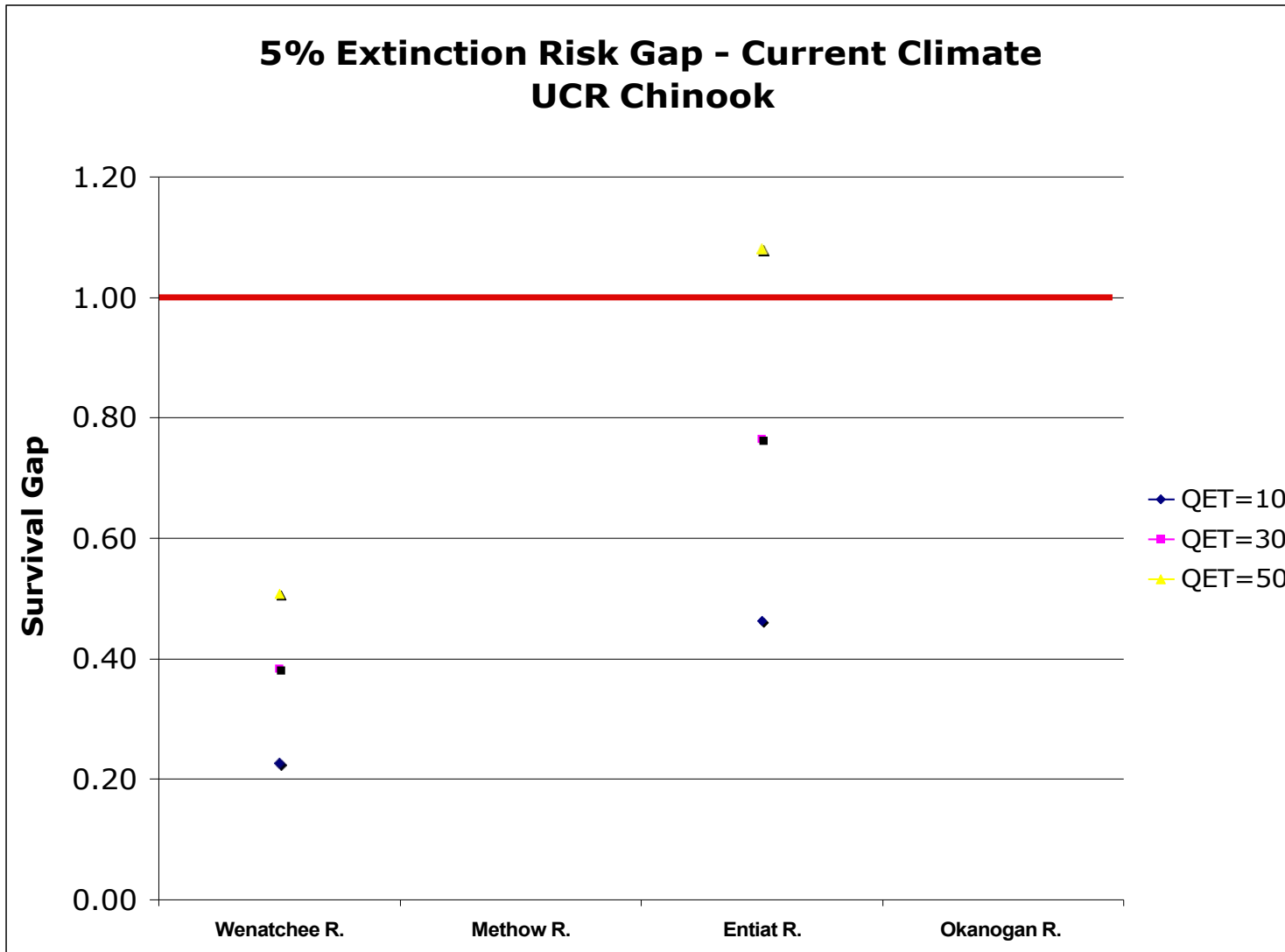
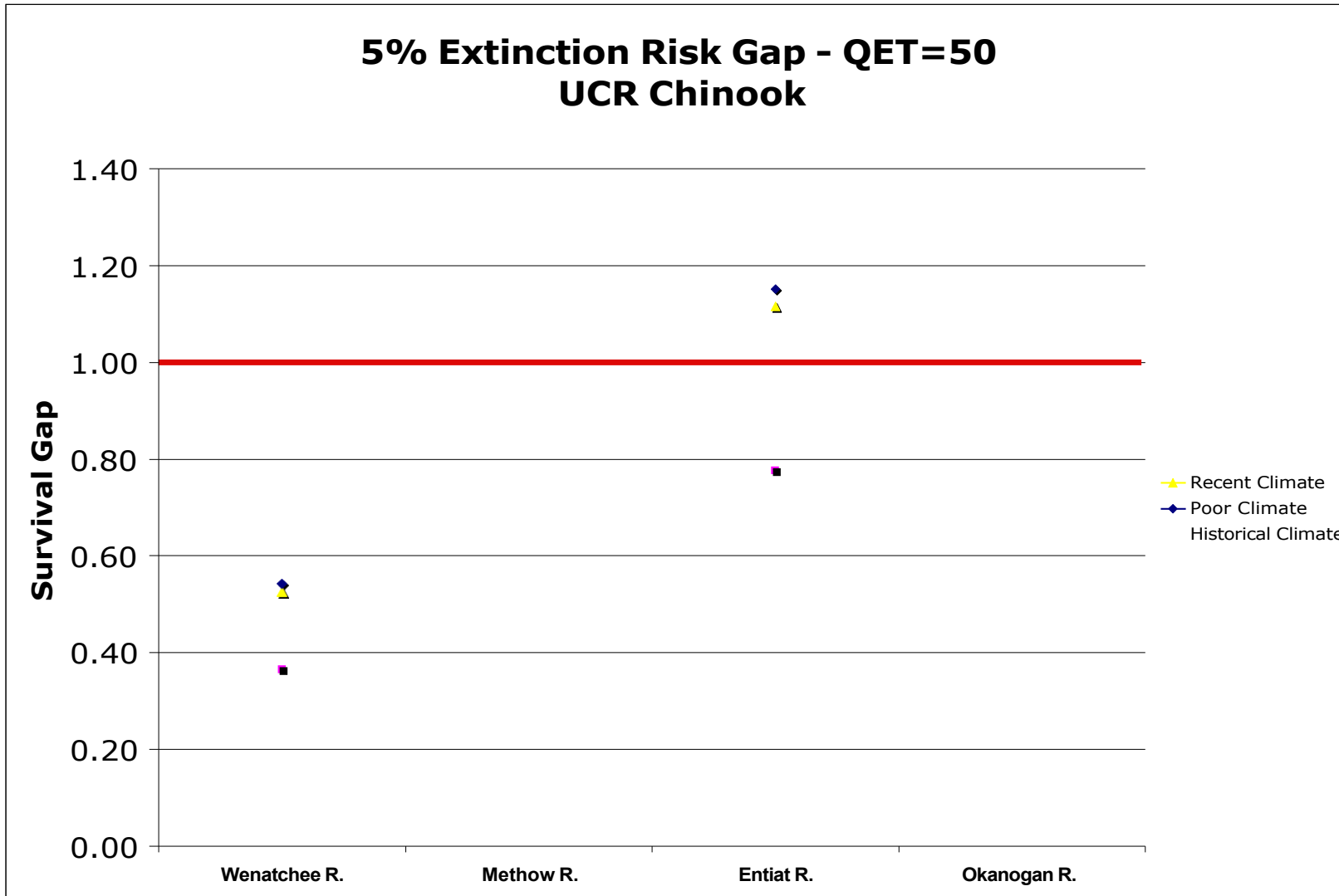
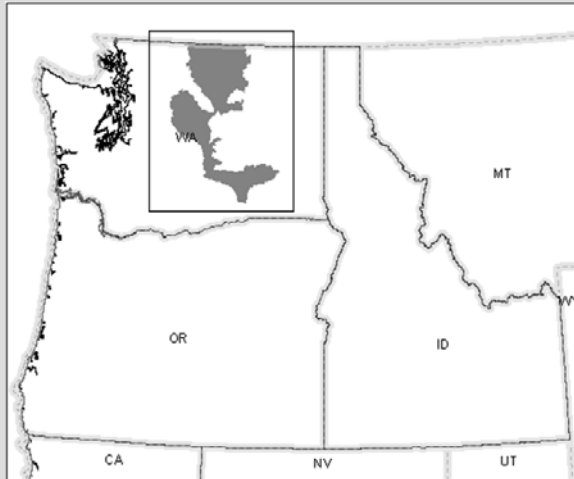


Figure 8.6.6-4. Summary of prospective 5% 24-year extinction risk gap estimates for UCR spring Chinook salmon under three climate assumptions.

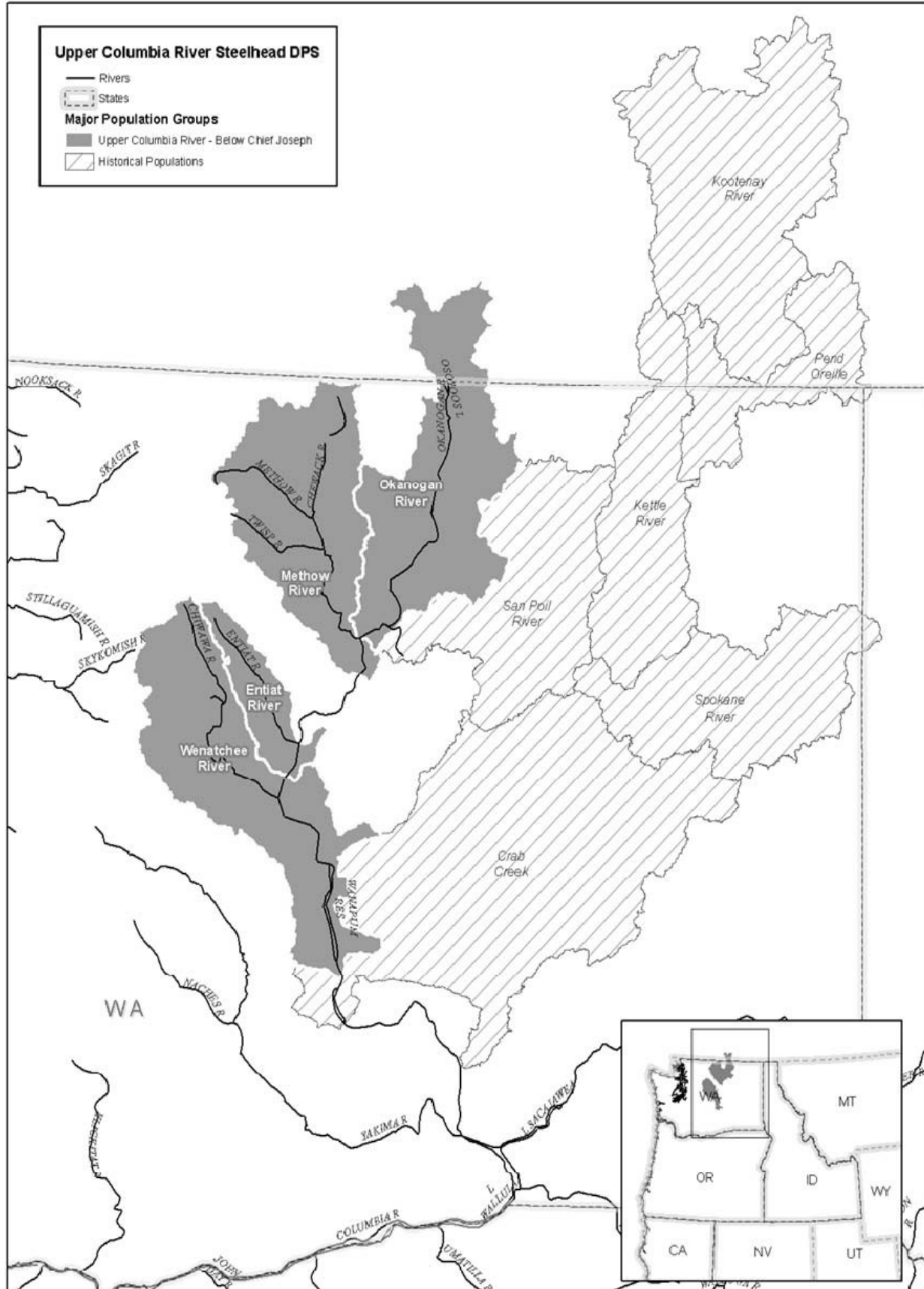


Section 8.7 Upper Columbia River Steelhead



- 8.7.1 Species Overview
- 8.7.2 Current Rangewide Status
- 8.7.3 Environmental Baseline
- 8.7.4 Cumulative Effects
- 8.7.5 Effects of the Prospective Actions
- 8.7.6 Aggregate Effects by MPG
- 8.7.7 Aggregate Effect on DPS

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Section 8.7

Upper Columbia River Steelhead

Species Overview

Background

The Upper Columbia River (UCR) steelhead DPS includes all anadromous populations that spawn and rear in the middle reaches of the rivers and tributaries draining the eastern slope of the Cascade Mountains upstream of Rock Island Dam. There are four populations in a single major population group. The Upper Columbia River steelhead DPS was listed under the ESA as endangered in 1997.

Hatchery steelhead have been released into the Methow and Okanogan since the late 1960s and into the Wenatchee and Entiat systems since the 1970s. Through the 1980s, operations were designed to accommodate harvest and there was no attempt to limit introgression of hatchery fish into the native populations. In many cases, the hatchery broodstock originated from outside the upper Columbia area. Naturally spawning hatchery fish were not adapted to local conditions, which most likely limited their effectiveness and depressed the production of the population as a whole. While there is no precise means to measure the full effect of these practices, they likely contributed substantially to the current low recruits-per-spawner (R/S) productivities for naturally spawning fish.

Since the early 1990s, hatchery programs that operate in the Wenatchee, Methow, and Okanogan basins have implemented reforms to support steelhead conservation and recovery. No hatchery fish are released into the Entiat and the hatchery broodstocks in other watersheds are now composed exclusively of steelhead from the Upper Columbia DPS. The hatchery programs are managed to preserve natural genetic resources.

Designated critical habitat for UCR steelhead includes all Columbia River estuarine areas and river reaches upstream to Chief Joseph Dam and several tributary subbasins.

Current Status & Recent Trends

Upper Columbia River (UCR) steelhead is an endangered species composed of the anadromous *O. mykiss* in four extant populations in one major population group (MPG). For all populations, abundance over the most recent 10-year period is below the thresholds that the ICTRT has identified as a minimum for recovery. Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds (all populations except the Okanogan) in a few years in the early 2000s, and is now at levels intermediate to those of the mid-1990s and early 2000s. Abundance since 2001 has substantially increased for the DPS as a whole.

Limiting Factors and Threats

The key limiting factors and threats for UCR steelhead include hydropower projects, predation, harvest, hatchery effects, degraded tributary habitat and degraded estuary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on UCR steelhead is assumed to be zero. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. UCR are all A-run fish.

Fisheries in the Columbia River are limited to assure that the incidental take of ESA-listed Upper Columbia River steelhead does not exceed specified rates. Non-Treaty fisheries are subject to a 2% harvest rate limit on A-run steelhead. Treaty Indian fall season fisheries are subject to a 15% harvest rate limit on B-run steelhead, but were not subject to a particular A-run harvest rate constraint since B-run steelhead are generally more limiting. Recent harvest rates on Upper Columbia River steelhead in non-Treaty and treaty Indian fisheries ranged from 1.0% to 1.9%, and 4.1% to 12.4%, respectively.

8.7.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.7.2.1 Current Rangewide Status of the Species

Upper Columbia River (UCR) steelhead is an endangered species composed of the anadromous *O. mykiss* in four extant populations in one major population group (MPG). All four populations must be viable to achieve the delisting criteria in the Upper Columbia River Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007). Key statistics associated with the current status of UCR steelhead are summarized in Tables 8.7.2-1 through 8.7.2-4. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. UCR steelhead are all A-run fish.

Limiting Factors & Threats

The key limiting factors and threats for UCR steelhead include hydropower projects, predation, harvest, hatchery effects, degraded tributary habitat and degraded estuary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years, improving only in the last few years. Limiting factors are discussed in detail in the context of critical habitat in Section 8.7.3.3.

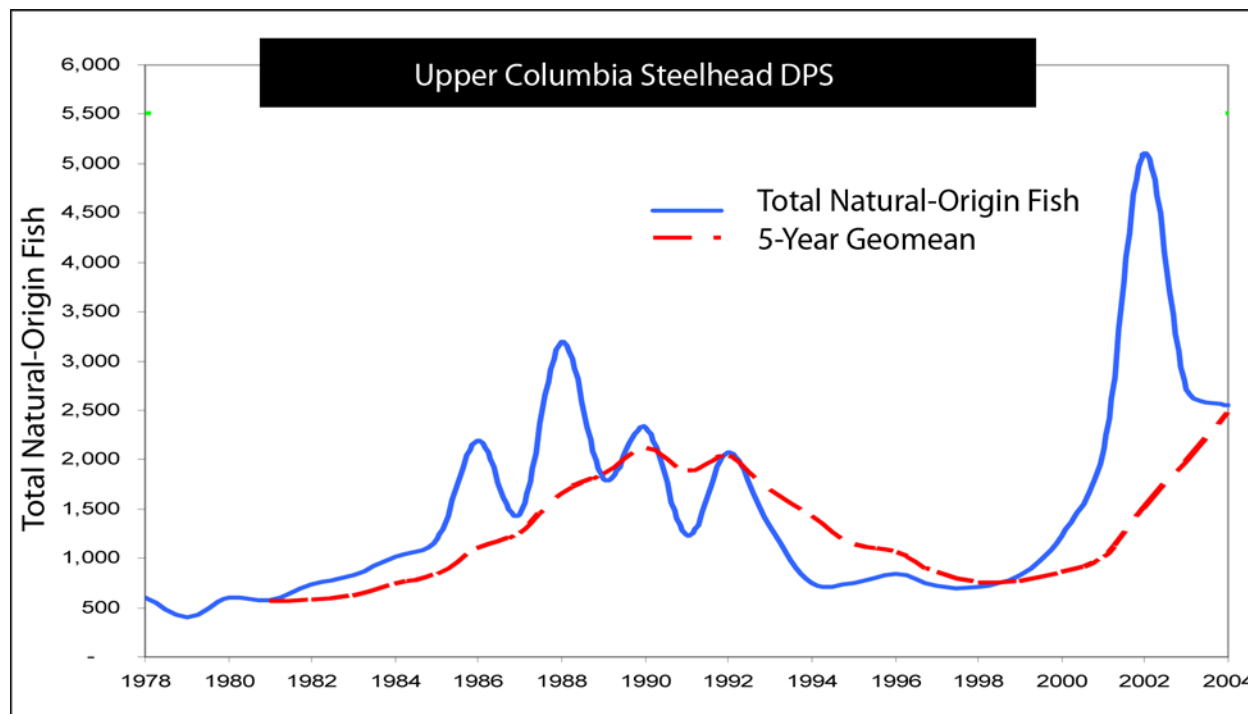
Abundance

For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT has identified as a minimum for low risk (Table 8.7.2-1).¹ Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds (all populations except the Okanogan) in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.7.2.1-1, showing annual abundance of combined populations).

Aggregate abundance of the four populations and a rolling 5-year geometric mean of abundance for the DPS are shown in Figure 8.7.2.1-1. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to 2003 period was 3,643 compared to 1,146 for the 1996 to 2000 period, a 218 percent improvement (Fisher and Hinrichsen 2006). The recent geomean abundance was influenced by exceptional returns in 2002, yet returns of natural-origin adults have been well above the 1996 to 2000 geomean in years since 2000.

¹ BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for “no jeopardy” determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.7.2.1-1. Upper Columbia River Steelhead Population Trends, 1978 to 2004 (adopted from Fisher and Hinrichsen 2006)



“Base Period” Productivity

On average over the last 20 full brood year returns (1980/81 through 1999/2000 brood years [BY], including adult returns through 2004-2005), UCR steelhead populations have not replaced themselves (Table 8.7.2-1) when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d] updated with Cooney [2008a]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5% extinction risk (ICTRT 2007c).

The BRT trend in abundance and median population growth rate (λ) calculated with an assumption that hatchery-origin natural spawners are not successful ($HF=0$) indicates an increase in abundance during this period for all three populations for which trend can be estimated (Table 8.7.2-1). λ , when calculated with an assumption that hatchery-origin and natural-origin natural spawners are equally effective ($HF=1$), indicated a declining trend similar to that of R/S (Table 8.7.2-1).

Spatial Structure

The ICTRT has characterized the spatial structure risk to UCR steelhead populations as “low” for the Wenatchee and Methow, “moderate” for the Entiat, and “high” for the Okanogan (Table 8.7.2-2). The ICTRT considers the risk high for the Okanogan population because only the lower of two major spawning areas in the United States is occupied.

Diversity

The ICTRT has characterized the diversity risk to all UCR steelhead populations as “high” (Table 8.7.2-2). The high risk is a result of reduced genetic diversity from homogenization of populations that occurred during the Grand Coulee Fish Maintenance Project from 1939-1943 and then again from 1960 to as recently as 1981 (Chapman et al. 1994). Additionally, the Methow and Okanogan populations have particularly high proportions of hatchery-origin spawners, and recent monitoring data suggests that hatchery fish may be straying into non-target areas, likely contributing to the continued homogenization of the populations.

“Base Period” Extinction Risk

The draft ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity of populations during the “base period” described above for R/S productivity estimates, as “High” (>25% 100-year extinction risk) for all four UCR steelhead populations. The ICTRT defined the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.7.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for each population. This short-term extinction risk analysis is also based on the assumption that productivity observed during the “base period” will be unchanged in the future. At QET=50 all populations have >5% risk of short-term extinction. Confidence limits on these estimates are extremely wide, ranging from 0 to 100% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET=30 and QET=10 all populations have >5% risk of short-term extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, short-term extinction risk is lower (Hinrichsen 2008, included as attachment 1 of the SCA Aggregate Analysis Appendix). This

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analysis indicates that short-term extinction risk at QET=50 is at or near 0% if continued supplementation is assumed for all except the Entiat population. However, dependence on hatcheries for more than three or four generations (9-16 years for UCR Steelhead), poses an increased risk to population diversity (ICTRT 2007d).

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 are displayed in Table 8.7.2-4. Mean base period R/S survival gaps range from 20% to over 700%. Under the HF=0 assumption, there is no survival gap for lambda, nor is there a survival gap for BRT trend. However, under the HF=1 assumption, the lambda gap ranges from 160% to nearly 500%.

Survival gaps for 24-year extinction risk could not be calculated using the methods employed in this analysis. However, based on the high base period risk it is likely that these gaps would be very large. An analysis that assumed that hatchery supplementation would continue indicated close to 0% risk of short-term extinction for all but the Entiat population (see above), so there would be no extinction risk gap for three populations if continued supplementation is assumed.

8.7.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for UCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and Upper Columbia/Priest Rapids (NMFS 2005b). There are 42 watersheds within the range of this DPS. Three watersheds received a low rating, 8 received a medium rating, and 31 received a high rating of conservation value to the DPS (see Chapter 4 for more detail). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 11 of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 1,332 miles of habitat areas eligible for designation, 1,262 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.7.3.3.

8.7.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.7.3.1 “Current” Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk were based on performance of populations during a 20-year “base period,” ending with the 1999 or 2000 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and the continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, the CA includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7.1 of this document. Results are presented in Table 8.7.3-1.

Briefly, reduction in the average base period harvest rate of natural origin fish (estimated at approximately a 4% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in both FCRPS and Public Utility District (PUD) dam configuration and operation (approximately a 8% to 25% survival change, based on ICTRT base survival and COMPASS analysis of current survival in CA Appendix B), and estuary habitat projects (a less than 1% survival change, based on CA Appendix D) result in a survival improvement for all UCR steelhead populations. Tributary habitat projects result in approximately 2-6% survival improvements, depending on population (CA Chapter 9, Table 9-7). In contrast, development of tern colonies in the estuary in recent years results in less than a 1% reduction in survival for all populations.

NOAA Fisheries reviewed hatchery information for the period 1936 to present, including the origin, number and location of hatchery origin fish (HOF) releases. In 1998, the goal of all the hatchery programs in the UCR steelhead DPS changed from providing fish for harvest to also

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conserving the genetic resources and reducing short-term extinction risk and increasing HOF fitness or effectiveness. Before 1998, all hatchery programs fell into Category 1 (HOF < 30% as effective as natural origin fish [NOF]) and HOF were planted in areas to accommodate fisheries, not promote HOF effectiveness (i.e., the majority of releases were not in prime steelhead production areas). After 1998, hatchery program reforms were initiated for each of the four steelhead populations. Additionally, starting in 1998 tributary fisheries were curtailed until a plan was developed that addressed impacts on ESA listed fish. Currently, ESA Section 10 permit #1395 authorizes steelhead fisheries targeting surplus hatchery fish in the Wenatchee, Methow, and Okanogan when natural-origin fish returns meet criteria established in the steelhead management plan.

The CA suggests a range of 52 to 113% survival improvement to the Wenatchee population from hatchery reforms that began in 1998 (CA Table 9-7). Hatchery reforms of PUD-funded programs in the Wenatchee basin include using broodstock collected only from the Wenatchee River, with a substantially increased proportion of natural-origin fish in the broodstock; released fish in primary steelhead production areas (to promote effectiveness); and mechanisms to manage hatchery returns on spawning grounds in years of high survival. Future reforms, called for in the 50-year Habitat Conservation Plan, include increased rearing and acclimation on Wenatchee basin surface water to improve survival and homing fidelity. PUD-funded RM&E actions are also called for and are anticipated to reduce risk associated with the hatchery program.

The “low” hatchery effectiveness estimate for the Wenatchee population used in Table 9-4 of the CA (1.52) is reasonable. When re-calculated with updated historical hatchery fractions from the ICTRT (Cooney 2008a), the estimate changes to 1.60 (SCA Quantitative Analysis of Hatchery Actions Appendix). Available information does not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on historical release practices and absent estimates of HOF straying into primary steelhead production areas.

The CA suggests a range of 56 to 150% survival improvement to the Entiat population based on hatchery reforms in place since 1998 (CA Table 9-7). Releases of hatchery steelhead from the PUD funded program in the Entiat River ended in 1997 as a hatchery reform measure. Based on limited telemetry studies, the Entiat population may have continued to be affected by hatchery steelhead from other programs, particularly the Wenatchee program, that stray into the Entiat River. The reform measure to increase rearing and acclimation of the hatchery program in the Wenatchee basin is expected to benefit Entiat population productivity and diversity by increasing homing fidelity to the Wenatchee and thus reducing Wenatchee hatchery steelhead straying into the Entiat. Estimates of prospective productivity improvements are disadvantaged by lack of spawner composition data and uncertainties over the implementation and effectiveness of reforms to reduce straying.

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The proportion of natural spawners made up of hatchery-origin fish is an important variable in estimating productivity changes. The FCRPS Action Agencies use ICTRT estimates of natural spawner composition for the Entiat, and these estimates are based on very limited data. Data for the Entiat is the least robust of any escapement data for basins in the upper Columbia because they are based only on dam count and tributary turn-off estimates. The last HOF releases into the Entiat were in 1999, and it is reasonable to assume that HOF on the spawning grounds declined after 2002. After 2002, the only HOF spawning in the Entiat were strays. Most strays are thought to be hatchery steelhead from the Wenatchee. Facilities have not been built to acclimate them to Wenatchee water before they are released to migrate to the ocean. Therefore, they are expected to stray more when they return as adults. Less than 10% HOF strays spawning naturally in the Entiat is a reasonable goal, but it will take time before improvements are operational (e.g., the construction of acclimation ponds in the Wenatchee) and the effectiveness of these improvements can be established. Based on the termination of hatchery steelhead releases in the Entiat (the last returns from hatchery releases were in 2004), NOAA Fisheries assumes a future hatchery fraction of 0.22 to 0.50.

For the period prior to hatchery program termination, available information does not support effectiveness estimates >0.3 . After termination, stray HOF in the Entiat originate from Category 1 hatchery programs, but since these fish are not from the Entiat, the effectiveness of stray HOF would be <0.3 . Considering all this information, NOAA Fisheries estimates a survival change of 0-18% to +56% for the Entiat, based on hatchery management changes (SCA Quantitative Analysis of Hatchery Actions Appendix).

The Methow population has a PUD funded program at Wells Hatchery and an Action Agency funded program at Winthrop NFH. In 1998, the goals of both programs changed from primarily providing fish for harvest to conserving genetic resources and increasing hatchery fish fitness or effectiveness. Both programs use broodstock collected at Wells Dam, which combines fish returning to the Methow and Okanogan basins. The Federal program at Winthrop NFH releases steelhead from the hatchery facility. The PUD funded program uses tank trucks to release steelhead at multiple locations in the Methow basin. The Winthrop NFH receives eyed eggs from the PUD funded program that are progeny of hatchery-by-hatchery fish crosses, while the PUD program maximizes and retains progeny of hatchery-by-natural fish crosses.

Before 1998, the programs fell into Category 1 (HOF $<30\%$ as effective as NOF) and HOF were planted in areas to accommodate fisheries, not promote HOF effectiveness (i.e., the majority of releases were not in prime steelhead production areas). After 1998, the broodstock included some NOF (Category 3) and the PUD funded program altered release locations to include steelhead production areas (to promote effectiveness). In recent years, NOF in broodstock have increased to about 30% in the PUD funded program. However, this program continues to be a composite of the Methow and Okanogan populations (not an optimum practice for a hatchery program intended to promote genetic diversity and improve natural survival). A further reform has been the transfer of eggs from earliest maturing broodstock, which are always hatchery-origin fish (this is thought to be a legacy effect of historical hatchery operation protocols that

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selected for early maturing fish in the broodstock) to the Ringold Program in the Middle Columbia River. Redd surveys in the Methow River have not found a difference in spawn timing between HOF and HOR (Snow and Humling 2006).

For the Methow population, available information would not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on release practices and the reliance on HOF for broodstock (i.e., hatchery domestication effects). After 1998, HOF effectiveness may be incrementally increasing over time, but still is likely to be quite low in the 0.30 to 0.45 range (the upper end of the Araki et al. 2007b range for a Category 3 program). This results in survival multipliers between 17 and 55% for the Methow population (SCA Quantitative Analysis of Hatchery Actions Appendix).

The Okanogan population is supplemented by two hatchery programs, the PUD funded Wells program and a relatively new program operated by the Colville Tribes. Similar to the situation in the Methow, prior to 1998 the program fell into Category 1 (HOF<30% as effective as NOF) and HOF were planted in areas to accommodate fisheries, not to promote HOF effectiveness (i.e., the majority of juvenile releases were not in prime steelhead production areas). After 1998, the steelhead program at Wells Hatchery has increased the use of NOF for broodstock. This is beneficial except that the broodstock is a composite of different spawning aggregates and different populations (not an optimum practice for a hatchery program intended to conserve genetic resources and increase HOF fitness or effectiveness).

The Colville Tribes have begun a relatively small hatchery program in Omak Creek to promote local adaptation in the Okanogan Basin. This program uses broodstock collected from Omak Creek or the Okanogan River. Overall, these hatchery reforms are beneficial, but for the Okanogan basin in particular, increases in natural productivity will depend on improvements in spawning and rearing habitat conditions. The available information does not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on release practices and the propagation of multiple generations of HOF. Since 1998, HOF effectiveness may be incrementally increasing over time, but is still likely to be quite low, in the 0.30 to 0.45 range (the upper end of the Araki et al. range for a Category 3 program). Supplementation levels and spawner composition data provided in Table 9-5 are used for this analysis except that “post-1998” relative effectiveness should be up to 0.45, not 0.5. This results in survival multipliers between 34 and 88% for the Okanogan population (SCA Quantitative Analysis of Hatchery Actions Appendix).

Another important parameter in estimating natural productivity and assessing risk is the composition of natural spawners (i.e., the proportion of natural spawners composed of HOF and NOF). In this analysis for the Wenatchee, Methow and Okanogan basins, NOAA Fisheries uses available data from supplementation levels over the “most recent 10 years” (Table 8.7.2-1). Assumptions in Table 9-4 of the CA that supplementation will be “significantly reduced from recent averages” and that the proportion of natural spawners composed of HOF will decline dramatically, depend on the increased abundance of natural-origin natural spawners in each

basin and on future Hatchery and Genetic Management Plans that reduce the proportion of natural spawners composed of HOF as the abundance of natural-origin fish increases.

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 83 to 159% for the Wenatchee, Methow, and Okanogan populations (Table 8.2.3-1). This also means that the survival “gaps” described in Table 8.2.2-4 would be proportionately reduced by this amount (i.e., [$\text{“Gap”} \div 1.83$] to [$\text{“Gap”} \div 2.59$], depending on the population and the hatchery effectiveness assumption). For the Entiat population, survival changes would be expected to range from a 2% decline to a 55% increase.

8.7.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.7.3.3 Status of Critical Habitat Under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by UCR steelhead. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

UCR steelhead spawn and rear in the major tributaries to the Columbia River between Rock Island and Chief Joseph dams. Adults reach spawning areas in late spring. Newly emerged fry move about considerably as they seek suitable rearing habitat, moving downstream in the fall in search of suitable overwintering habitat (Chapman et al. 1994). Fry use stream margins and cascades and larger juvenile life stages use progressively deeper and faster water, sheltering behind boulders in the highest gradient riffles and cascades. Most juvenile steelhead spend two or three years in freshwater before migrating to salt water. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by UCR steelhead for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Physical passage barriers [*mortality at hydroelectric projects in the mainstem Columbia River; water withdrawals and unscreened diversions*]

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- Excess sediment in spawning gravels and in substrates that support forage organisms [*land and water management activities*]
- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures [*degraded riparian and channel function*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile steelhead migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]
- Juvenile and adult passage mortality [*hydropower projects in the mainstem Columbia River*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS corridor, the Action Agencies have improved safe passage for juvenile steelhead with the construction and operation of surface bypass routes at Bonneville Dam and other configuration improvements listed in Section 5.3.1.1 in Corps et al. (2007a).

The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For these salmonids, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 9.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although UCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in areas for growth and development to adulthood are not considered further in this consultation.

8.7.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Mainstem Mid-Columbia Hydroelectric Projects

NOAA Fisheries completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County Public Utility Districts in support of the proposed Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91% combined adult and juvenile survival standard for each salmon and steelhead DPS migrating through each project. In addition, compensation for up to 9% unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7% mortality provided through hatchery programs and compensation for up to 2% provided through tributary habitat improvement programs.

In May 2004, NOAA Fisheries also completed an ESA Section 7 consultation on FERC's proposed amendment to the existing license for the Grant County PUD's Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NOAA Fisheries expects that project-related mortalities (i.e., direct, indirect, and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 23.2% for juvenile UCR steelhead. NOAA Fisheries also expects that implementation of the interim protection plan will result in mortality rates of no more than 3% per project or 6% combined for adult UCR steelhead.

Thus, NOAA Fisheries expects the cumulative mortality through the mid-Columbia reach of juvenile UCR steelhead will be 19% for the Wenatchee population; 22% for the Entiat population; and 25% for the Methow population. The total mortality rates (natural and project-related) of adult UCR steelhead are expected to be 4% for adult steelhead returning to the Wenatchee River, 5% for those returning to the Entiat, and 6% for those returning to the Methow.

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Wenatchee River

The USFS proposed fuels reduction projects in the White River–Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, as well as a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River–Nason Creek and Chiwawa River watersheds). The USFS’ project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River–Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project in 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The FHWA/WSDOT consulted on a road construction project in the Wenatchee River–Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River–Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NOAA Fisheries consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the Corps consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River–Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

As part of the Chelan and Douglas PUD’s HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Wenatchee basin. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon, sockeye salmon, and endangered spring Chinook salmon in the Wenatchee basin, which could have effects on natural-origin steelhead, resulting in the issuance of ESA Section 10 permits. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Wenatchee basin.

The BPA consulted on funding the Yakama Nation Tribes’ hatchery program to reintroduce Coho salmon to the Wenatchee basin, which could affect natural-origin steelhead in the Wenatchee basin.

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Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NOAA Fisheries consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River–Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into seven miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to nine miles of habitat in a wilderness area (Middle Methow River watershed). The USFS completed two projects during 2007 under its programmatic consultation with NOAA Fisheries (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp River/North Creek Trail to improve five acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to four miles of stream.

Reclamation consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River–Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

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The FERC consulted on a license amendment for the Wells hydroelectric project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens.

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Methow basin. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon and endangered spring Chinook salmon in the Methow basin that could have effects on natural-origin steelhead. These resulted in the issuance of ESA Section 10 permits. Included in these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Methow basin.

The USFW consulted on the implementation of a hatchery program rearing listed steelhead at Winthrop NFH. They also consulted on the implementation of a hatchery program rearing listed spring Chinook salmon at Winthrop NFH.

The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce coho salmon to the Methow basin that could affect natural-origin steelhead in the Methow basin.

Okanogan

The Corps consulted on a project to install a boat ramp on the Okanogan River (Upper Okanogan River watershed). The FHWA/WSDOT consulted on projects to improve the road between Loomis and Oroville (Upper Okanogan River) and to replace the Salmon Creek Bridge (Salmon Creek watershed).

As part of the Chelan and Douglas PUD's HCPs described, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Okanogan basin. NOAA Fisheries also conducted a separate consultation on a hatchery program of unlisted summer Chinook salmon in the Okanogan basin that could affect the natural population of steelhead. Included in these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Okanogan basin.

The Bureau of Indian Affairs (BIA) consulted on funding the Colville Tribe's hatchery supplementation program in Omak Creek.

Projects Affecting Multiple Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration,

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restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.7.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of UCR steelhead that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including hydroelectric generation, forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Other types of Federal projects such as hydroelectric generation (including the FERC-licensed hydro projects in the mid-Columbia River), forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7

consultation and were found to meet the ESA standards for avoiding adverse modifications of critical habitat.

8.7.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Washington and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Entiat, Methow, Okanagan, and Wenatchee populations as well as actions that will be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.² Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for the Upper Columbia River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of

² The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.7.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.7.5.1, 8.7.5.2, and 8.7.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvements and predator reduction actions, which are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the Hatchery Effects Appendix of the SCA and in this section.

8.7.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions projects are also included in this analysis. These effects on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the effects in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.8.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (from McNary to the Bonneville tailrace) of UCR steelhead from 47.9% (Current) to 52.8% (Prospective), a relative change of 10.2%. Transportation at McNary Dam is expected to occur only in 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs). In this unlikely circumstance, about 75.7% of the juveniles arriving at McNary Dam would likely be transported (see Table 11.7 of the FCRPS Biological Opinion). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely

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low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller, benefit would exist from transportation at McNary Dam.

The COMPASS model estimates that (combined with in-river migrant survivals through the non-Federal mainstem projects) smolt-to-adult returns (McNary Dam to the ocean and back to Rock Island Dam - assuming SR steelhead post-Bonneville survival relationships as a surrogate) will likely increase from 0.58% to 0.63% for Wenatchee River fish (a relative improvement of about 8.5%); 0.53% to 0.58% (a relative improvement of 9.6%) for Entiat River fish; and 0.51% to 0.56% (a relative improvement of 9.7%) for Methow and Okanogan River fish.

These increases are a result of the Prospective Actions and the expected survival improvement from actions implemented as a result of completed biological opinions on the existence and operation of the five mid-Columbia mainstem hydro projects (NMFS 2006e; SCA Hydro Modeling Appendix). These actions are expected to increase the relative survival of in-river migrants to the Bonneville tailrace by approximately 23.5% for the four populations.

The Prospective Hydro Actions addressing hydro operation and the RM&E program should maintain or improve the levels of survival currently observed for adult UCR steelhead migrating from Bonneville Dam upstream to McNary Dam. The current PIT tag based survival estimate, taking account of harvest and “natural” stray rates within this reach, is 84.5% (about 94.5% per project). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The hydro Prospective Actions also are likely to positively affect the survival of UCR steelhead in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams in concert with training spill (amount and pattern) to provide safe egress should reduce juvenile travel times within the forebays of the individual projects, where predation rates are currently often the highest (see Section 8.1). This is likely to result in survival improvements. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating steelhead smolts in tailraces where juvenile mortality rates are relatively high.

Prospective Actions implementing passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, also are likely to benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times, which lead to a reduction in total travel time, may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of

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improvement expected, because the interactions between improved surface passage and improved kelt survival and return rates is not well known. However, some improvement is likely.

The Prospective Actions governing reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks, where they are fed and medicated to enhance survival. Current programs either hold kelts for 3 to 5 weeks and release them below Bonneville, or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Transportation of kelts involves capturing kelts, transporting them to a point downstream of Bonneville dam, and releasing them. Kelt transportation studies in the Snake River found that not only was there an improvement in FCRPS survival of between 4-33% to actual survival of approximately 98% in transported kelts, but also transported kelts returned to Lower Granite dam at a rate of 1.7% versus in-river migrating kelts, which returned at a rate of 0.5% (Boggs and Peery, 2004).

Both transportation and reconditioning of kelts require capture of downstream migrating kelts. Given kelt preference for surface passage and the potential for future implementation of surface passage routes, the number of kelts that can be collected is limited. Upper and Mid-Columbia DPSs present significant challenges to successfully collecting kelts. Existing bypass systems and transportation facilities on the Snake River dams make successful collection of Snake River steelhead more likely. An analysis by Dygert (2007) estimated that 7% (during spill) to 22% (no spill) of the upstream steelhead run could be captured at LGR as downstream migrating kelts. The hydro Prospective Actions would employ collection at both LGR and LGS. NOAA Fisheries analysis of the Prospective Actions suggests that employing a combination of transportation, reconditioning, and in-stream passage improvements could increase kelt returns enough to increase the number of Snake River B-run steelhead spawners by approximately 6%. If logistical difficulties associated with capture of Upper Columbia River steelhead kelts can be overcome, similar benefits could be expected for that DPS as well.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 52.8%. A portion of the 47.2% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of UCR steelhead in a hypothetical, unimpounded Columbia River would be 90.6%. Therefore, approximately 20% (9.4%/47.2%) of the expected mortality experienced by in-river migrating juvenile steelhead is probably due to natural factors.

The direct survival rate of adults through the FCRPS is already relatively high. The prospective actions include additional passage improvements (e.g., to the ladders at John Day and McNary dams). Adult steelhead survival from Bonneville to Priest Rapids Dam will be approximately 84.5% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to yearling migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.7.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Wenatchee population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.7.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Table 9-9, p. 9-14. For targeted populations in this DPS the effect is a 4-14% expected increase in egg-smolt survival, depending on population, as a result of implementing the Prospective Actions tributary habitat projects, which improve habitat function by addressing

significant limiting factors and threats.³Based on the ICTRT population-level criteria (ICTRT 2007a), projects that restore the number of, or improve the size, quality or access to, major and minor spawning areas could have a beneficial effect on population spatial structure. The Action Agencies will address limiting factors by replacing barrier culverts and screen irrigation pumps in the Wenatchee, Entiat, and Methow subbasins (Table 1-b in Attachment B.2.2-2 to Corps et al. 2007b). These passage projects in many instances will enable juvenile steelhead to access rearing habitat in tributaries that are too small to support spawning, but are generally more productive per unit area for rearing than are mainstem settings. The Action Agencies will also fund channel complexity projects and restore streamflows. Channel complexity projects include reconnecting oxbows that were isolated by highway and railroad construction in the Upper Wenatchee (Nason Creek in particular) and reconnecting small side channel habitats in the Methow and Entiat that have been stranded as a consequence of mainstem channel incision.

Effects on Critical Habitat

As describe above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space and safe passage/access.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.7.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Upper Columbia River steelhead (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007 to 2010 is 1.4%. The survival benefit for Upper Columbia River steelhead (stream-type life history) associated with actions to be implemented from 2010 through 2018 is 4.3%. The total survival benefit for Upper Columbia River steelhead as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (CA Section 9.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats used by juvenile steelhead migrants from the upper

³ The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 1a; 4c; and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

Columbia River to increase life history, diversity and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as critical habitat for this species (section 9.3.3.3 in Corps et al. 2007c). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by juvenile steelhead from the Upper Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.7.5.2). The estuary Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by juvenile steelhead from the upper Columbia River.

8.7.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Qualitative assessment of the Prospective Actions was provided in Section 9.3.3.5, page 9-18, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as a new hatchery program in the Okanogan basin and a new kelt reconditioning program for the Wenatchee, Entiat, and Methow populations. Each of these programs will be subject to ESA consultation based on an HGMP developed through BMPs.

The Prospective Actions include the continued funding of hatcheries and the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The Action Agencies intend to adopt these programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs. Site-specific application of BMPs will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44). Available information, principles, and guidance for operating hatchery programs are described in Appendix E of the CA and the SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

The Federal hatchery program in the Upper Columbia preserves genetic resources and reduces short-term extinction risk (SCA Hatchery Effects Appendix). Increasing dependence on the hatchery poses longer-term risk to population diversity and productivity. NOAA Fisheries

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expects that hatchery reform measures will include a plan for reducing the dependence on hatchery fish to spawn naturally as the abundance of natural-origin fish increases.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.7.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stock groups of summer steelhead used for management including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. All UCR steelhead populations are designated A-run steelhead.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are subject to a 2% harvest rate limit on wild steelhead from each steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS. The total annual harvest rate limit for A-run steelhead, for example, is 4%. This is consistent with ESA-related management. The expected harvest impacts on non-Treaty fisheries are less than those proposed. The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.7.5.5-1). Harvest rates for A-run steelhead in non-Treaty fisheries are not expected to change over the course of this Agreement (TAC 2008).

There are no specific harvest rate limits for tribal fisheries on steelhead during the spring or summer seasons which extend through July 31. Some impacts, however, do occur. The harvest rate on A-run steelhead in tribal spring season fisheries has averaged 0.2% from 1985 (Table 8.7.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.7.5.5-1). The harvest rate in fall season fisheries averaged 9.6% since 1985 and 4.2% since 1998 (Table 8.7.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are likely similar to the 1998-2006 average of 4.2%.

With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2% since 1985 (Table 8.7.5.5-1). No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA). Summer

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Chinook were chronically depressed for decades until returns began to increase in 2001. As of 2002, higher runs provided more fishing opportunity. However, there is no evidence of an associated increase in the catch of listed steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001, and 10.9% from 2002 to 2006 (TAC 2008). During those same years, the harvest rate of steelhead averaged 2.3% to 2.4% (Table 8.7.5.5-1). As with spring fisheries, no further changes in future fisheries are expected as a result of the Prospective Action that would lead to changes in the expected catch of steelhead. However, as a result of PIT-tag data, there is recent information regarding adult conversion rates that indicate that more UCR steelhead than SR steelhead are lost in upstream passage. The greater losses may be due to differential harvest rates that currently are not detectable. It is also plausible that the losses are due to timing differences, passage conditions, or some combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

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Table 8.7.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				
1998-06 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

Prospective treaty-Indian fall season fisheries will be managed using the abundance based harvest rate schedule for B-run steelhead contained in the 2008 Agreement (Table 8.7.5.5-2). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance-based harvest rate schedule, harvest may vary from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts on B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide the tribes with greater opportunity to satisfy their treaty right to harvest 50% of the harvestable surplus of fall Chinook in years when conditions are favorable. Even with these provisions, it is unlikely that the treaty right for Chinook steelhead can be fully satisfied. The harvest rate in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate will remain fixed at 2%.

8.7.5.5-2. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	River Mouth URB Run Size	Treaty Total B Harvest Rate	Non-Treaty wildB Harvest Rate	Total Harvest Rate
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries, and thus are the indicator stock used for management purposes. Generally, the status of B-run steelhead is poorer than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead typically are higher because their timing coincides with the return of fall Chinook. A-run steelhead generally return a few weeks earlier, resulting in less susceptibility to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.2% and ranged from 5.4 to 12.4% (Table 8.7.5.5-1).

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The abundance-based harvest rate schedule allows tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size data, a determination can be made as to how often fisheries would be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years. The primary limiting constraint from this retrospective analysis is the abundance of upriver fall Chinook. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.7.5.5-3).

Table 8.7.5.5-3. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries (Upriver fall Chinook run size from TAC 2008, Table 7; B-run Steelhead run size from TAC 2008, Table 12).

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%

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Year			
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.1%

Although the prospective harvest rate schedule will allow the harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty- Indian fisheries have been lower than the allowed rates. Since 1998, the fall season fisheries have been subject to a combined 17% harvest rate limit on B-run steelhead. From 1998 to 2006 the observed harvest rate has averaged 12.7% (TAC 2008).

For fall season fisheries it is necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty-Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.7.5.5-3). This represents a 14% increase over the current harvest rate limit of 15% ($17.1/15.0 = 1.14$). Harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.7.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998 when the current ESA limits were applied, the fall season harvest rate averaged 4.2% while the total harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% ($0.042 * 1.140 = 0.48$) and 7.2%.

The net result will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on *U.S. v. Oregon* memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for this species.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally

disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, identified as a limiting factor for the Wenatchee population (see Habitat Technical Work Group 2006b).

8.7.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Upper Columbia River steelhead from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4 % (CA Attachment F-2, Table 4). Compensatory mortality may occur, but based on the discussion in 8.3.5.6, it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Columbia dams will continue to reduce the number of smolts taken by birds in project forebays and tail races (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.7.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of this document.

8.7.5.8 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.7.5.1 through 8.7.5.8 and are summarized in Table 8.7.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 36 to 54% increased survival, compared to the “current” condition, and 43 to 299% increased survival, compared to the “base” condition.

8.7.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.7.6-1 and 8.7.6-2 and in Figures 8.7.6-1 and 8.7.6-2. In addition to these summary tables and figures, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Additionally, because quantitative short-term extinction risk gaps could not be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.7.6 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and DPS viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Eastern Cascades MPG is the only MPG within the Upper Columbia River steelhead DPS. Because there is only one MPG, Section 8.7.7 applies to both the Eastern Cascades MPG and the entire Upper Columbia River steelhead DPS. All four populations must be viable to achieve the delisting criteria in the Upper Columbia River Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007).

8.7.7 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects on the Upper Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.7.7.1 Potential For Recovery

It is likely that the Upper Columbia River steelhead DPS will trend toward recovery.

The future status of all four populations in the single MPG of UCR steelhead will be improved compared to their current status. It will be improved through a reduction of adverse effects associated with FCRPS and Upper Snake Projects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.7.5, 8.7.6, and 8.7.7.2. These actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning, and tributary habitat improvements for each population. These beneficial actions also completely offset the slightly decreased survival associated with the harvest Prospective Action. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and move closer toward a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.5.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.7.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatcheries, and degradation of tributary and estuary habitat. Prospective habitat improvements will initiate and at least partially correct ICTRT concerns regarding high spatial structure risk for the Okanogan population. The ICTRT has indicated concerns for all four populations relative to high diversity risk, including legacy effects of historical hatchery practices. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions that are appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to result in only a very small change from the current harvest rates in the environmental baseline.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions

also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Some of the problems limiting recovery of UCR steelhead, such as the effects of legacy hatchery practices, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements to address these factors and they can be reasonably implemented within the next 10 years.

Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. This includes a new steelhead study in the Methow to determine hatchery fish effectiveness compared to natural-origin fish and to determine the effects of hatchery fish on population productivity. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the UCR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of some of the metrics indicating a trend toward recovery, discussed below, also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, such as those affecting all four UCR steelhead populations (Section 8.7.5.4), but R/S may be the best indicator of the ability of populations to be self-sustaining without hatchery supplementation. R/S calculations incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

R/S is expected to be less than 1.0 for all four populations after implementation of the Prospective Actions, except under the high base-to-current hatchery assumption for the Entiat population (Table 8.7.6.1-1; Figure 8.7.6-1). Additional management actions would have to more than double the average survival rate to achieve mean R/S greater than 1.0 for the Okanogan and Methow populations.

This result takes into account the range of base-to-current survival improvements estimated to result from changes in hatchery practices that have already been implemented. However, if the percentage of natural-origin fish on the spawning grounds increases, then it is likely that further increases in productivity, as reflected in the R/S estimates, would occur.

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The present analysis does not include any assumptions about future reductions in the hatchery-origin fraction of natural spawners, although such improvements are likely as a result of future changes in Federal and non-Federal hatchery practices. The CA included such an analysis, which demonstrated that if hatchery fractions were to be reduced sufficiently in the future, R/S estimates could be greater than 1.0 for three of the four populations. NOAA Fisheries acknowledges the potential that R/S could be greater than 1.0 for these populations when the natural-origin abundance increases and dependence on hatcheries can be reduced. Since some of the changes are outside the authority of the Action Agencies, and have not yet been fully consulted upon, the potential benefits from such changes have not been included here.

It is, however, important to recognize that the Action Agencies have made substantial progress, within their control, in addressing the factors affecting this DPS. The estimate of juvenile survival through Federal dams in the lower Columbia River under the Prospective Actions is 53% and the estimate of survival through a free-flowing river of equal length is 88% (Section 8.7.5.1). Since achieving a R/S rate of greater than 1.0 will require doubling the survival of the natural spawners for some populations, it is apparent that additional Federal hydropower management actions alone cannot bring this DPS to recovery. It is a reasonable hypothesis that productivity in this DPS is being limited by reduced quality and quantity of spawning and rearing habitat and the residual effects of past Federal and non-Federal hatchery practices using non-native broodstock. The corrective measures already adopted in hatchery practices, together with additional reforms to increase the percentage of natural-origin fish on the spawning grounds and improved hatchery broodstock practices, are likely to reduce these residual effects and increase productivity. However, multiple generations of these better hatchery practices may be required before productivity improves to an adequate level.

Population growth rate (λ) and BRT trend estimates, as calculated in this analysis, are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by hatchery programs, since recovery implies self-sustaining populations absent continuing hatchery supplementation. In particular, λ as calculated in this analysis has limited utility since the UCR steelhead populations are so heavily supplemented.

All three populations in this DPS for which estimates were possible have λ (HF=0) and BRT trends that are expected to be greater than 1.0 with implementation of the Prospective Actions (Table 8.7.6.1-1). This indicates that these populations are expected to continue to increase in abundance in the future, but the contrast in R/S and these trend estimates suggests that the future increase is at least partially explained by second generation hatchery progeny (F_2 generation) spawning naturally. λ estimates that assume that the effectiveness of hatchery-origin spawners is equal to that of hatchery-origin spawners (HF=1) results in estimates similar to R/S estimates, with all populations less than 1.0.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario, 1-2 of the four populations are expected to have R/S trend greater than 1.0, depending upon hatchery base-to-current assumption, compared to all four less than 1.0 under the recent ocean climate scenario (SCA Aggregate Analysis Appendix; Figure 8.7.6-2). Under the ICTRT “Warm PDO” (poor) results are very similar to results based on the current climate scenario, described above.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.
- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S is expected to be less than 1.0 at the lower 95% confidence limit and greater than 1.0 at the upper 95% confidence limit for two of the four populations (SCA Aggregate Analysis Appendix; Figure 8.7.6-1). Confidence limits for lambda and BRT trend are variable, but also generally include a range above and below 1.0. These results suggest that it also is important to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors discussed above indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements.

NOAA Fisheries cannot demonstrate quantitatively that UCR steelhead populations will be increasing without hatchery supplementation (indicated by R/S and lambda with HF=1) as a result of the actions considered in the aggregate analysis, but it is likely that abundance will increase given the aggregate effects, including a continuing supplementation program (indicated by BRT trend and lambda with HF=0). The impact from historic hatchery practices on this species has likely been significant, as has mortality associated with Federal and non-Federal

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hydropower projects in the mainstem Columbia River. However, the difference in current status between Upper Columbia River Spring Chinook Salmon and Upper Columbia River steelhead populations is telling. Listed fish from both species pass through the same hydrosystem. Both occupy habitat that has been similarly impacted by human activity. Biological differences between the species generally do not account for the great discrepancy in their status in the Upper Columbia River, as evidenced by the similar status of SR spring/summer Chinook salmon and SR steelhead. The status of Upper Columbia River steelhead, as evidenced by recruit-per-spawner productivity and other base period biological indicators, is generally much worse than the status of Upper Columbia River Spring Chinook Salmon. Three factors that distinguish steelhead from spring Chinook salmon populations in the Upper Columbia River are harvest rates between 50-90% until the early 1980s, the extremely high proportion of hatchery fish in historical steelhead spawning populations, and the homogenization of hatchery broodstock due to past and present (for the Methow population) broodstock collection practices. To the extent that hatchery practices have contributed to current low productivities for the Wenatchee, Entiat, Methow, and Okanogan populations, hatchery reforms already underway in the Wenatchee (i.e., the use of Wenatchee steelhead for broodstock and reforms to reduce straying into the Entiat) and Prospective Actions to develop a local broodstock for the Methow and Okanogan are expected to improve the situation for the Wenatchee, Entiat, Methow and Okanogan populations. Substantial reduction in the homogenization of the Methow population will require reforms at Winthrop NFH and in the Wells Hatchery program (a hatchery program not funded by the Action Agencies).

It will take a considerable time before legacy hatchery effects are resolved and diversity risk is reduced. Similarly, it will take some time for habitat and other improvements to take effect, which will be necessary before managers conclude that dependence on hatcheries can be reduced. When survival increases and natural-origin abundance grows, dependence on the hatcheries to supplement natural spawning can be reduced (i.e., the fraction of hatchery-origin fish on the spawning grounds can be reduced), in which case it appears that the natural productivity as indicated by R/S will be positive. In the meantime, the current supplementation program, as indicated by expected BRT trend greater than 1.0, suggests that the DPS will be increasing in abundance and trending toward recovery.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.7.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described above and in Sections 8.7.3 and 8.7.5.

As described above, abundance is expected to be stable or increasing and populations are expected to grow as indicated by lambda and the BRT trend. Recent abundance levels are estimated between 94 and 900 spawners, depending on the population, which is well above the QET levels under consideration (Table 8.7.2-1). These factors also indicate a decreasing risk of extinction.

A well-run conservation hatchery program in the Wenatchee reduces short-term extinction risk for the Wenatchee steelhead population. There is no hatchery program for the Entiat. Hatchery programs in the Methow and Okanogan use a composite of listed fish and preserve genetic resources, but they do not currently follow optimum broodstock practices for improving diversity for the Methow and Okanogan populations. The Prospective Actions address only one hatchery program in the Methow basin at Winthrop NFH. Reforms of this program are expected as an outcome of several hatchery program review processes.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. These include a new hatchery effectiveness and effects study in the Methow. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

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In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.2.6, extinction risk after implementing the Prospective Actions cannot be estimated quantitatively. However, because base period extinction risk (assuming no future supplementation) is extremely high, it is likely that short-term extinction risk under the Prospective Actions would also be high if calculated in the same manner. These estimates assume that all hatchery supplementation ceases, which is not a reasonable assumption. Because hatchery supplementation programs now in place will preserve genetic resources into the future, short-term extinction risk is negligible. The sensitivity analysis of Hinrichsen (2008), included as Attachment 1 of the SCA Aggregate Analysis Appendix, indicates that there is 0% chance of short-term extinction risk at QET=50 under continued supplementation for three of the four populations if supplementation programs continue under current management plans. Short-term extinction risk for the Entiat population would be greatly reduced, but would still be greater than 5%.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to near 100% for some populations (Table 8.7.2-3). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that UCR steelhead will have a low risk if all supplementation ceases. However, both qualitative considerations and quantitative sensitivity analyses indicate that short-term extinction risk is low given continuation of current supplementation programs. The combination of recent abundance estimates for average populations, expected survival improvements, expected positive trends for most populations, and supplementation programs that reduce short-term risk indicate that these populations are likely to have a low enough risk of extinction to conclude that the DPS as a whole will have a low risk of short-term extinction.

8.7.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for UCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and Upper

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Columbia/Priest Rapids. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for UCR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem, tributary and estuary land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established to serve the intended conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Upper Columbia River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Upper Columbia River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

Several of the analyses presented above are projections of DPS health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA

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Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in DPS health demonstrated above have been accompanied by regional efforts to protect and restore this DPS, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this DPS.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this DPS will continue to improve.⁴

⁴ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.7.2-1. Status of UCR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: 20-yr non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0) ³	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current ⁴	Lower 95% CI	Upper 95% CI
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	900	1997-2006	1000	0.35	0.22	0.55	1.07	0.83	1.38	0.80	0.62	1.03	1.04	1.00	1.11
		Methow (Summer A)	281	1997-2006	1000	0.21	0.15	0.30	1.09	0.83	1.43	0.67	0.56	0.81	1.07	1.03	1.14
		Entiat (Summer A)	94	1997-2006	500	0.52	0.37	0.73	1.05	0.82	1.36	0.81	0.67	0.97	1.04	1.01	1.12
		Okanogan (Summer A)	104	1997-2006	1000	0.08	0.06	0.11									

1 Most recent year for 10-year geometric mean abundance is 2004-2005, depending upon population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c).

2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years in Cooney (2008a). Actual years in average vary by population.

3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008b).

4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008b).

Table 8.7.2-2. Status of UCR steelhead with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure ¹	ICTRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.40
		Methow (Summer A)	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.10
		Entiat (Summer A)	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.20
		Okanogan (Summer A)	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.06

1 ICTRT conclusions for UCR steelhead are from draft ICTRT Current Status Summaries (ICTRT 2007d).

2 Average fractions of natural-origin natural spawners are from the ICTRT (2007c).

Table 8.7.2-3. Status of UCR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the “base period” of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

ESU	MPG	Population	24-Year Extinction Risk											
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - (Summer A)	0.01	0.00	0.38	0.06	0.00	0.59	0.19	0.00	0.84	0.27	0.00	0.92
		Methow (Summer A)	0.00	0.00	0.82	0.07	0.00	0.99	0.28	0.00	1.00	0.47	0.02	1.00
		Entiat (Summer A)	0.53	0.00	0.67	0.80	0.00	0.95	0.95	0.01	1.00	0.99	0.10	1.00
		Okanogan (Summer A)	0.93	0.18	1.00	1.00	0.56	1.00	1.00	0.71	1.00	1.00	0.77	1.00

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.7.2-4. Changes in density-independent survival of UCR steelhead (“gaps”) necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for UCR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹			Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²			Survival Gap For 20 yr lambda = 1.0 @ HF=1 ²			Survival Gap For 1980-current BRT trend = 1.0 ³			Survival Gap for 24 Yr Ext. Risk <5% (QET=1) ⁴				
			Upper 95% CI	Lower 95% CI		Upper 95% CI	Lower 95% CI		Upper 95% CI	Lower 95% CI		Upper 95% CI	Lower 95% CI		Upper 95% CI	Lower 95% CI			
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	2.85	4.45	1.83	0.75	2.34	0.24	2.76	8.78	0.86	0.85	0.99	0.63					
		Methow (Summer A)	4.68	6.63	3.30	0.69	2.33	0.20	5.90	>10	2.60	0.75	0.88	0.56					
		Entiat (Summer A)	1.93	2.71	1.38	0.80	2.50	0.25	2.60	5.90	1.14	0.84	0.97	0.61					
		Okanogan (Summer A)	12.65	18.17	8.81														

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.7.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.7.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.7.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap could not be calculated for this species (see Aggregate Analysis Appendix).

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Table 8.7.3-1. Proportional changes in average base period survival of UCR steelhead expected from completed actions and current human activities that are likely to continue into the future. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

ESU	MPG	Population	Base-to-Current Adjustment (Divisor)									
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Marine Mammal Predation ⁵	Harvest ⁶	"Low" Hatcheries ⁷	"High" Hatcheries ⁷	Total (Low Hatchery) ⁸	Total (High Hatchery) ⁹
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	1.08	1.02	1.00	1.00	1.00	1.04	1.60	1.60	1.83	1.83
		Methow (Summer A)	1.25	1.02	1.00	1.00	1.00	1.04	1.17	1.55	1.55	2.06
		Entiat (Summer A)	1.13	1.02	1.00	1.00	1.00	1.04	0.82	1.30	0.98	1.55
		Okanogan (Summer A)	1.25	1.06	1.00	1.00	1.00	1.04	1.34	1.88	1.85	2.59

1 From SCA hydro appendix. Based on differences in average base and current smolt-to-adult survival estimates for both FCRPS and PUD dams.

2 From CA Chapter 9, Table 9-7.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.

5 SCA Marine Mammal Appendix. No populations in this DPS are winter-run.

6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

6 From SCA Quantitative Analysis of Hatchery Actions Appendix

8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column, except for the high hatchery estimate.

9 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column, except for the low hatchery estimate.

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Table 8.7.5-1. Proportional changes in survival of UCR steelhead expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)									
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Kelt Reconditioning ⁶	Marine Mammal ⁷	Allowable Harvest ⁸	Expected Harvest ⁹	Hatcheries ⁹
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	1.23	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Methow (Summer A)	1.23	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Entiat (Summer A)	1.23	1.08	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Okanogan (Summer A)	1.23	1.14	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)				Total (Expected Harvest) ¹¹	Total (Expected Harvest) ¹¹	High	Low
			Non-Hydro With Allowable Harvest ¹⁰	Non-Hydro With Expected Harvest ¹⁰	Total (Allowable Harvest) ¹¹	Total (Expected Harvest) ¹¹			Total Base-Current and Current-Future ¹²	Total Base-Current and Current-Future ¹²
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	1.14	1.14	1.41	1.41	2.58	2.58		
		Methow (Summer A)	1.14	1.14	1.41	1.41	2.18	2.89		
		Entiat (Summer A)	1.19	1.19	1.46	1.46	1.43	2.26		
		Okanogan (Summer A)	1.25	1.25	1.54	1.54	2.85	3.99		

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates for both FCRPS and PUD dams.

2 From CA Chapter 9, Table 9-9.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 SCA Kelt Reconditioning Appendix

7 SCA Marine Mammal Appendix. No populations in this DPS are winter-run.

8 From SCA Harvest Appendix. Primary source: memorandum from US v. Oregon ad hoc technical workgroup.

9 No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative .

10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

11 Same as Footnote 10, except it is calculated from all Prospective Actions, including hydro actions.

12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multipliers (with high and low hatchery estimates) from Table 8.7.3-1.

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Table 8.7.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for UCR steelhead. Low and high productivity estimates are a result of the range of changes in hatchery-origin spawner effectiveness from the base to the current conditions, as described in Section 8.7.3.1 and CA Section 9.3.1.5.

Low Base-to-Current Hatchery Adjustment

ESU	MPG	Population	Low Base-to-Current Hatchery Adjustment				ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ²
			20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³				
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	0.90	1.32	0.98	2.67	Two must be HV and 1 must be V	Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <1	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Methow (Summer A)	0.47	1.29	0.80	2.32		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <3	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Entiat (Summer A)	0.74	1.14	0.88	1.48		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <4	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Okanogan (Summer A)	0.23					R/S<1	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)

High Base-to-Current Hatchery Adjustment

ESU	MPG	Population	High Base-to-Current Hatchery Adjustment				ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ²
			20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³				
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	0.90	1.32	0.98	2.67	Two must be HV and 1 must be V	Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <3	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Methow (Summer A)	0.62	1.38	0.85	3.08		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <5	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Entiat (Summer A)	1.17	1.26	0.97	2.35		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <6	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Okanogan (Summer A)	0.32					R/S<1	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)

1 Calculated as the base period 20-year R/S productivity from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1.

2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

4 From ICTRT (2007c), Attachment 2

5 From Table 8.7.2-2

Figure 8.7.6-1. Summary of prospective mean R/S estimates for UCR steelhead under the “recent” climate assumption, including 95% confidence limits.

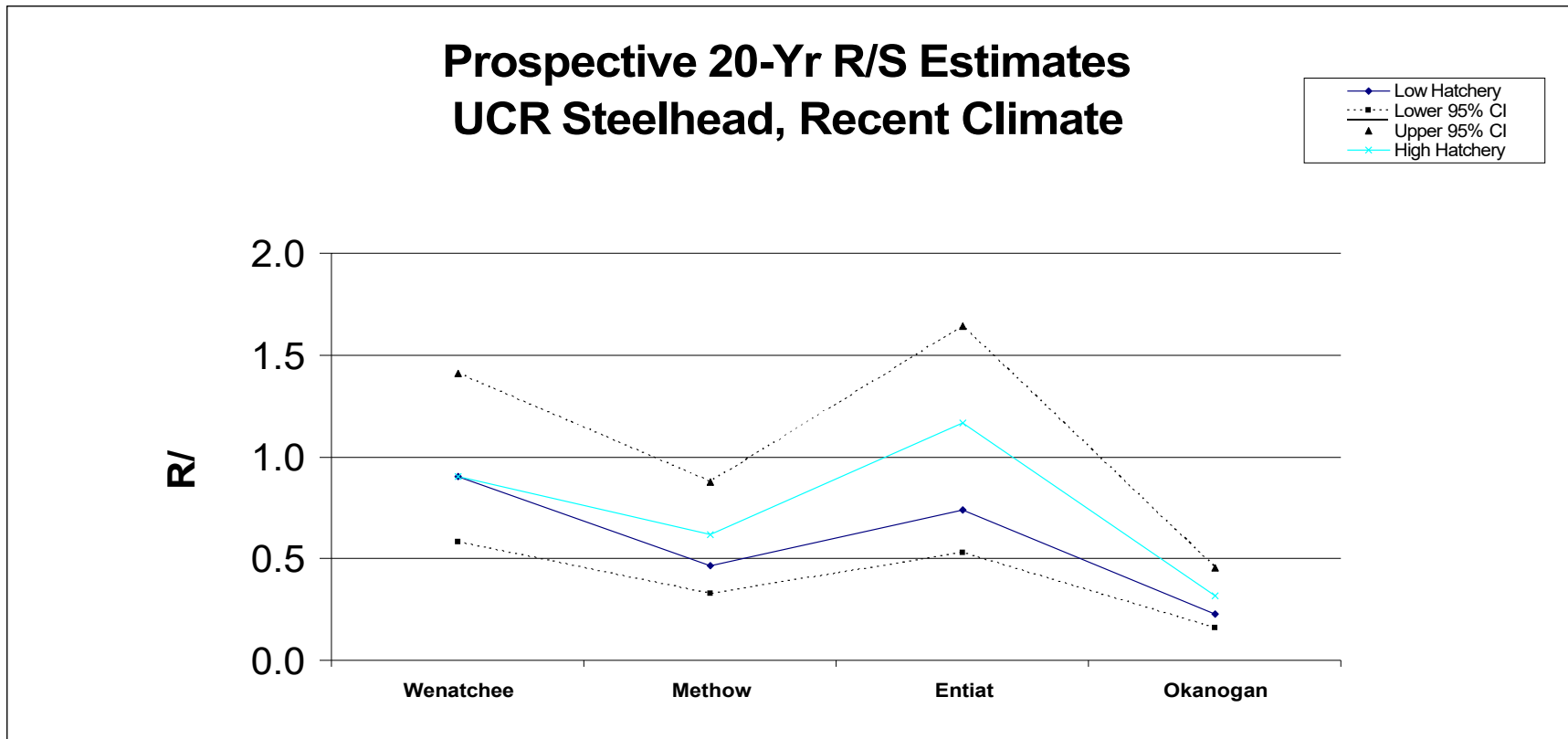
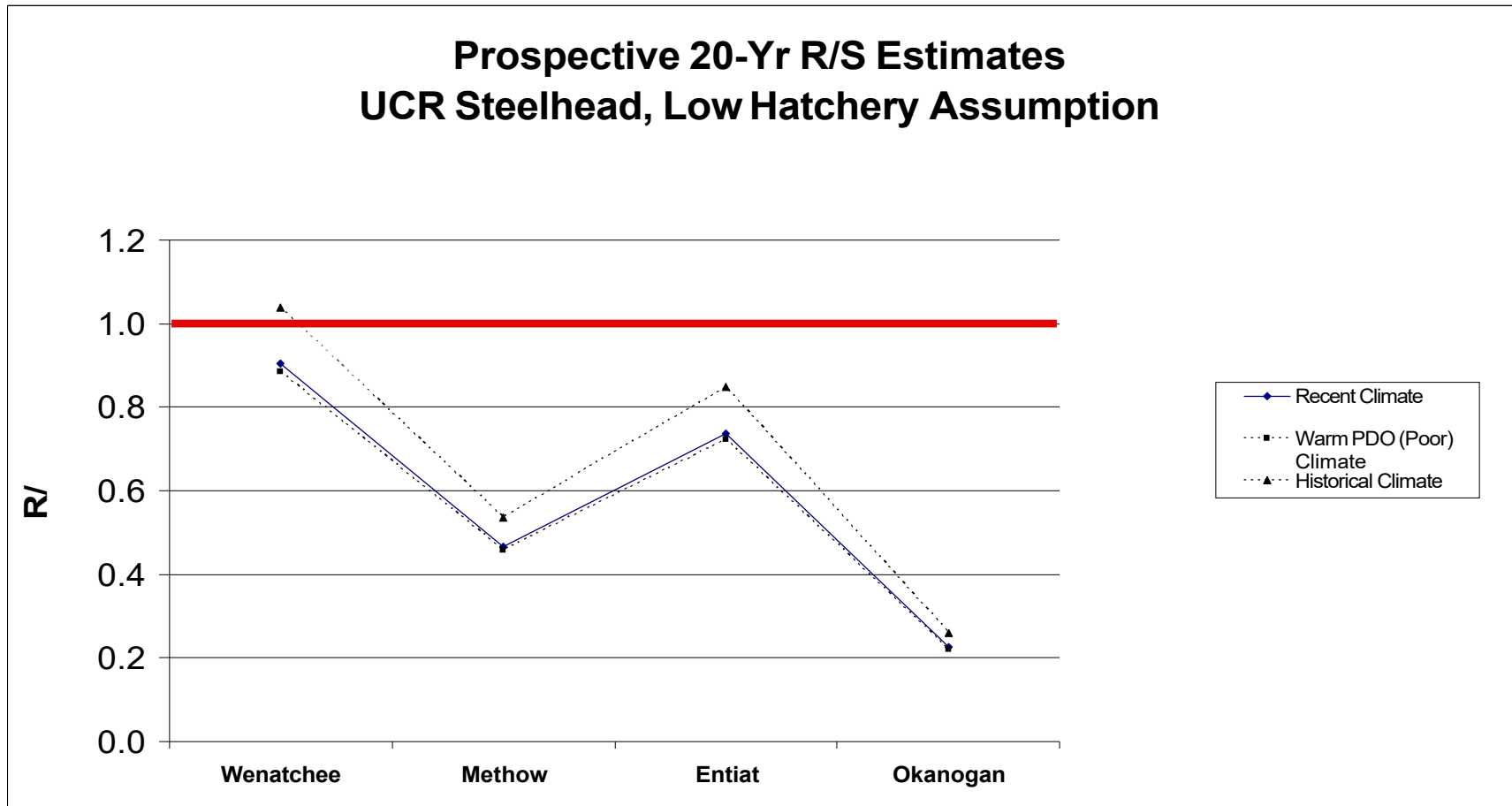
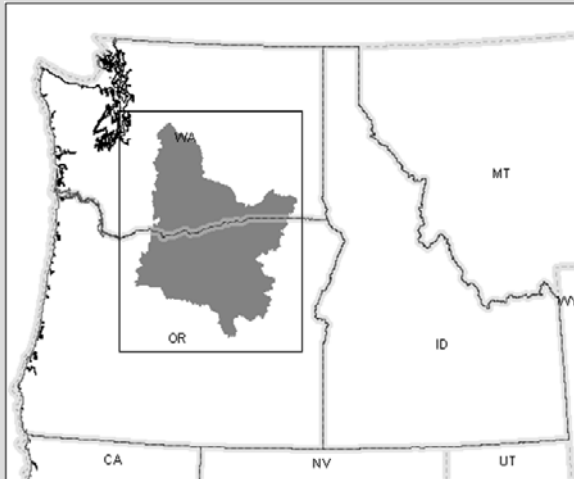


Figure 8.7.6-2. Summary of prospective mean R/S estimates for UCR steelhead under three climate assumptions.



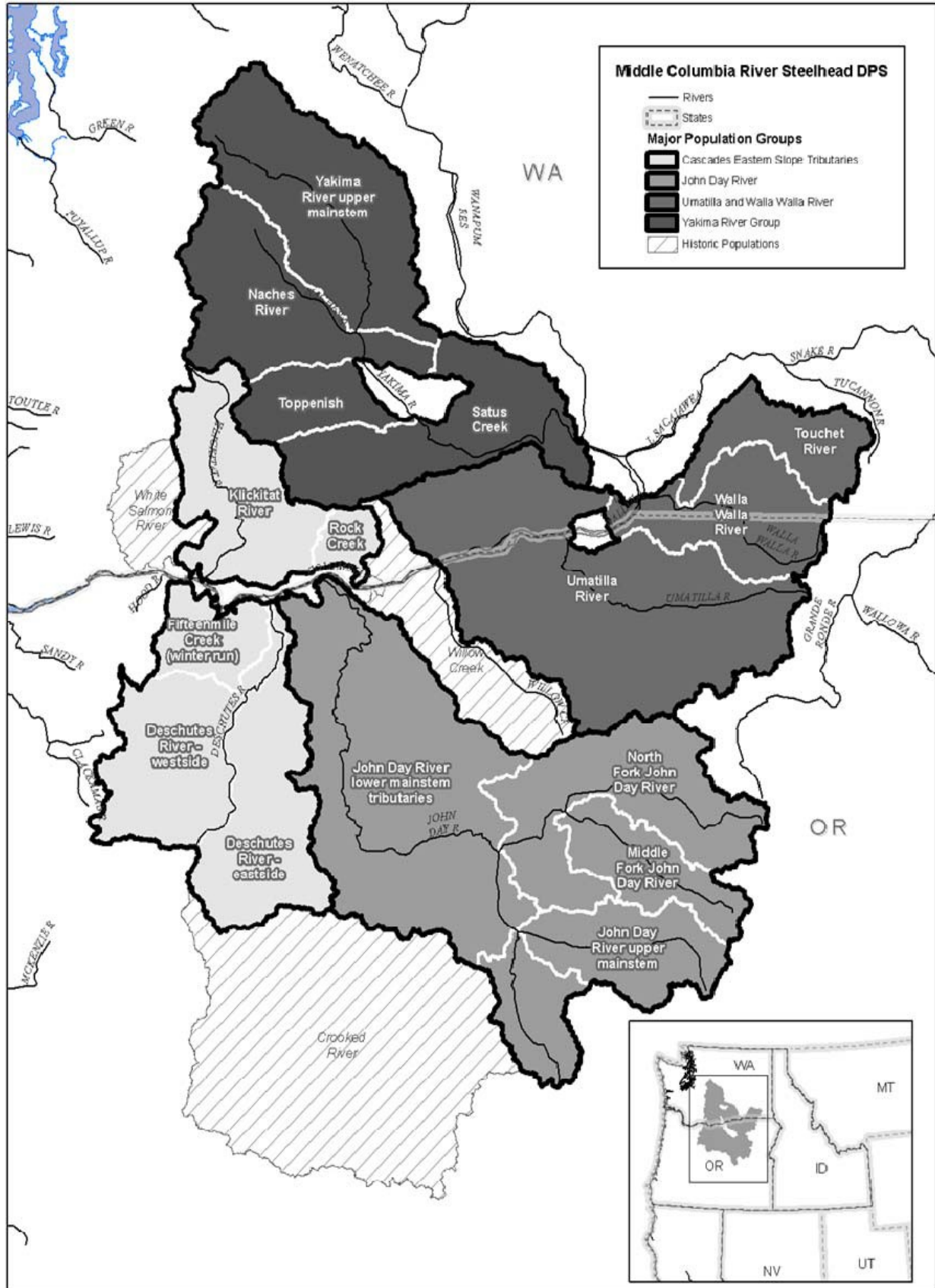
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Section 8.8 Middle Columbia River Steelhead



- 8.8.1 Species Overview
- 8.8.2 Current Rangewide Status
- 8.8.3 Environmental Baseline
- 8.8.4 Cumulative Effects
- 8.8.5 Effects of the Prospective Actions
- 8.8.6 Aggregate Effects by MPG
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Section 8.8

Middle Columbia River Steelhead

Species Overview

Background

The Middle Columbia River (MCR) Steelhead DPS includes anadromous populations in Oregon and Washington subbasins upstream of the Hood and Wind River systems to and including the Yakima River. There are four major population groups with 17 populations in this DPS. Almost all populations are summer-run fish; two winter-run populations return to the Klickitat and Fifteenmile Creek watersheds. Blockages have prevented access to sizable historical production areas in the Deschutes, White Salmon, and White Salmon rivers. The Middle Columbia River Steelhead DPS was listed under the ESA as threatened in 1999, reaffirmed in 2006.

Designated critical habitat for MCR steelhead includes all Columbia River estuarine and river reaches proceeding upstream to the confluence of the Yakima River and a number of tributary subbasins.

Current Status & Recent Trends

During the most recent 10-year period for which trends in abundance could be estimated, they were positive for approximately half of the populations and negative for the remainder. On average, when only natural production is considered, most of the MCR steelhead populations have replaced themselves.

Limiting Factors and Threats

Historically, the key limiting factors for MCR steelhead include mainstem hydropower projects, tributary habitat and hydropower, water storage projects, predation, hatchery effects, harvest, and estuary conditions. Ocean conditions have been generally poor over most of the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on Middle Columbia River steelhead is assumed to be zero. The MCR steelhead DPS is made up of mostly summer run populations, although there are a few populations with winter run timing. The summer run populations are all categorized as A-run based on run timing and age and size characteristics.

Fisheries in the Columbia River are limited to assure that the incidental take of ESA-listed Middle Columbia River steelhead does not exceed specified rates. Non-Treaty fisheries were subject to a 2% harvest rate limit on A-run steelhead. Treaty Indian fall season fisheries were subject to a 15% harvest rate limit on B-run steelhead, but were not subject to a particular A-run harvest rate constraint since B-run steelhead are generally more limiting. Recent harvest rates on Middle Columbia River A-run steelhead in non-Treaty and treaty Indian fisheries ranged from 1.0% to 1.9%, and 4.1% to 12.4%, respectively.

The yearly incidental catch of winter-run steelhead populations in non-Treaty fisheries has averaged 1.9% and has ranged from 0.2 to 9.3% since 2001. The high harvest rate observed in 2002 (i.e. 9.3%) was due to a lack of proper in-season management guidelines. These guidelines were subsequently corrected in 2003 and have been in place since that time. The yearly incidental take of winter-run steelhead populations in tribal fisheries, which is limited to winter populations above Bonneville Dam, has averaged 2.2% and has ranged from 0.8 to 5.8% since 2001.

8.8.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.8.2.1 Current Rangewide Status of the Species

Middle Columbia River (MCR) steelhead is a threatened species composed of 17 extant anadromous populations in four major population groups (MPG). Key statistics associated with the current status of MCR steelhead are summarized in Tables 8.8.2-1 through 8.8.2-4. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. MCR steelhead are all A-run fish.

Limiting Factors & Threats

The key limiting factors and threats for MCR steelhead include hydropower projects, tributary habitat and in-basin hydropower, predation, hatchery effects, harvest and estuary conditions. Ocean conditions generally have been poor over most of the last 20 years, improving only in the last few years. Limiting factors and threats are discussed in detail in the context of critical habitat in Section 8.8.3.3.

Abundance

For three of the 14 populations with estimates of recent abundance, average abundance over the most recent 10-year period is above the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.8.2-1).¹ The remaining 11 populations have lower average abundance than the ICTRT abundance thresholds. Abundance for most populations was relatively high during the late 1980s, declined to low levels in the mid-1990s, and increased to levels similar to the late 1980s during the early 2000s (Figure 8.8.2-1, showing annual abundance of combined populations).

Figure 8.8.2-1 shows the aggregate abundance of all populations and rolling 5-year geometric mean of abundance for the DPS as a whole. The 1980 to 2002 and the 1990 to 2002 DPS-level trends indicate a declining trend over 1980 to 2002 and an increasing trend for 1990-2002. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to the most recent period was 17,553 compared to 7,228 for the 1996 to 2000 period, a 143 percent improvement (all aggregate population abundance trend information from Fisher and Hinrichsen 2006). The 5-year geometric mean in 2002 was still less than the 5-year geometric mean in 1988.

¹ BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 11, 2006 (NMFS 2006h, i).

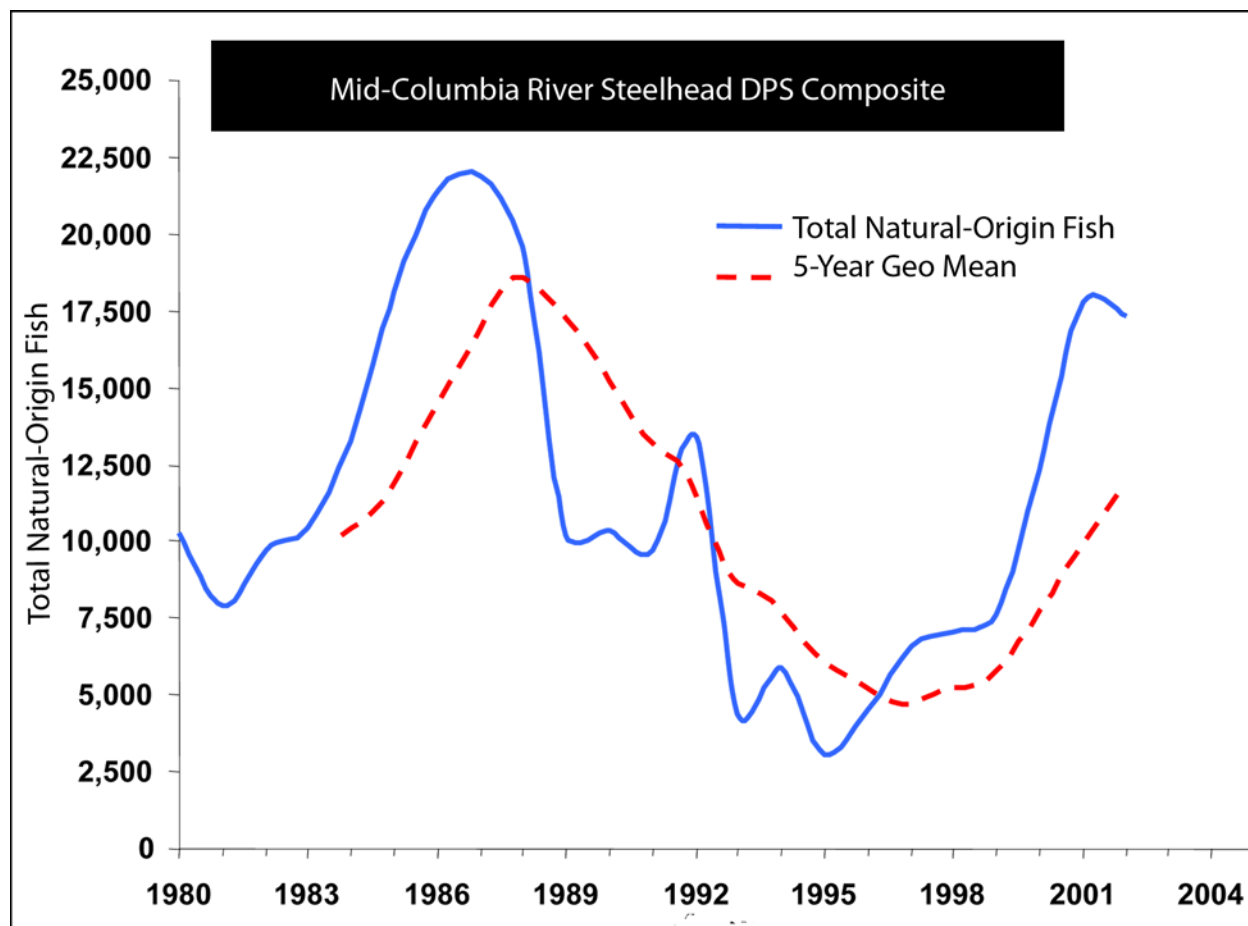


Figure 8.8.2-1. Middle Columbia River Steelhead Abundance Trends (adopted from Fisher and Hinrichsen 2006).

“Base Period” Productivity

Over the last 20 full brood year returns, of the MCR steelhead populations for which estimates are available, most have replaced themselves ($R/S > 1.0$) and a few have not ($R/S < 1.0$; Table 8.8.2-1) when only natural production is considered. These estimates are based on brood years [BY] starting in 1979-1985, depending on population, and ending in 1998 or 1999, including adult returns through 2004 or 2005. In general, R/S productivity was relatively high during the early 1980s, lower during the late 1980s and 1990s, and high again in the most recent brood years (Cooney 2008a)

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at $\leq 5\%$ extinction risk for most of the populations and has been at or above the identified levels for a few (ICTRT 2007c).

The BRT trend in abundance was at or above 1.0 during this period for about half of the populations for which this trend could be estimated and less than 1.0 for the remainder (Table 8.8.2-1). Estimates

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of median population growth rate (λ) when calculated with the assumption that the effectiveness of hatchery-origin and natural-origin spawners are equal ($HF=1$; Table 8.8.2-1) were similar to the BRT trend results. Under the $HF=0$ assumption, most populations have population growth rates greater than 1.0.

Spatial Structure

The ICTRT characterizes the spatial structure risk to MCR steelhead populations as “very low” to “moderate” for all populations except the Upper Yakima (Table 8.8.2-2). This population has “high” diversity risk because 7 of 10 historical major spawning areas are not occupied.

Diversity

The ICTRT characterizes the diversity risk to all but one MCR steelhead population as “low” to “moderate” (Table 8.8.2-2). The Upper Yakima is rated as having “high” diversity risk because of introgression with resident *O. mykiss* and loss of presmolt migration pathways.

“Base Period” Extinction Risk

The draft ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the “base period” described above for R/S productivity estimates, as “Moderate” (6-25% 100-year extinction risk) for most MCR steelhead populations. One population (North Fork John Day) has “very low” (<1%) risk and four populations (Rock Creek, Touchet, Toppenish, and Upper Yakima) have “high” (>25%) risk. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.8.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for each population. This short-term extinction risk analysis is also based on the assumption that productivity observed during the “base period” will be unchanged in the future. At QET=50, most of the populations, for which short-term risk could be estimated, had <5% risk of short-term extinction. Confidence limits on these estimates are extremely wide, ranging from 0 to 100% risk of extinction for some populations.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. However, for this species, alternative QET estimates had no effect on the number of populations with <5% risk of short-term extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current

levels for those populations affected by hatchery programs, short-term extinction risk is likely to be lower, as evidenced by analyses for SR fall Chinook, SR spring/summer Chinook, and UCR steelhead (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 are displayed in Table 8.8.2-4. Mean base period R/S survival gaps range from no needed change to 16%, no needed change to a 21% improvement for lambda, and BRT trend survival gaps range from no change to 26%. It is not possible to estimate survival changes necessary to reduce short-term extinction risk to $\leq 5\%$ using the methods employed in this analysis, as described in Chapter 7. However, because base extinction risk is $< 5\%$ for most populations, there would be no gap except for a few populations.

8.8.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for MCR steelhead includes all Columbia River estuarine areas and river reaches in the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids (NMFS 2005b). There are 114 watersheds within the range of this DPS. Nine watersheds received a low rating, 24 received a medium rating, and 81 received a high rating of conservation value to the DPS (see Chapter 4 for more detail). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in three of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 6,529 miles of habitat areas eligible for designation, 5,815 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.8.3.3.

8.8.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.8.3.1 "Current" Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section estimates of productivity and extinction risk were based on performance of populations during a 20-year “base period,” ending with the 1998 or 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, the CA includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Section Chapter 7.1 of this document. Results are presented in Table 8.8.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 4% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in dam configuration and operation (approximately a 0-2%² survival change, based on ICTRT base survival and COMPASS analysis of current survival in Corps et al. 2007a Appendix B), and estuary habitat projects (a less than 1% survival change, based on Corps et al. 2007a Appendix D) result in a survival improvement for all MCR steelhead populations. Tributary habitat projects result in approximately 0-4% survival improvements, depending on population (CA Chapter 10, Table 10-8). A conservation hatchery program for the Umatilla population, (see SCA Hatchery Effects Appendix,) and a kelt reconditioning program affecting four Yakima River populations improved survival, but the effects could not be quantified. In contrast, development of tern colonies in the estuary in recent years results in less than a 1% reduction in survival for all populations. Also, marine mammal predation probably reduced survival by 8% for the one winter-run population to which quantitative estimates can be applied (Fifteenmile Creek).

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to decrease 19% for the Fifteenmile Creek population and increase 4-10% for the other populations (Table 8.8.3-1). This also means that the survival “gaps” described in Table 8.8.2-4 would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.01] to [“Gap” ÷ 1.22], depending on the population).

² These numbers probably underestimate the survival improvements made between the base and current periods because they depend upon “average per project survival estimates.” This approach may overestimate base period survival at the larger Columbia River projects. Thus these estimates should be viewed as conservative, showing smaller survival improvements than are likely to have actually occurred.

8.8.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.8.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by MCR steelhead. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

Middle Columbia River steelhead spawn and rear in tributaries to the Columbia River upstream from the Wind River to and including the Yakima (but excluding the Snake) River. Almost all populations are summer-run fish. Juveniles from most of the populations in this DPS rear in the tributaries for 1 to 2 years before outmigrating. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by MCR steelhead for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]
- Excess sediment in spawning gravels and in substrates that support forage organisms [*land and water management activities*]
- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures [*degraded riparian and channel function*]
- Degraded water quality [*toxics from agricultural runoff; high temperatures due to water withdrawal/return practices*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water

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quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile steelhead migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]
- Juvenile and adult mainstem passage mortality [*hydropower projects in the mainstem Columbia River; northern pikeminnows and other fish predators*]
- Pinniped predation on adults due to habitat changes in the lower river [*existence and operation of Bonneville Dam and an increased sea lion population*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the FCRPS Action Agencies have improved safe passage through the hydrosystem for juvenile steelhead from the mid-Columbia River with the configuration and operational improvements listed in section 10.3.1.1 in Corps et al. (2007a).

The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For these salmonids, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 10.3.1.3 in Corps et al. 2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult winter steelhead in the tailrace of Bonneville Dam (NMFS 2008d).³ This action is expected to increase the survival of winter steelhead by 7.6%.

Areas for Growth & Development to Adulthood

Although MCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River

³ Winter-run steelhead return to the Klickitat River and Fifteenmile Creek watersheds.

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NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in areas for growth and development to adulthood are not considered further in this consultation.

8.8.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

John Day River MPG

Lower Mainstem John Day

The USFS consulted on three grazing allotment projects and one culvert replacement project in the Lower John Day River—Kahler Creek watershed.

The Corps consulted on the permit for replacing boat docks at Philippi Park at River Mile 3 on the John Day River (Lower John Day River—McDonald Ferry watershed) and a culvert replacement in Wheeler Creek (Lower John Day River—Kahler Creek watershed). The latter project included the construction of step pools and rock weirs to enhance fish passage conditions.

The National Park Service consulted on two pest management projects in the Bridge Creek and Lower John Day River—Clarno Rapids watersheds, respectively. The BLM replaced a push-up dam with a screened water withdrawal facility that allows safe passage and planted cottonwoods along three stream miles to improve shading and provide a future source of LWD in Bridge Creek (Bridge Creek watershed). BLM also consulted on projects to fence off one stream mile in the Lower John Day River – Scott Canyon watershed and to convert an agricultural field to perennial grasses and cottonwood trees in the Lower John Day River – Butte Creek watershed. Both projects were intended to improve riparian conditions including cooler water temperatures. The cottonwoods will provide a future source of LWD.

North Fork John Day

The USFS consulted on eight grazing allotment projects in the North Fork John Day River - Big Creek, Upper Camas Creek, Lower Camas Creek, and North Fork John Day River-Potamus Creek, Wall Creek, and Cottonwood Creek watersheds. The USFS also consulted on a project to reroute the Round Meadows Trail in the Upper Camas Creek and a vegetation management project in the Wall Creek watershed. In Granite Creek, the USFS proposed to move historical mine tailings from Clear Creek (Granite Creek watershed), reconnect the creek with its floodplain, and install large woody debris. The latter project was expected to improve cover, shade, and forage conditions.

The BLM consulted on two bridge repair/replacement projects in the North Fork John Day River - Potamus Creek watershed, one at Skull Canyon and one at Stoney Creek. Both projects included stormwater runoff facilities. The FHWA/ODOT consulted on a culvert retrofit on Beech Creek in the

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Cottonwood Creek and projects to replace the Monument and Kimberly bridges in the Lower North Fork John Day River watersheds. The culvert retrofit was expected to enable year-round safe passage and shade (from riparian plantings). The bridge replacements increased the amount of impervious surface at each site but also reduced chronic stormwater inputs and restored shade and cover conditions along the streambank (tree plantings).

Middle Fork John Day

The USFS consulted on three culvert replacement projects on Bridge Creek and Lunch Creek in the Upper Middle Fork John Day River watershed; all were designed to improve fish passage. The USFS also consulted on two riparian planting projects (Flood Meadows and Southeast Galena) in the Camp Creek watershed and two grazing allotment projects in the Big Creek and Long Creek watersheds, respectively.

The FHWA/ODOT consulted on a project to remove four culverts, build four bridges, and improve the stream channel and riparian vegetation on Bridge Creek in the Upper Middle Fork John Day River watershed. The project was expected to restore passage and riparian function and to otherwise improve stream channel function.

South Fork John Day

The USFWS consulted on the effects of water withdrawals and herbicide applications related to managing the Philip W. Schneider Wildlife Area in the Murderers Creek watershed. The project was expected to have small, local negative effects on water quantity, water temperatures, and water quality and sublethal effects on fish condition.

The BLM consulted on a project to develop springs in upland areas of the Middle South Fork John Day watershed, improving streambank and riparian conditions.

Upper Mainstem John Day

The USFS consulted on three grazing allotment projects in the Upper John Day River, Canyon Creek, and Laylock Creek watersheds, respectively. The Corps consulted on a bank stabilization project along 110 feet of the south bank of the John Day River (Laylock Creek watershed) and the installation of stream barbs at River Mile 236 (Upper Middle John Day watershed). The latter project was designed to reduce erosion and support the re-establishment of riparian vegetation by moving flow away from the south bank. The FHWA/ODOT consulted on culvert retrofits at seven locations in Beech Creek (Beech Creek watershed) which were designed to improve fish passage. Riparian plantings were expected to increase shade and thereby to lower instream temperatures. The National Park Service consulted on a vegetation management project in the Rock Creek watershed.

Yakima River Group MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Toppenish River population.

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Yakima River Upper Mainstem

The USFS consulted on a timber sale in the Upper Yakima River watershed and a fuels reduction project and two mining plan projects in the Middle Yakima River watershed. The Corps consulted on permits for a bank stabilization project in the Upper Yakima watershed; maintenance dredging and bank stabilization in the Tenaway River watershed; erosion control and habitat restoration; breakwater, dock, and boat ramp repairs; and installation of a natural gas pipeline in the Middle Yakima River watershed; two fish passage projects in the Yakima River – Umatanum Creek watershed; and dredging at an irrigation withdrawal in the mainstem Columbia River (Upper Lake Wallula). The BLM consulted on campground construction in the Yakima River – Umatanum Creek watershed.

The Department of the Army consulted on several projects at the Yakima Training Center in the Middle Yakima River watershed: a plan for erosion control and resource sustainability, the use of military explosives, facilities repairs, bridge repairs, bank stabilization and riparian improvements, and a plan to modify aerial fire suppression requirements.

The NRCS consulted on habitat restoration in the Yakima River – Umatanum Creek watershed. Reclamation consulted on a fish ladder at a diversion dam, a watercraft barrier at an irrigation wasteway water diversion, a permit for a bank protection structure (Middle Yakima River watershed), and a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula).

Naches River

The USFS consulted on a recreation management plan for the Little Naches River watershed and a habitat restoration project in the Naches River – Rattlesnake Creek watershed. USFWS consulted on a wildlife area management plan, the Corps consulted on a bank protection and enhancement project, and Reclamation consulted on bridge repairs and a project to improve fish passage and reduce fallback at a diversion dam in the Naches River – Tieton River watershed. The FHWA/WSDOT consulted on road construction and NOAA Fisheries consulted with itself on funding a barrier removal project in the Ahtanum Creek watershed. The Department of the Army consulted on several projects at the Yakima Training Center in the Upper Lower Yakima River watershed involving the use of military explosives and erosion control. Reclamation consulted on the acquisition of water rights in the Upper Lower Yakima River watershed and a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula). The Corps consulted on dredging at an irrigation withdrawal structure in the mainstem Columbia River (Upper Lake Wallula).

Satus Creek

The USFWS consulted on management of a wildlife refuge in the Yakima River – Spring Creek watershed. The Department of the Army consulted on an erosion control project at the Yakima Training Center and the Corps consulted on a permit for a diffuser at a waste disposal site in the Yakima River – Cold Creek watershed. The Corps also consulted on dredging at an irrigation withdrawal structure in the mainstem Columbia River (Upper Lake Wallula). Reclamation consulted on a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula).

Walla Walla & Umatilla Rivers MPG

Umatilla River

The USFWS consulted on management of a wildlife refuge (Upper Lake Umatilla) and a wildlife area (Lower Umatilla River watershed). The Corps consulted on construction of a pipeline and a dredging project in the Upper Lake Umatilla watershed; construction of a fuel dock and improvements to fish passage at a water withdrawal location in the Middle Lake Umatilla watershed; fish passage improvements on the West Fork of Birch Creek (Birch Creek watershed); bank stabilization and riparian improvements; repair of a railroad bridge and two road construction/maintenance projects in the Umatilla River – Alkali Canyon watershed; and repair/construction of a boat ramp in the Lower Umatilla River watershed.

The USFS consulted on road construction/maintenance in the Upper Umatilla River watershed, Reclamation consulted on a gravel removal project at a fish weir in the McKay Creek watershed. The FHWA/ODOT consulted on a culvert replacement in the McKay Creek watershed and structural improvements at a highway interchange in the Umatilla River – Alkali watershed.

Willow Creek

The Corps consulted on construction of a commercial dock in the Lower Lake Umatilla watershed.

Walla Walla River

The BLM consulted on a recreation management plan for the Upper Walla Walla River watershed. FHWA/WSDOT consulted on a road construction project in the Mill Creek – Walla Walla River watershed and a bridge replacement project in the Cottonwood Creek watershed. The Corps consulted on several projects in the Cottonwood Creek watershed: several culvert replacements, replacement of a push-up dam at a water diversion, and bridge replacements. All of these projects were expected to improve fish passage. The USFWS consulted on a stream rehabilitation project in Cottonwood Creek.

Touchet River

The Corps consulted on a fish passage project in the Upper Touchet River watershed; a bridge repair project with habitat enhancement elements (LWD, habitat heterogeneity, substrate availability) in the Middle Touchet watershed; and fire suppression in the Upper Touchet watershed.

Cascade Eastern Slope Tributaries MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the White Salmon River, Klickitat River, Deschutes West, Deschutes East, Crooked River or Rock Creek populations.

Fifteenmile Creek

The Corps consulted on permits to dredge a culvert outlet and to drill exploratory holes for a bridge repair project in the Fifteenmile Creek watershed, improve railroad facilities in the Fivemile Creek watershed, replace culverts in the Middle Columbia River – Mill Creek watershed, and build a waterfront park and excavate a retention basin in the Mosier Creek watershed. The USFS consulted on a grazing allotment in the Middle Columbia River – Mosier Creek watershed.

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.8.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs

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establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of MCR steelhead. Some will improve access to blocked habitat, riparian condition, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including grazing allotments, dock and pier construction, and bank stabilization will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on

some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding in any adverse modification of critical habitat.

8.8.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Walla Walla, Deschutes, North Fork John Day, and other populations as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.⁴ Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for Middle Columbia River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and

⁴ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.8.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Section 8.8.5.1 and 8.8.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions, which are expected to be beneficial. These beneficial effects are described in Sections 8.8.5.2, 8.8.5.3, and 8.8.5.6. Some RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects, as described in Section 8.8.5.7.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix. The Prospective Actions will ensure continuation of the beneficial effects of supplementation hatcheries and will reduce adverse impacts of other hatchery programs.

8.8.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions projects also are included in this analysis. These effects on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (see SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions (compared to the Current condition) is expected to increase the in-river survival of MCR steelhead by 0.3%, 5.1%, 8.2% and 10.2% for those populations migrating through the one to four dams in the lower Columbia River.⁵ Transportation at McNary Dam is expected to

⁵ For MCR steelhead, the in-river survival estimate and total system survival estimate are virtually identical because no fish are likely to be transported in 69 out of 70 years (>98% of the time) in the 70-year water record. This is even truer for MCR steelhead than for UCR steelhead because the great majority of the populations enter the Columbia

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occur in only 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs. In this unlikely circumstance, about 75.7% of the juveniles from the Yakima and Walla Walla River populations arriving at McNary Dam would likely be transported (see Table 11.7 of the FCRPS Biological Opinion [NMFS 2008a]). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller, benefit would exist from transportation at McNary Dam.

Because this DPS migrates through only one to four mainstem hydro projects, NOAA Fisheries does not have confidence that the SR steelhead post-Bonneville survival relationships could be used as a surrogate for estimating SARs for MCR steelhead populations. NOAA Fisheries made no attempt to estimate SARs for this DPS with the COMPASS model, thus assuming that no differences in post-Bonneville survival would be observed between the Current and Prospective conditions.

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult MCR steelhead migrating from Bonneville Dam upstream to MCN Dam. The current PIT tag based survival estimate, taking account of harvest and “natural” stray rates within this reach, is approximately 98.5% per project (a total of 95.6 %, 97.0%, and 98.5% for fish passing three, two, and one projects, respectively). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the hydro Prospective Actions.

The Prospective Actions are also likely to positively affect the survival of Mid-Columbia steelhead in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects for Yakima and Walla Walla river populations (which migrate through both dams) and for the Umatilla and John Day river populations (which migrate through John Day dam alone). This is likely to result in survival improvements in the forebays of these projects, where predation rates currently are often the highest. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating fall Chinook smolts in tailraces where juvenile mortality rates are relatively high.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the

River downstream of McNary Dam and are therefore not subject to transportation under any circumstance (only the Yakima and Walla Walla River populations enter the mainstem Columbia River upstream of McNary Dam).

tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 52.4% for fish passing four dams and to 90.3% for fish passing one dam. A portion of the 9.7% to 47.6% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a hypothetical free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of MCR steelhead in a hypothetical unimpounded Columbia River would be 90.6% for fish migrating through four dams. Therefore, approximately 19.7% (9.4%/47.6%) of the expected mortality experienced by in-river juvenile steelhead migrating through four dams is probably due to natural factors.

The direct survival rate of adults through the FCRPS is already quite high. The prospective actions include additional passage improvements (to the ladders at John Day and McNary dams and other improvements in section 10.3.1.1 in Corps et al. 2007a). Adult steelhead survival from Bonneville to above McNary Dam will be approximately 95.6% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.8.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Klickitat population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.8.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Chapter 10, Table 10-8, p. 10-15 Corps et al. (2007a). For targeted populations in this DPS, the effect is a <1% - 4% expected increase in egg-smolt survival, depending on population, as a result of implementing the tributary habitat Prospective Actions, which improve habitat function by addressing significant limiting factors and threats. For example, as part of the John Day Watershed Restoration project, the Action Agencies will remove passage barriers and improve water quality and riparian habitat. Under the Oregon Fish Screen Project, they will install and replace out-dated fish screens and

other passage devices at irrigation diversions in the John Day, Umatilla, and Walla Walla subbasins. In the Yakima, they will screen diversions, install fish passage at migration barriers, and secure riparian easements.

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of areas that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access. Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long term.

8.8.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for MCR steelhead (stream-type life history) associated with the specific actions to be implemented from 2007-2010 is 1.4 %. The survival benefit for MCR steelhead (stream-type life history) associated with specific Prospective Actions to be implemented from 2010 through 2018 is 4.3 %. The total survival benefit for MCR steelhead as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (CA Section 10.3.3.3). These benefits will be derived from estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 10.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs needed by juvenile steelhead from the mid-Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.8.5.2).

8.8.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Population-specific effects of the hatchery Prospective Actions on survival of MCR steelhead are not quantitatively evaluated by the FCRPS Action Agencies in the Comprehensive Analysis.

Qualitative assessment of the Prospective Actions is provided in Section 10.3.3.5, pages 10-18, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as reforms to current federally funded programs that will be identified in future ESA consultations (see Tier 2 actions in the BA). Current federally funded programs include one conservation hatchery program, a kelt reconditioning program, and two harvest mitigation programs.

The Prospective Actions require the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The FCRPS Action Agencies intend to adopt these programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs, and site specific application of BMPs will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (Corps et al. 2007b, page 2-44). ESA consultations for more than one hundred hatchery programs in the Columbia Basin funded by the Action Agencies are to be completed by June 2010. For middle Columbia hatchery programs, consultations are to be initiated in July 2009 and completed by January 2010. Available information and principles and guidance for operating hatchery programs are described in Appendix E of the CA and in SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.8.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stocks of summer steelhead used for management, including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. All UCR steelhead populations are designated A-run steelhead. Two populations of the MCR steelhead DPS are winter run populations.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are

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subject to a 2% harvest rate limit on wild steelhead from the Lower Columbia River, Upper Willamette River, and Middle Columbia River steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS with summer run populations (A-run and B-run). The total annual harvest rate limit for A-run steelhead, for example, is 4%, and 2% for the winter-run population of the MCR steelhead DPS. This is consistent with the ESA-related management. The expected harvest impacts on non-Treaty fisheries are less than those proposed. The incidental catch of winter-run steelhead in non-Treaty winter, spring and summer season fisheries has averaged 1.9% since 1999 (Table 8.8.5.5-1). The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.8.5.5-1). Harvest rates are not expected to change over the course of this Agreement (TAC 2008).

Table 8.8.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%

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Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				
1998-07 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

There are no specific harvest rate limits for tribal fisheries on steelhead during the spring or summer seasons which extend through July 31. Some impacts, however, do occur. The harvest rate for tribal winter season fisheries (generally February 1 - March 21) from 2001 to 2007 averaged 2.2% and has ranged from 0.8% to 5.8% (Table 8.8.5.5-2). The spring season extends through June 15. The harvest rate of A-run steelhead for tribal spring season fisheries has been consistent and low, at approximately 0.16% since 1985 (Table 8.8.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.8.5.5-1). The harvest rate in fall season fisheries averaged 9.64% since 1985 and 4.21% since 1998 (Table 8.8.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are similar to the 1998-2006 average of 4.21%. Harvest rates are not expected to change over the course of this Agreement (TAC 2008).

Table 8.8.5.5-2. Treaty Indian harvest rates of winter-run steelhead expressed as a proportion of the unmarked winter-run steelhead counts at Bonneville Dam in the winter season (TAC 2008).

Harvest Year	Rate
2001	3.4%
2002	0.3%
2003	5.8%
2004	0.8%
2005	0.8%
2006	1.8%
2007	2.3%
Average 2001-2007	2.2%

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With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2% since 1985 (Table 8.8.5.5-1). No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Snake River steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA). Summer Chinook were chronically depressed for decades until returns began to increase in 2001. Higher runs provided more fishing opportunity beginning in 2002. However, there is no evidence of an associated increase in the catch of steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001, and 10.9% from 2002 to 2006 (TAC 2008, Table 6). During those same years, the harvest rate of steelhead averaged 2.3% to 2.4% (Table 8.8.5.5-1). As with the spring fisheries, no further changes in future fisheries are expected as a result of the Prospective Action that would lead to changes in the expected catch of steelhead. However, as a result of analysis from recent PIT-tag data, there is information regarding adult conversion rates that indicates that more UCR steelhead than SR steelhead are lost in upstream passage. It may be that the greater losses are due to differential harvest rates that are not currently detectable. It is also plausible that the losses are due to timing differences, passage conditions, or some combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

Prospective treaty-Indian fall season fisheries will be managed using the abundance-based harvest rate schedule for B-run steelhead contained in the 2008 Agreement (Table 8.8.5.5-3). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance based harvest rate schedule, harvest may vary up or down from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts to B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide greater opportunity for the tribes to satisfy their treaty right to harvest 50% of the harvestable surplus of fall Chinook in years when conditions are favorable. Even with these provisions, it is unlikely that the treaty right for Chinook or steelhead can be fully satisfied. The harvest rate for B-run steelhead in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate for B-run steelhead will remain fixed at 2%.

Table 8.8.5.5-3. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	River Mouth URB Run Size	Treaty Total B Harvest Rate	Non-Treaty Wild B Harvest Rate	Total Harvest Rate
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

As in the past, B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries, and thus are the indicator stock used for management purposes. Generally, the status of B-run steelhead is worse than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead typically are higher because their timing coincides with the return of fall Chinook. A-run steelhead typically return a few weeks earlier, reducing their susceptibility to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.21% and ranged from 5.4% to 12.4% (Table 8.8.5.5-1).

The abundance based harvest rate schedule allows the tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size data, a determination can be made as to how often fisheries will be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years. The primary limiting constraint from this retrospective analysis will be the abundance of upriver fall Chinook. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.8.5.5-4).

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Table 8.8.5.5-4. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries (Upriver fall Chinook run size from TAC 2008, Table 7; B-run Steelhead run size from TAC 2008).

Year			
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.10%

Although the prospective harvest rate schedule will allow the harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty-Indian fisheries have generally been lower than the allowed rates. Since 1998, fall season fisheries have been subject to a combined 17% harvest rate limit on B-run steelhead. From 1998 to 2006 the observed harvest rate has averaged 12.7% (TAC 2008).

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For fall season fisheries, it is necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty-Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.8.5.5-4). This represents a 14% increase over the current harvest rate limit of 15% ($17.1/15.0 = 1.14$). The harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.8.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998, when the current ESA limits were applied, the yearly fall season treaty-Indian harvest rate averaged 4.2% while the total treaty-Indian harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% ($0.042 * 1.140 = 0.48$) and 7.2%.

The net result will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on US v Oregon memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for this species.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor and will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. This was identified as a limiting factor from the Klickitat population by the Remand Collaboration Habitat Workgroup (Habitat Technical Subgroup 2006b).

8.8.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to MCR steelhead from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4 % (CA Attachment F-2, Table 4). Compensatory mortality may occur but based on the discussion in 8.3.5.6 is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Columbia River dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continued implementation and improvement of avian deterrence at mainstem dams, and the continuation of the increased reward structure in the sport-reward fishery are expected to improve the long-term conservation value of critical habitat by increasing the survival of juvenile salmonids (safe passage PCE) within the migration corridor.

8.8.5.7 Effects of Kelt Reconditioning Prospective Actions

Effects on Species Status

Effects of the FCRPS outmigrating adult steelhead kelts are not well known but are thought to be significant as both turbine passage survival and passage through juvenile collection and bypass systems are poor. Comparing recent juvenile bypass system kelt counts before and after increases in spring spill and the installation of surface bypass facilities (e.g., RSWs) suggest that steelhead kelts may benefit from spring spill and surface bypass improvements included in the Prospective Actions. However, no definitive information is available to clearly demonstrate such effects. The prospective kelt reconditioning program is likely to increase the number of spawning adult MCR steelhead, but it is not possible to estimate a survival rate change at this time because of uncertainty regarding the percentage of the run that can be collected.

Prospective passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, are also likely to benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times which lead to a reduction in total travel time may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interaction between improved surface passage and improved kelt survival and return rates is poorly known. However, some improvement is likely.

The Prospective Actions implementing the reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks where they are fed and medicated to enhance survival. Current programs either hold kelts for 3-5 weeks and release them below Bonneville, or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Effects on Critical Habitat

NOAA Fisheries will analyze any effects of the kelt reconditioning actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.8.5.8 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of this document.

8.8.5.9 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.8.5.1 through 8.8.5.7 and are summarized in Table 8.8.5-2. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 15-37% increased survival, compared to the “current” condition, and 11-39% increased survival, compared to the “base” condition.

8.8.5.10 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.8.6-1 and 8.8.6-2 and in Figures 8.8.6-1 and 8.8.6-2. In addition to these summary tables and figures, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007

Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Additionally, because quantitative short-term extinction risk gaps could not be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.8.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and DPS viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Yakima MPG

This MPG consists of four extant populations, one of which should be highly viable and one of which should be viable to achieve the ICTRT's suggested MPG viability scenario. Either the Naches River or the Upper Yakima should be viable because these are the only two "large" populations. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for all populations in this MPG under the Prospective Actions, meaning that with implementation of the Prospective Actions the population is expected to replace itself and grow (Table 8.8.6.1-1; Figure 8.8.6-1). There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1 [SCA Aggregate Analysis Appendix; Figure 8.8.6-1]), for some populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure is "very low" to "moderate," as defined by the ICTRT, for all populations except the Upper Yakima (Table 8.8.2-2). That population has "high" spatial structure risk because 7 of 10 historical major spawning areas are not occupied.
- Current risk associated with diversity is "low" to "moderate," as defined by the ICTRT, for all populations except the Upper Yakima (Table 8.8.2-2). That population has been affected by

introgression from planted resident rainbow trout and out-of-basin steelhead. While these practices have stopped, legacy effects continue.

- For these populations, it will take longer than 10 years to resolve the problems that must be addressed in order to have higher productivity. In particular, reduced access to historic spawning areas and reduced genetic diversity will take longer than 10 years to resolve.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT “historical” and “Warm PDO” (poor) ocean scenarios, all Yakima MPG populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0-1% risk of short-term extinction at QET=50 for the Satus Creek population (Table 8.8.2-3). Quantitative estimates of base period extinction risk indicate 34-79% risk of short-term extinction at QET=50 for the other three populations. The survival gap needed to reduce this risk to <5% is unknown, but may be greater than the 10% base-to-current survival improvement and the proportion of the 26% Prospective Actions survival improvement that will result from immediate actions.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate the base period extinction risk would be >5% for the upper Yakima, Toppenish, and Naches populations at all QET levels considered in this analysis (Table 8.8.2-3).

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There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to near 100% for some populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There are no safety-net hatchery programs for these populations to further reduce extinction risk.
- A kelt reconditioning program affects all four populations in this MPG and is expected to provide an unquantifiable survival improvement.
- The recent 10-year geometric mean abundance has been above the 50 fish QET level (85-472) for all four populations (Table 8.8.2-1). Only the Upper Yakima population has dropped below 50 fish during the available time series (Cooney 2008a).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Cascades Eastern Slopes MPG

This MPG consists of five extant populations, one of which should be highly viable and three of which should be viable to achieve the ICTRT's suggested MPG viability scenario. Key populations in this MPG include Fifteenmile Creek because it is the only winter steelhead population and the Deschutes River Westside population because it is the only "large" population. The Klickitat and Deschutes River Eastside populations are the only two "intermediate" sized populations and they are important because two "intermediate" populations should be viable to meet the ICTRT's suggested viability criteria. One historic population (Crooked River) has been extirpated and a second (White River) is functionally extirpated. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the three populations with sufficient data to make estimates, under the Prospective Actions (Table 8.8.6.1-1; Figure 8.8.6-1), meaning that with implementation of the Prospective Actions these populations are expected to replace themselves and grow. These three populations (Deschutes West, Deschutes East, and Fifteenmile) are among the critical populations identified by the ICTRT.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1, SCA Aggregate

Analysis Appendix; Figure 8.8.6-1) for some populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Actions. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure is “very low” to “moderate,” as defined by the ICTRT, for all populations (Table 8.8.2-2). Current risk associated with diversity is “low” to “moderate,” as defined by the ICTRT, for all populations. The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, both Eastern Cascades Slopes MPG populations for which estimates are available are expected to have R/S, lambda, and BRT trend greater than 1.0, as under recent climate conditions, but the resulting productivity estimates are higher (SCA Aggregate Analysis Appendix; Figure 8.8.6-2). Under the ICTRT “Warm PDO” (poor) climate scenario, all productivity metrics are also expected to be greater than 1.0, except for lambda, under the assumption that effectiveness of hatchery-origin spawners is equal to that of natural-origin spawners (HF=1), for the Deschutes West population. In this case the estimate was 0.99.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors

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and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0-1% risk of short-term extinction at QET=50 for the Deschutes West and Fifteenmile populations (Table 8.8.2-3). However, there is an estimate of 53% risk of short-term extinction at QET=50 for the Deschutes East population. The survival gap needed to reduce this risk to <5% is unknown, but may be greater than the 5% base-to-current survival improvement for this population and the proportion of the 19% Prospective Actions survival improvement that will result from immediate actions. No estimates are available for the Rock Creek and Klickitat populations. However, the ICTRT identified the Rock Creek population as one with a high (>25%) risk of long-term (100-year) extinction.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate >5% base short-term extinction risk for the Deschutes East population at all evaluated QET levels (Table 8.8.2-3).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to 100% for some populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- The recent 10-year geometric mean abundance has been well above the 50 fish QET level (456-1599) for the three populations for which 10-year averages are available (Table 8.8.2-1). None of these populations have dropped below 50 fish during the available time series (Cooney 2008b).
- Population abundance is expected to increase in the future for all populations for which trends could be calculated, as a result of actions already completed and additional Prospective Actions (see above).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Walla Walla/Umatilla MPG

This MPG consists of three extant populations, one of which should be highly viable and one of which should be viable to achieve the ICTRT's suggested MPG viability scenario. The Umatilla population is important because it is the only "large" population in the MPG. One historic population (Willow Creek) has been extirpated. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the Umatilla population, which is the only population with sufficient data to make estimates, under the Prospective Actions. (Table 8.8.6.1-1; Figure 8.8.6-1). This means that with implementation of the Prospective Actions, these populations are expected to replace themselves and grow.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) for this population. For this reason, other qualitative information is also considered:

- Life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. They also indicate that estimates of productivity >1 for the Umatilla, and by inference the other populations, are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure is “low” to “moderate,” as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for this factor, as long as productivity is adequate.
- Current risk associated with diversity is “moderate,” as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for this factor, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT “historical” and “Warm PDO” (poor) ocean assumptions, the Umatilla population is expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

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- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0% risk of short-term extinction at QET=50 for the Umatilla and Walla Walla populations (Table 8.8.2-3). No estimates are available for the Touchet population. However, the ICTRT identified the Touchet population as one with high (>25%) risk of long-term (100-year) extinction.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. It was not possible to estimate extinction risk or generate sensitivity analyses to alternative QET levels for the Touchet population.

There is uncertainty associated with quantitative estimates of extinction risk because of the range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to 37% for these populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There is a conservation hatchery program for the Umatilla population to further reduce short-term extinction risk.
- The recent 10-year geometric mean abundance has been well above the 50 fish QET level (1003, 1472) for the two populations for which 10-year averages are available (Umatilla and Walla Walla; Table 8.8.2-1). Neither of these populations has dropped below 50 fish during the available time series (Cooney 2007).
- Population abundance is expected to increase in the future for the Umatilla population, which is the only one for which trends could be calculated, as a result of actions already completed and additional Prospective Actions (see above).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As

described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

John Day MPG

This MPG consists of five extant populations, one of which should be highly viable and two of which should be viable to achieve the ICTRT's suggested MPG viability scenario. The North Fork John Day and Lower John Day populations are important because they are the only "large" and "very large" populations in the MPG. One historic population (Willow Creek) has been extirpated. The Middle Fork and Upper Mainstem populations are important because they are the only "intermediate" sized populations, one of which must be viable to achieve the ICTRT's viability criteria. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity, based on all three metrics (R/S, lambda, and BRT trend), is estimated to be greater than 1.0 for all five populations (Table 8.8.6.1-1; Figure 8.8.6-1), meaning that with implementation of the Prospective Actions these populations are expected to replace themselves and grow.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicates productivity >1 while lower 95% confidence intervals indicates productivity <1 for some populations [SCA Aggregate Analysis Appendix; Figure 8.8.6-1]). For this reason, other qualitative information is also considered:

- Life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. They also indicate that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.
- Current risk associated with spatial structure and diversity is "very low" to "moderate," as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT "historical" and "Warm PDO" (poor) ocean scenarios, all John Day MPG populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).

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- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate <5% risk of short-term extinction at QET=50 for all five populations (Table 8.8.2-3).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (e.g., 95% confidence limits for base period extinction risk at QET=50 range from 0% to 69% for the South Fork John Day population; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There are no safety-net hatchery programs in this MPG.
- The recent 10-year geometric mean abundance has been above the 50 fish QET level (259-1800) for all populations (Table 8.8.2-1). None of these populations has dropped below 50 fish during the available time series (Cooney 2008b).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.8.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Middle Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.8.7.1 Potential for Recovery

It is likely that the Middle Columbia River steelhead DPS will trend toward recovery.

The future status of all populations and MPGs of MCR steelhead will be improved compared to their current status through the reduction of adverse effects associated with the FCRPS and Reclamation's Upper Snake projects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.8.5, 8.8.6, and 8.8.7.2. These beneficial actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning, and tributary habitat improvements for most populations. These beneficial actions also completely offset the slightly decreased survival associated with the harvest Prospective Action. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This conclusion also takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.8.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.8.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatchery programs, and degradation of tributary and estuary habitat. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions that are appropriately considered cumulative effects also address limiting factors and threats.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects include dike removal and opening off-channel habitat, which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The ICTRT has indicated that the longer hatchery programs are expected to subsidize natural spawners, the more likely their effects will threaten recovery. As described in Section 8.8.5.4, some ongoing hatchery programs that affect this DPS pose risks to diversity and natural productivity. The

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Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce threats to productivity and diversity from continued reliance on hatchery programs to subsidize natural spawning. Some of the problems limiting recovery of MCR steelhead, such as spatial structure and genetic diversity concerns for the Upper Yakima population, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent improvements that can be implemented reasonably within the next 10 years.

In addition, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the MCR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, 11 of which are described in Section 8.8.5.4, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.8.6, with implementation of the Prospective Actions, R/S is expected to be greater than 1.0 for all 12 of the populations for which there are quantitative estimates (Table 8.8.6.1-1).

Population growth rate (lambda) and BRT trend estimates, as calculated in this analysis, are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by hatchery programs, since recovery requires self-sustaining populations.

As described in Section 8.8.6, all 12 populations in this DPS with population-specific estimates have lambda and BRT trends that are expected to be greater than 1.0 with implementation of the Prospective Actions.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0, as under recent climate conditions, but the resulting productivity estimates are higher (SCA Aggregate Analysis Appendix; Figure 8.8.6-2). Under the ICTRT “Warm PDO” climate scenario, all populations but one are also expected to have all three metrics greater than 1.0, with only slightly lower productivity estimates than under recent climate conditions. The lambda (HF=1) metric, which assumes that hatchery-origin spawners and natural-origin spawners are equally effective, for the Deschutes West population would be 0.99.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.
- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S estimates for most populations are expected to be greater than 1.0 at the upper 95% confidence limits and less than 1.0 at the lower 95% confidence limits (SCA Aggregate Analysis Appendix). The uncertainty in quantitative estimates indicates that it is important to take qualitative factors into account.

Taken together, the combination of all the qualitative and quantitative factors indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. Quantitative estimates of R/S, population growth rate, and BRT trend support this conclusion.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.8.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through net survival improvements resulting from the Prospective Actions and a continuation of other current management actions, as described above and in Section 8.8.5.

As described above and in Section 8.8.6, abundance is expected to be increasing for all populations and natural productivity (R/S) is expected to be sufficient for all populations to grow. Recent abundance levels are estimated to be between 92 and 1800 spawners, depending on population, all of which are above the QET levels under consideration (Table 8.8.2-1). These factors also indicate a decreasing risk of extinction.

There is a conservation hatchery program for the Umatilla population, which reduces the likelihood of short-term extinction risk. However, over time this level of supplementation results in a higher level of long-term risk to diversity and natural productivity than would occur in an unsupplemented population.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.2.6, short-term extinction risk derived from performance during the base period is 0-2% at QET=50 for 10 of the 14 populations in this DPS for which estimates are available. The four populations with base period extinction risk greater than 5% are the Upper Yakima, Naches, Toppenish, and Deschutes East populations. Three of these populations are in the Yakima MPG, which suggests that this MPG is at particularly high extinction risk. It was not possible to determine the survival improvements needed to reduce extinction risk to 5% for these populations. However, base-to-current survival improvements range from 5-10% for these populations. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 19-26% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they should reduce the base period extinction risk significantly.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0 to 100% for some populations. This uncertainty indicates that it is important also to consider qualitative factors in reaching conclusions.

As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. Quantitative results indicate that most populations and MPGs will have low short-term extinction risk. The most troubling result is that three of the four populations in the Yakima MPG have a high base period extinction risk that may not be reduced sufficiently by current and Prospective Actions. However, all Yakima MPG populations are expected to have productivities greater than 1.0, in fact with R/S ranging from 1.4 to 2.0 (Table 8.8.6.1-1), and these estimates indicate that abundance should increase and risk should decrease as the Prospective Actions are implemented. The combination of recent abundance estimates, expected survival improvements, expected positive trends for all populations, quantitative risk estimates, and a conservation hatchery program for the Umatilla population, indicate that enough populations are likely to have a low enough risk to conclude that the DPS as a whole will have a low risk of short-term extinction.

8.8.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for MCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Yakima River as well as specific stream reaches in the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for MCR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in

the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem, tributary and estuary land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat winter steelhead will do the same for adults from the Fifteenmile and one of the Klickitat populations. Habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Proposed Action, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Middle Columbia River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Middle Columbia River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

Several of the analyses presented above are projections of DPS health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

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- The noted changes in DPS health demonstrated above have been accompanied by regional efforts to protect and restore this DPS, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this DPS.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this DPS will continue to improve.⁶

⁶ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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Table 8.8.2-1. Status of MCR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the “base period” of the 15-20 most recent brood years (approximately 1980-1985 BY through 1998-1999 BY, depending on population).

ESU	MPG	Population	Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
			Most Recent 10-yr Geomean Abundance ¹	Years Included In Geomean	ICTRT Recovery Abundance Threshold ¹	Average R/S: 20-yr non-SAR adj.; non-delimited ²	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0) ³	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1) ³	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current ⁴	Lower 95% CI	Upper 95% CI
Mid Columbia Steelhead	Yakima	Upper Yakima	85	1995-2004	1500	1.02	0.69	1.51	1.01	0.74	1.39	1.01	0.74	1.39	1.01	0.95	1.17
		Naches	472	1995-2004	1500	1.02	0.69	1.51	1.02	0.74	1.41	1.00	0.72	1.39	1.02	0.96	1.18
		Toppenish	322	1995-2004	500	1.46	0.89	2.39	1.09	0.76	1.57	1.07	0.74	1.55	1.09	1.02	1.32
		Satus	379	1995-2004	1000	0.86	0.62	1.20	0.98	0.76	1.25	0.96	0.75	1.23	0.98	0.93	1.12
	Eastern Cascades	Deschutes W.	456	1996-2005	1000	0.92	0.67	1.25	1.02	0.81	1.29	0.97	0.78	1.20	0.99	0.96	1.17
		Deschutes E.	1599	1996-2005	1000												
		Klickitat			1000												
		Fifteenmile Cr.	703	1996-2005	500	1.17	0.84	1.63	1.03	0.83	1.28	1.03	0.83	1.28	1.03	0.98	1.15
		Rock Cr.			500												
		White Salmon - Extirpated															
	Umatilla/Walla Walla	Umatilla	1472	1995-2004	1500	0.94	0.73	1.22	1.04	0.86	1.25	0.99	0.83	1.17	1.01	0.98	1.13
		Walla-Walla	650	1996-2005	1000												
		Touchet			1000												
	John Day	Lower Mainstem	1800	1996-2005	2250	1.24	0.76	2.04	1.01	0.71	1.43	1.00	0.71	1.41	0.98	0.94	1.14
		North Fork	1740	1996-2005	1500	1.17	0.79	1.75	1.00	0.80	1.26	1.00	0.79	1.25	0.99	0.95	1.16
		Upper Mainstem	524	1996-2005	1000	1.07	0.71	1.59	0.99	0.77	1.28	0.99	0.77	1.27	0.95	0.92	1.03
		Middle Fork	756	1996-2005	1000	1.17	0.82	1.69	1.01	0.80	1.27	1.00	0.79	1.26	0.97	0.93	1.06
		South Fork	259	1996-2005	500	0.99	0.64	1.54	0.99	0.74	1.33	0.98	0.74	1.32	0.95	0.91	1.09

1 Most recent year for 10-year geometric mean abundance is 2004-2005, depending upon population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c)

2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years in Cooney (2008a). Actual years in average vary by population.

3 Median population growth rate (lambda) during the most recent period of approximately 20 years Actual years in estimate vary by population. Lambda estimates are from Cooney (2008b).

4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in the Aggregate Analysis Appendix, Cooney (2008b).

Table 8.8.2-2. Status of MCR steelhead with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure ¹	ICTRT Current Risk For Diversity ¹	10-yr Average % Natural-Origin Spawners ²
Mid Columbia Steelhead	Yakima	Upper Yakima	Currently High Risk (7 of 10 historical MaSAs are not occupied)	Currently High Risk (Introgression with resident <i>O. mykiss</i> and loss of presmolt migration pathways)	0.98
		Naches	Currently Low Risk	Currently Moderate Risk	0.94
		Toppenish	Currently Moderate Risk	Currently Moderate Risk	0.94
		Satus	Currently Low Risk	Currently Moderate Risk	0.94
	Eastern Cascades	Deschutes W.	Currently Very Low Risk	Currently Moderate Risk	0.74
		Deschutes E.	Currently Low Risk	Currently Moderate Risk	0.61
		Klickitat	Currently Low Risk	Currently Moderate Risk	
		Fifteenmile Cr.	Currently Very Low Risk	Currently Low Risk	1.00
		Rock Cr.	Currently Moderate Risk	Currently Moderate Risk	
		White Salmon - Extirpated			
	Umatilla/Walla Walla	Umatilla	Currently Moderate Risk	Currently Moderate Risk	0.64
		Walla-Walla	Currently Low Risk	Currently Moderate Risk	0.98
		Touchet	Currently Low Risk	Currently Moderate Risk	
	John Day	Lower Mainstem	Currently Very Low Risk	Currently Moderate Risk	0.90
		North Fork	Currently Very Low Risk	Currently Low Risk	0.92
		Upper Mainstem	Currently Very Low Risk	Currently Low Risk	0.92
		Middle Fork	Currently Very Low Risk	Currently Low Risk	0.92
		South Fork	Currently Very Low Risk	Currently Low Risk	0.92

1 ICTRT conclusions for MCR steelhead are from draft ICTRT Current Status Summaries (ICTRT 2007d).

2 Average fractions of natural-origin natural spawners are from the ICTRT (2007a).

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Table 8.8.2-3. Status of MCR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the “base period” of the 15-20 most recent brood years (approximately 1980-1985 BY through 1998-1999 BY, depending upon population).

ESU	MPG	Population	24-Year Extinction Risk											
			Risk (QET=1) ¹	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10) ¹	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30) ¹	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50) ¹	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Mid Columbia Steelhead	Yakima	Upper Yakima	0.37	0.00	1.00	0.50	0.00	1.00	0.60	0.00	1.00	0.68	0.08	1.00
		Naches	0.06	0.00	0.58	0.18	0.00	0.77	0.27	0.00	0.83	0.34	0.00	0.87
		Toppenish	0.48	0.00	0.58	0.61	0.00	0.73	0.73	0.00	0.92	0.79	0.00	0.97
		Satus	0.00	0.00	0.04	0.00	0.00	0.13	0.00	0.00	0.22	0.00	0.00	0.30
	Eastern Cascades	Deschutes W.	0.00	0.00	0.48	0.00	0.00	0.75	0.00	0.00	0.84	0.01	0.00	0.90
		Deschutes E.	0.42	0.00	1.00	0.48	0.00	1.00	0.51	0.00	1.00	0.53	0.00	1.00
		Klickitat												
		Fifteenmile Cr.	0.00	0.00	0.22	0.00	0.00	0.32	0.00	0.00	0.40	0.00	0.00	0.44
		Rock Cr.												
		White Salmon - Extirpated												
	Umatilla/Walla Walla	Umatilla	0.00	0.00	0.14	0.00	0.00	0.26	0.00	0.00	0.34	0.00	0.00	0.37
		Walla-Walla	0.00	0.00	0.11	0.00	0.00	0.23	0.00	0.00	0.31	0.00	0.00	0.35
		Touchet												
	John Day	Lower Mainstem	0.00	0.00	0.21	0.00	0.00	0.29	0.00	0.00	0.35	0.00	0.00	0.38
		North Fork	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.07
		Upper Mainstem	0.00	0.00	0.36	0.00	0.00	0.43	0.00	0.00	0.61	0.00	0.00	0.67
		Middle Fork	0.00	0.00	0.16	0.00	0.00	0.28	0.00	0.00	0.38	0.00	0.00	0.44
		South Fork	0.00	0.00	0.40	0.00	0.00	0.55	0.01	0.00	0.61	0.03	0.00	0.69

¹ Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), included as Attachment 1 in SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

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Table 8.8.2-4. Changes in density-independent survival of MCR steelhead (“gaps”) necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for MCR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated “gaps” are based on population performance during the “base period” of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0 ¹	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 20 yr lambda = 1.0 @ HF=1 ²	Upper 95% CI	Lower 95% CI	Survival Gap For 1980. current BRT trend = 1.0 ³	Upper 95% CI	Lower 95% CI	Survival Gap for 24 Yr Ext. Risk <5% (OET=1) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=10) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=30) ⁴	Survival Gap for 24 Yr Ext. Risk <5% (OET=50) ⁴
Mid Columbia Steelhead	Yakima	Upper Yakima	0.98	1.44	0.66	0.94	3.85	0.23	0.96	4.00	0.23	0.98	1.24	0.49				
		Naches	0.98	1.45	0.66	0.92	3.97	0.21	0.99	4.30	0.23	0.93	1.18	0.48				
		Toppenish	0.69	1.12	0.42	0.68	3.50	0.13	0.73	3.81	0.14	0.69	0.92	0.29				
		Satus	1.16	1.61	0.83	1.11	3.36	0.37	1.21	3.67	0.40	1.12	1.39	0.60				
	Eastern Cascades	Deschutes W.	1.09	1.49	0.80	0.91	2.64	0.32	1.16	3.13	0.43	1.03	1.21	0.50				
		Deschutes E.																
		Klickitat																
		Fifteenmile Cr.	0.85	1.19	0.61	0.88	2.34	0.33	0.88	2.34	0.33	0.88	1.08	0.53				
		Rock Cr.																
			White Salmon - Extirpated															
	Umatilla/Walla Walla	Umatilla	1.06	1.38	0.82	0.86	2.00	0.37	1.07	2.35	0.49	0.98	1.11	0.57				
		Walla-Walla																
		Touchet																
	John Day	Lower Mainstem	0.80	1.32	0.49	0.96	4.61	0.20	1.00	4.67	0.21	1.11	1.35	0.55				
		North Fork	0.85	1.27	0.57	1.00	2.81	0.35	1.02	2.84	0.37	1.05	1.25	0.51				
		Upper Mainstem	0.94	1.40	0.63	1.04	3.24	0.33	1.07	3.30	0.34	1.26	1.49	0.87				
		Middle Fork	0.85	1.23	0.59	0.97	2.79	0.34	1.00	2.84	0.35	1.16	1.37	0.77				
		South Fork	1.01	1.57	0.65	1.05	3.95	0.28	1.08	3.97	0.29	1.26	1.51	0.68				

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.8.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.8.2-1)^{Mean Generation Time}. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.8.2-1)^{Mean Generation Time}. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap could not be calculated for this species .

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Table 8.8.3-1. Proportional changes in average base period survival of MCR steelhead expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

ESU	MPG	Population	Base-to-Current Adjustment (Divisor)							
			Hydro ¹	Tributary Habitat ²	Estuary Habitat ³	Bird Predation ⁴	Marine Mammal Predation ⁵	Harvest ⁶	Hatcheries ⁷	Total ⁸
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Naches (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Toppenish (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Satus (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
	Eastern Cascades	Deschutes W. (above TDA)	0.998	1.002	1.003	0.996	1.00	1.041	1.00	1.04
		Deschutes E. (above TDA)	0.998	1.010	1.003	0.996	1.00	1.041	1.00	1.05
		Klickitat (above BON)	0.999	1.040	1.003	0.996	1.00	1.041	1.00	1.08
		Fifteenmile Cr. (above TDA)	0.998	1.001	1.003	0.996	0.78	1.041	1.00	0.81
		Rock Cr. (above JDA)	1.005	1.000	1.003	0.996	1.00	1.041	1.00	1.05
		White Salmon - Extirpated								
	Umatilla/Walla Walla	Umatilla (above JDA)	1.005	1.040	1.003	0.996	1.00	1.041	1.00	1.09
		Walla-Walla (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Touchet (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
	John Day	Lower Mainstem (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		North Fork (above JDA)	1.005	1.003	1.003	0.996	1.00	1.041	1.00	1.05
		Upper Mainstem (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		Middle Fork (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		South Fork (above JDA)	1.005	1.007	1.003	0.996	1.00	1.041	1.00	1.05

1 From SCA Hydro Modeling Appendix, Based on differences in average base and current smolt-to-adult survival estimates.

2 From CA Chapter 10, Table 10-7.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Current 2 S/Baseline 2 S” approach, as described in Attachment F-2.

5 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. Fifteenmile Creek is affected because it is a winter-run steelhead population.

6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

7 Hatchery improvements considered qualitatively

8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

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Table 8.8.5-1. Estimates of percent juvenile steelhead in-river survival rates through the lower Columbia River under the Prospective Actions and in a hypothetical free-flowing reach of equal length (source: Table 5.1 in NMFS 2004a).

Pool Entered	Prospective Actions Lower Columbia Survival		Hypothetical— Free-flowing Reach
	In-river	Rel. Improvement	
McNary	65	12	89
John Day	70	10	91
The Dalles	83	5	96
Bonneville	93	< 1	99

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Table 8.8-2. Proportional changes in survival of MCR steelhead expected from the Prospective Actions. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)									
			Hydro ¹	Tributary Habitat ² (2007-2017)	Estuary Habitat ³	Bird Predation ⁴	Pike-minnow Predation ⁵	Kelt Reconditioning ⁶	Marine Mammal ⁷	Allowable Harvest ⁸	Expected Harvest ⁸	Hatcheries ⁹
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Naches (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Toppenish (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Satus (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	Eastern Cascades	Deschutes W. (above TDA)	1.05	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Deschutes E. (above TDA)	1.05	1.03	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Klickitat (above BON)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Fifteenmile Cr. (above TDA)	1.05	1.00	1.06	1.03	1.01	1.00	1.18	0.99	0.99	1.00
		Rock Cr. (above JDA)	1.08	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		White Salmon - Extirpated										
	Umatilla/Walla Walla	Umatilla (above JDA)	1.08	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Walla-Walla (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Touchet (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	John Day	Lower Mainstem (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		North Fork (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Upper Mainstem (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Middle Fork (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		South Fork (above JDA)	1.08	1.02	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00

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Table 8.8.5-2. Continued.

ESU	MPG	Population	Current-to-Future Adjustment (Divisor)				High	Low
			Non-Hydro With Allowable Harvest ¹⁰	Non-Hydro With Expected Harvest ¹⁰	Total (Allowable Harvest) ¹¹	Total (Expected Harvest) ¹¹	Total Base-Current and Current-Future ¹²	Total Base-Current and Current-Future ¹²
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
		Naches (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
		Toppenish (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
		Satus (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
	Eastern Cascades	Deschutes W. (above TDA)	1.11	1.11	1.16	1.16	1.21	1.21
		Deschutes E. (above TDA)	1.13	1.13	1.19	1.19	1.25	1.25
		Klickitat (above BON)	1.14	1.14	1.15	1.15	1.24	1.24
		Fifteenmile Cr. (above TDA)	1.30	1.30	1.37	1.37	1.11	1.11
		Rock Cr. (above JDA)	1.10	1.10	1.19	1.19	1.24	1.24
		White Salmon - Extirpated						
	Umatilla/Walla Walla	Umatilla (above JDA)	1.14	1.14	1.24	1.24	1.34	1.34
		Walla-Walla (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
		Touchet (above MCN)	1.14	1.14	1.26	1.26	1.39	1.39
	John Day	Lower Mainstem (above JDA)	1.11	1.11	1.20	1.20	1.25	1.25
		North Fork (above JDA)	1.11	1.11	1.20	1.20	1.25	1.25
		Upper Mainstem (above JDA)	1.11	1.11	1.20	1.20	1.26	1.26
		Middle Fork (above JDA)	1.11	1.11	1.20	1.20	1.25	1.25
		South Fork (above JDA)	1.12	1.12	1.21	1.21	1.28	1.28

1 From Supplemental Comprehensive Analysis, SCA Hydro Modeling Appendix. Based on differences in average current and future smolt-to-adult survival estimates.

2 From CA Chapter 10, Table 10-9.

3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.

5 From CA Appendix F, Attachment F-1.

6 It was not possible to quantify survival changes associated with the kelt reconditioning program.

7 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. Fifteenmile Creek is affected because it is a winter-run steelhead population.

8 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.

9 No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.

10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.

11 Same as Footnote 8, except it is calculated from all Prospective Actions, including hydro actions.

12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.8.3-1.

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Table 8.8.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for MCR steelhead.

ESU	MPG	Population	20-Yr R/S Recent Climate ¹	20-yr lambda Recent Climate @ HF=0 ²	20-yr lambda Recent Climate @ HF=1 ³	1980-Current BRT Trend Recent Climate ³	ICTRT MPG Viability Scenario ⁴	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure ⁵	Recovery Prong Notes for Diversity ⁵
							Need 1 HV and 1 V:			
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.42	1.09	1.09	1.39	1 of these 2 populations must be HV or V	All three metrics >1	Currently High Risk (7 of 10 historical MaSAs are not occupied)	Currently High Risk (Introgression with resident <i>O. mykiss</i> and loss of presmolt migration pathways)
		Naches (above MCN)	1.42	1.10	1.08	1.41		All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Toppenish (above MCN)	2.02	1.17	1.15	1.51	Can be 1 of the 2 needed HV or V populations	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Status (above MCN)	1.20	1.05	1.03	1.35	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Moderate Risk
							Need 1 HV and 3 V:			
	Eastern Cascades	Deschutes W. (above TDA)	1.11	1.06	1.01	1.20	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		Deschutes E. (above TDA)					Must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Klickitat (above BON)					Must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Fifteenmile Cr. (above TDA)	1.30	1.05	1.05	1.15	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Low Risk
		Rock Cr. (above JDA)					"Maintained" Population	No Data	Currently Moderate Risk	Currently Moderate Risk
			White Salmon - Extirpated							
							Need 1 HV and 1 V:			
	Umatilla/Walla Walla	Umatilla (above JDA)	1.26	1.11	1.05	1.35	Must be HV or V	All three metrics >1	Currently Moderate Risk	Currently Moderate Risk
		Walla-Walla (above MCN)					1 of these 2 populations must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Touchet (above MCN)						No Data	Currently Low Risk	Currently Moderate Risk
							Need 1 HV and 2 V:			
John Day	Lower Mainstem (above JDA)	1.56	1.06	1.05	1.22	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk	
	North Fork (above JDA)	1.47	1.05	1.05	1.24	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Low Risk	
	Upper Mainstem (above JDA)	1.34	1.04	1.04	1.20	1 of these 2 populations must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk	
	Middle Fork (above JDA)	1.47	1.06	1.05	1.21		All three metrics >1	Currently Low Risk	Currently Low Risk	
	South Fork (above JDA)	1.26	1.05	1.04	1.21	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk	

1 Calculated as the base period 20-year R/S productivity from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2.

2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

4 From ICTRT (2007c), Attachment 2

5 From Table 8.

Figure 8.8.6-1. Summary of prospective mean R/S estimates for MCR steelhead under the “recent” climate assumption, including 95% confidence limits.

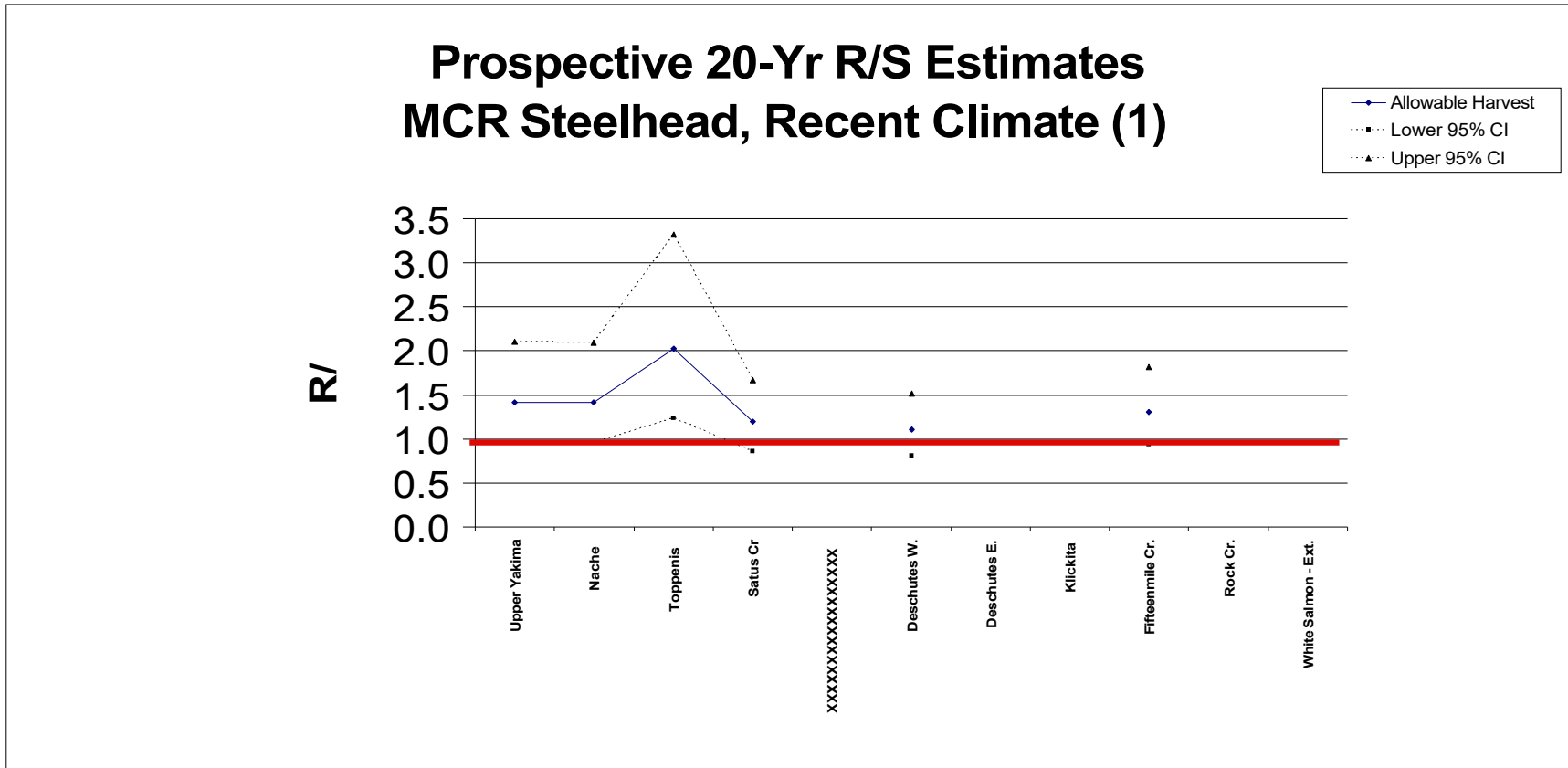


Figure 8.8.6-1. Continued.

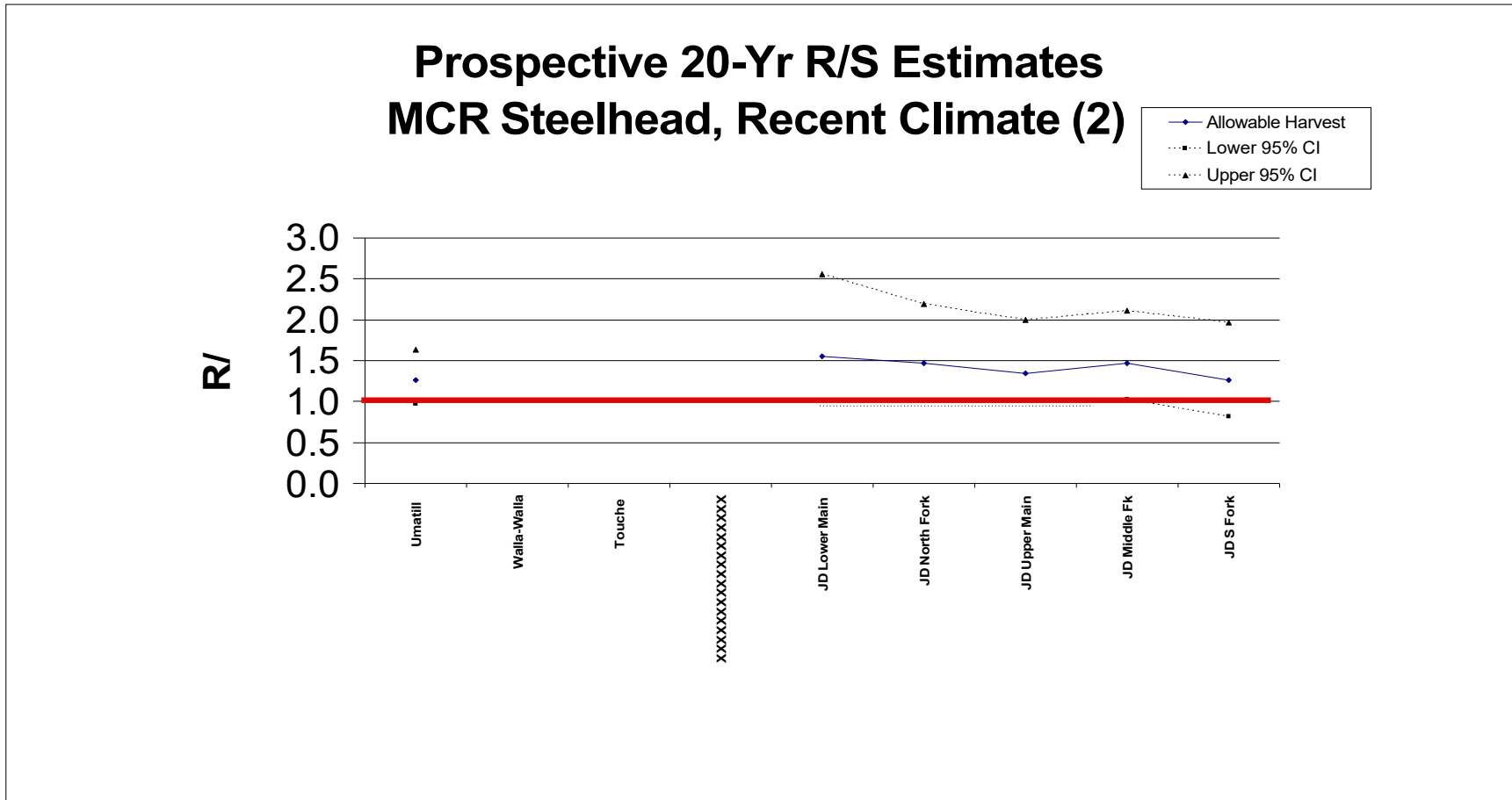


Figure 8.8.6-2. Summary of prospective mean R/S estimates for MCR steelhead under three climate assumptions.

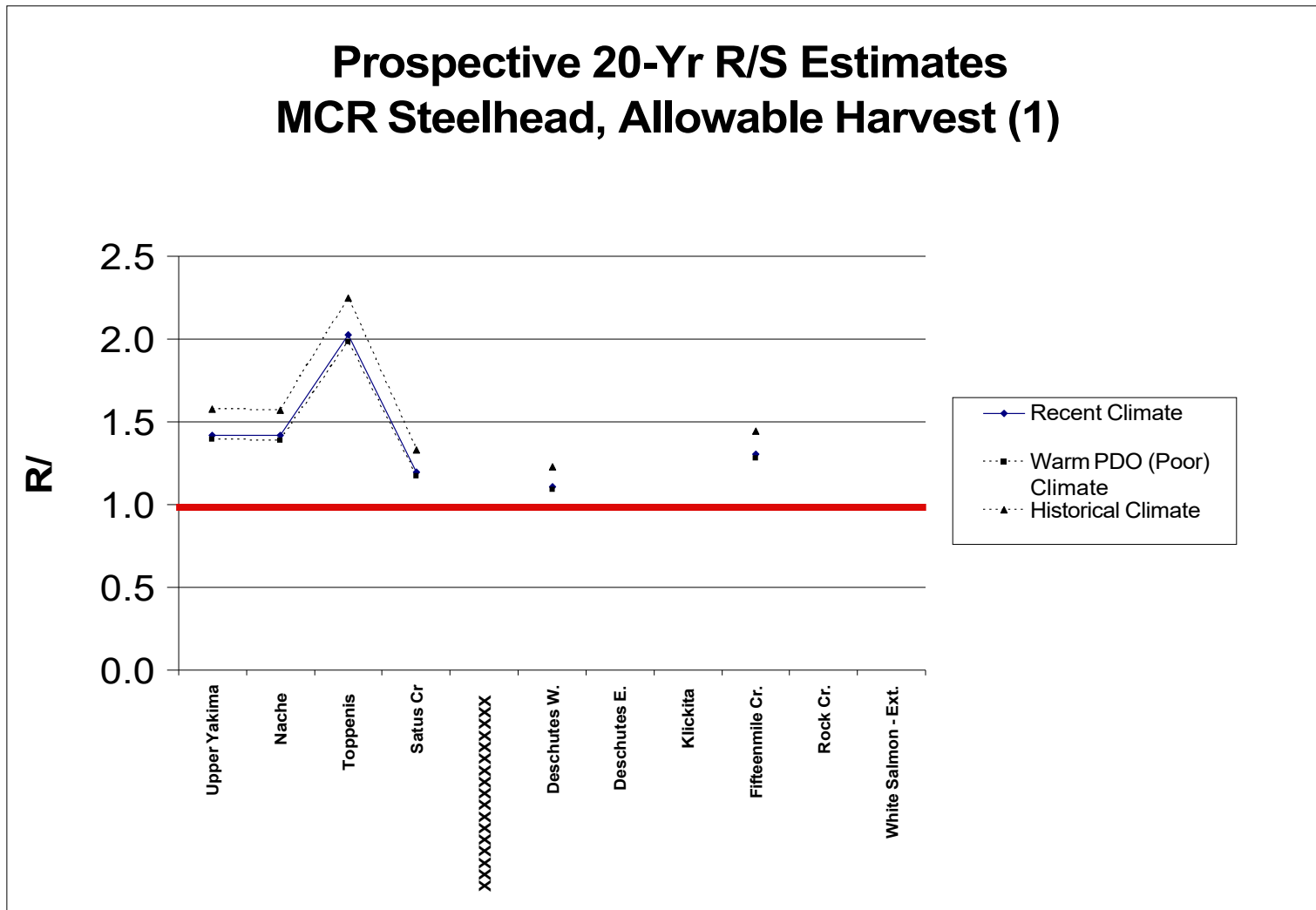
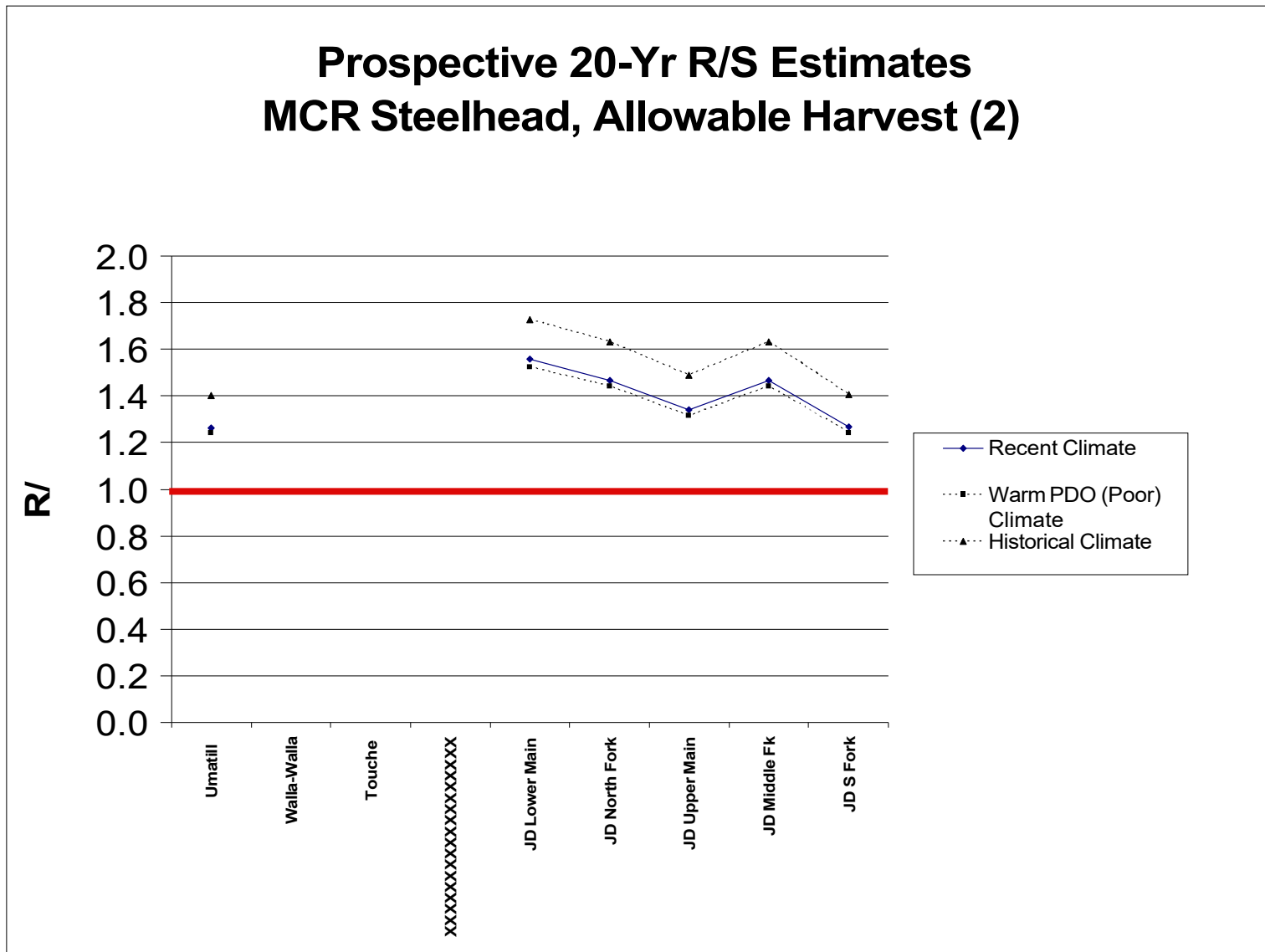


Figure 8.8.6-2. Continued.

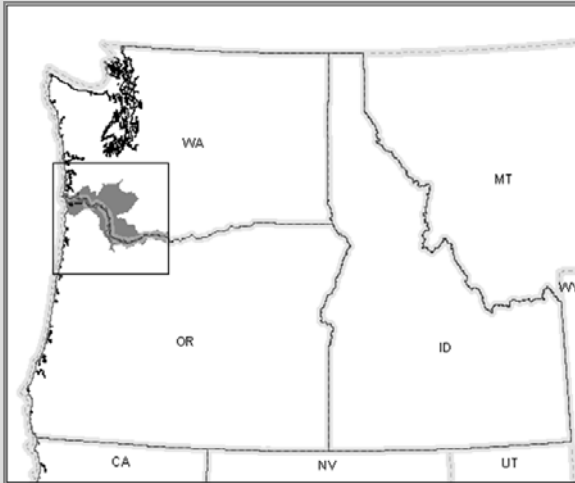


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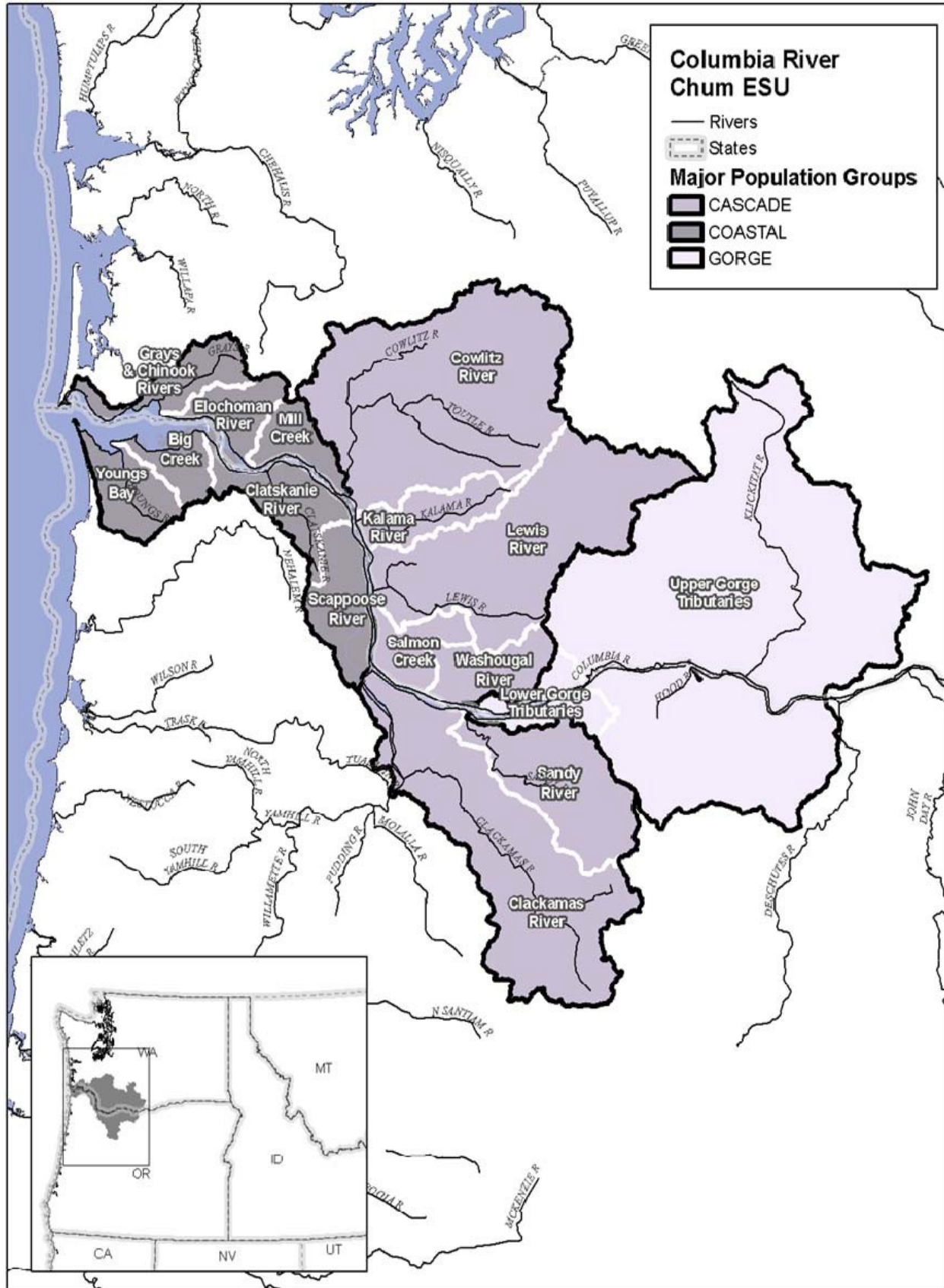
Introduction to the Lower River Species

The following ESUs or DPS' (species) are found largely in the lower Columbia River below Bonneville Dam, the FCRPS project furthest downriver. Three of these species have several populations that spawn above Bonneville. None migrate past The Dalles Dam, the next upriver. These lower river species are substantially less affected by the FCRPS and USBR projects relative to listed salmonid species that range into the interior Columbia River Basin, migrating past multiple FCRPS projects. Their generally poor status is primarily the result of other limiting factors and threats, as detailed in the sections that follow. The FCRPS and USBR address the influence of their projects on these lower river species and thereby contribute to their survival with an adequate potential for recovery. For these species, NOAA evaluates, in this Supplemental Comprehensive Analysis, whether the Prospective Actions further deteriorate the pre-action condition and will not cause additional jeopardy.

Section 8.9 Columbia River Chum Salmon



- 8.9.1 Species Overview
- 8.9.2 Current Rangewide Status
- 8.9.3 Environmental Baseline
- 8.9.4 Cumulative Effects
- 8.9.5 Effects of the Prospective Actions
- 8.9.6 Aggregate Effects



Section 8.9

Columbia River Chum Salmon

Species Overview

Background

The Columbia River (CR) chum salmon ESU includes all naturally-spawned populations of chum salmon in the Columbia River and its tributaries as well as three artificial propagation programs. There were 16 historical populations in three major population groups in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Significant spawning now occurs for two of the historical populations, meaning that 88% of the historical populations are extirpated or nearly so. Because chum salmon spend only a short time in natal streams before emigration, the loss or impairment of rearing habitat in the Columbia River estuary may have been an important factor in their decline. Another important factor was the inundation of historical spawning areas by Bonneville Reservoir.

Designated critical habitat for this ESU includes all Columbia River estuarine areas and river reaches upstream to the confluence with the White Salmon River and specific stream reaches in a number of subbasins.

Current Status & Recent Trends

Most of the populations in this ESU are extirpated or nearly so. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations. Abundances for these was low, but trends were relatively stable in the decade beginning 1990. Since then they increased for several years before declining.

Limiting Factors

Human impacts and limiting factors for the Columbia River chum salmon ESU have come from multiple sources, including mainstem and tributary hydropower development and loss or impairment of tributary and estuarine habitat.

Recent Ocean and Mainstem Harvest

Ocean fishing mortality on Columbia River chum salmon is assumed to be zero. Fisheries in the Columbia River are limited to insure that the incidental take of ESA-listed Columbia River chum does not exceed specified rates. Non-Treaty fisheries in the lower Columbia River have been limited to an incidental harvest rate of 5% in recent years. Recent harvest rates have averaged about 1.6%. Columbia River chum are not caught in the treaty Indian fisheries above Bonneville Dam.

8.9.2 Current Rangelwide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.9.2.1 Current Rangelwide Status of the Species

The Columbia River chum ESU includes 16 historical populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Chum salmon return to the Columbia River in late fall (mid-October to December). They primarily spawn in the lower reaches of rivers, digging their redds along the edges of the mainstem and in tributaries or side channels. Some spawning sites are located in areas where geothermally-warmed groundwater or mainstem flow upwells through the gravel.

Chum fry emigrate from March through May shortly after emergence in contrast to other salmonids (e.g., steelhead, coho salmon, and most Chinook salmon), which usually migrate to sea at a larger size after months or years of freshwater rearing. Juvenile chum salmon feed in estuaries to feed before beginning a long-distance oceanic migration. The period of estuarine residence appears to be a critical life history phase and may play a major role in determining the size of the subsequent adult run back to fresh water. Summary data for the ESU are shown in Table 8.9.2.1-1.

Table 8.9.2.1-1. Columbia River chum ESU description and major population groups (MPGs). (Sources: NMFS 2005a; Myers et al. 2006). The designations “-C” and “-G” identify Core and Genetic legacy populations, respectively.¹

ESU Description	
Threatened	Listed under ESA in 2005
3 major population groups	16 historical populations
Major Population Group	Population
Coastal	Grays (C,G), Elochoman (C), Mill Creek, Youngs Bay (C), Big Creek (C), Clatskanie, Scappoose
Cascade	Cowlitz (C),* Kalama, Lewis (C), Salmon Creek, Washougal, Clackamas (C), Sandy
Gorge	Lower Gorge (C,G), Upper Gorge
Hatchery programs included in ESU (3)	Chinook River (Sea Resources Hatchery), Grays River, and Washougal/Duncan Creek
* Myers et al. 2006 stated that “whether [Cowlitz] summer chum salmon constitute a demographically independent population ... needs to be studied further.” Subsequent genetic analysis (Small et al. 2006) indicated that Cowlitz summer chum are distinct, but population delineations have not yet been revised.	

¹ Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU (WLCTRT 2003).

Human impacts and current limiting factors are primarily related to habitat degradation (Table 8.9.2.1-2). Chum spawning habitat has been substantially limited by the loss of off-channel and side channel habitat and, since 1938, inundation of historically productive areas by Bonneville pool.

Limiting Factors

Summarized below (Table 8.9.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB 2004)]. Oregon is currently engaged in the recovery planning process for Columbia River chum.

Table 8.9.2.1-2. Key limiting factors for Columbia River chum.

Mainstem Hydro	Direct mainstem hydro impacts on the Columbia River chum ESU are most significant for the Upper and Lower Gorge populations. For the Upper Gorge population, some productive historical spawning habitat was inundated by Bonneville pool. FCRPS flow management affects the amount of submerged spawning habitat for the mainstem component of the Lower Gorge population and whether adults can enter (and fry can emerge from) Hardy and Hamilton creeks. Impacts on populations originating in subbasins further downstream (i.e., below the Portland/Vancouver area) are limited to migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Avian predators are assumed to have minimal effect on chum salmon. The significance of fish predation on juvenile chum is unknown.
Harvest	Harvest is limited to indirect fishery mortality. In the 1950s, due to severe population declines, commercial chum salmon fisheries were closed or drastically minimized. Now there are neither recreational nor commercial fisheries in the Columbia River. The number of chum landed as take incidental to the lower river commercial gill net fisheries has been less than 50 fish in each of the last five years.
Hatcheries	Historical hatchery practices do not appear to have influenced chum populations. WDFW's conservation hatcheries are currently an element of chum salmon protection and restoration efforts. Along with other state and Federal hatchery programs throughout the lower Columbia River, these are currently the subject of a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is an important habitat for migrating juveniles from Columbia River chum populations. Alterations in attributes of flow and diking have

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	<p>resulted in the loss of emergent marsh, tidal swamp and forested wetlands. These habitats are used extensively by chum juveniles which migrate from their natal areas soon after emergence (Fresh et al. 2005). Estuary limiting factors and recovery actions are addressed in detail as part of a comprehensive regional planning process (NMFS 2006b).</p>
Habitat	<p>Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in the low to moderate elevation habitats most often used by chum. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for chum by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.</p>
Ocean & Climate	<p>Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status the ESU to some extent, future trends, especially during the time period relevant to the Prospective Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).</p>

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Abundance, Productivity, & Trends

Base status information through 2000 is shown in Table 8.9.2.1-3. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations. The 10-year trend was negative for the Grays River population and just over 1.0 for the Lower Gorge. After 2000, populations increased for a few years before declining (Keller 2006).

Table 8.9.2.1-3. Abundance, productivity, and trends of Columbia River chum populations. (Sources: NMFS 2005b; McElhany et al. 2007).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term trend		Median Growth Rate	
			Years ¹	No. ²	pHO S ³	Years	Value ⁴	Years	λ^5
Coastal	Grays	W	96-00	331	na	90-00	0.904 ⁶	90-00	0.807 ⁶
	Elochoman	W	na	na	na	na	na	na	na
	Mill Creek	W	na	na	na	na	na	na	na
	Youngs Bay	O	na	na	na	na	na	na	na
	Big Creek	O	na	na	na	na	na	na	na
	Clatskanie	O	na	na	na	na	na	na	na
	Scappoose	O	na	na	na	na	na	na	na
Cascade	Cowlitz	W	na	na	na	na	na	na	na
	Kalama	W	na	na	na	na	na	na	na
	Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	na	na	na	na	na	na	na
	Clackamas	O	na	na	na	na	na	na	na
	Sandy	O	na	na	na	na	na	na	na
Gorge	Lower Gorge	O/W	96-00	425	N/A	90-00	1.003	90-00	1.00
	Upper Gorge	O/W	na	na	na	na	na	na	na

¹ Years of data for recent means

² Geometric mean of total spawners

³ Average recent proportion of hatchery-origin spawners

⁴ Long-term trend of total spawners

⁵ Long-term median population growth rate (including both natural- and hatchery-origin spawners)

⁶ Hymer 2000 as cited in NMFS 2005b

Extinction Probability/Risk

The 100-year risk of extinction (Table 8.9.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (2004) for use in recovery plan assessments. The rating

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system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

The risk of extinction is high or very high for all populations except the Washington portion of the Lower Gorge. The Upper Gorge population, and all four of the populations on the Oregon side of the river in the Coastal MPG, are extirpated or nearly so (McElhany et al. 2007).

Table 8.9.2.1-4. Risk of extinction in 100 years; categories for populations of Columbia River chum (sources: Washington’s Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Coastal	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	VH
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	VH
	Scappoose	O	VH
Cascade	Cowlitz	W	VH
	Kalama	W	VH
	Lewis	W	VH
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	VH
	Sandy	O	VH
Gorge	Lower Gorge	O/W	VH/M
	Upper Gorge	O/W	VH/VH

Spatial Structure

The Columbia River chum ESU consists of three MPGs made up of two to seven historical populations each. In the Coastal MPG, spatial structure is limited by tide gates, dikes, culverts, and hatchery weirs. The filling of Bonneville pool eliminated mainstem and lower tributary habitat for the Upper Gorge population (WLCTRT et al. 2004). Over the past several years, few Columbia River chum salmon have been observed in tributaries between The Dalles and Bonneville dams. Surveys of the White Salmon River in 2002 found one male and one female carcass and the latter had not spawned (Ehlke and Keller 2003). Chum salmon were not observed

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in any of the upper gorge tributaries, including the White Salmon River, during the 2003 and 2004 spawning ground surveys (Keller 2005a, b). Radio-tracking studies show that a few adult chum tagged at Bonneville Dam were near the confluence of the White Salmon, but did not appear to enter the river and did not stay in the area.

In the Cascade MPG, chum salmon habitat was inundated by Mayfield Lake in the Cowlitz River and Merwin Lake in the North Fork Lewis River. The following measures, which could positively affect the spatial structure of chum populations in the Cascade MPG and thus rangewide status, were included in the new FERC licenses for these two projects:

- Lewis River Hydroelectric Project – chum salmon once ascended the mainstem Lewis River above the current location of Merwin Dam. Because this area is now inundated, PacifiCorps may use its In Lieu fund to repair a landslide upstream of the Lewis River Hatchery which buried chum salmon spawning habitat and fund a partnership with a gravel mining company to create spawning habitat on the East Fork Lewis and/or reconnect and enhance side channels and areas with upwelling to restore spawning habitat in the lower mainstem Lewis (NMFS 2007f)
- Cowlitz River Hydroelectric Project – Tacoma Power will provide minimum flows from Mayfield Dam to protect chum habitat during spawning, incubation, and emergence and will implement gravel augmentation projects in the habitat below the dam (NMFS 2004c)

Diversity

Most Columbia River chum populations have been functionally extirpated or are presently at very low abundance levels. However, in the Cascade MPG, chum sampled from each tributary recently were shown to be the remnants of genetically distinct populations (Small et al. 2006).

Historical hatchery introductions were limited to populations in the Coastal MPG and these were both small in scale and intermittent. As a result, they have not had lasting effects on the diversity of the affected populations. Three recently established artificial propagation programs produce chum salmon at this time; these are conservation programs which use naturally-produced adults for broodstock and release juveniles as fry, boosting egg-to-fry productivity. The current Washougal Hatchery program provides chum salmon for re-introduction into recently restored habitat in Duncan Creek (Washington). This program also provides a safety net for the naturally-spawning population in the mainstem Columbia River below Bonneville Dam during low flow years. The other two programs are designed to augment natural production in the Grays River and to reintroduce chum to the Chinook River. Effects on diversity are expected to be neutral.

8.9.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for CR chum salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the White Salmon River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Cowlitz, Lower Columbia, and Grays/ Elochoman (NMFS 2005b). There are 20 watersheds within the range of this ESU. Three watersheds received a medium rating

and 17 received a high rating for their conservation value to the ESU (i.e., for recovery). For more information see Chapter 4. The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 725 miles of habitat areas eligible for designation, 708 stream miles are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased steam temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.9.3.8.

8.9.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of CR chum salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.9.2.1-3) will improve.

8.9.3.1 Recent FCRPS Hydro Improvements

Chum salmon have benefited from operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in habitat just downstream from Bonneville Dam (Lower Gorge population). The flow operation supports spawning, incubation, and emergence and ensures access to Hamilton and Hardy creeks. However, some chum fry have been stranded on shallow water flats on Pierce Island as a result of daily flow fluctuations.

8.9.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving access by replacing culverts and by fish habitat restoration activities at FERC-licensed dams. The latter category includes the removal of Condit Dam in 2009 (NMFS 2006j), a portion of the historical spawning habitat that was inundated by Bonneville pool could be restored over time if sediment released upon the removal of Condit Dam, and natural bedload, deposit in the lower White Salmon River in a way that elevates the stream bottom (NMFS 2006k). However, NOAA Fisheries is uncertain that this action will lead to the restoration of this component of the Upper Gorge population.

As described in Section 8.10.3.2, a comprehensive habitat assessment and restoration plan for the Grays River watershed was conducted by the Pacific Northwest National Laboratory (PNNL) in cooperation with Washington Department of Fish and Wildlife (WDFW) and Pacific States Marine Fisheries Commission (PSMFC) in 2006, focusing on the fall-run Chinook population. Several related projects have been implemented (see attachment to NOAA Fisheries' 2008 Guidance letter to the Pacific Fisheries Management Council PFMC; NMFS 2008i). These include habitat restoration in the upper (reducing excess sediment loads) and lower (reconnecting the river delta-estuarine habitat at Seal Slough, the tidal floodplain at Devils Elbow, estuarine wetlands at Seal Slough, adding large wood to the lower West Fork, reducing temperatures and improving habitat diversity near Grays RM 11.8, and replacing the Nikka tidegate to restore connectivity and increase fish passage) Grays River watersheds. These projects are likely to benefit the Grays River chum salmon population because chum salmon also have a subyearling juvenile life history type and rear in the types of habitats that will be addressed.

8.9.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving wetland and riparian function. These have resulted in an estimated .0.7% survival benefit for Columbia River chum (ocean-type juvenile life history) (Corps et al. 2007a).

8.9.3.4 Recent Predator Management Improvements

Avian Predation

Avian predators are assumed to have little effect on the survival of Columbia River chum salmon.

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. Benefits of recent northern pikeminnow management activities to chum salmon are unknown, but could be comparable to those for other salmon species with a subyearling juvenile life history: 2% (Friesen and Ward 1999).

8.9.3.5 Recent Hatchery Management Issues

Hatchery effects have not been identified as a limiting factor for Columbia River chum salmon (LCFRB 2004; ODFW 2006b). NOAA Fisheries described three programs that release chum salmon below Bonneville Dam (Table 8.9.2.1-1) as improving population viability by increasing abundance and spatial distribution (NMFS 2004b), as well as reducing short-term extinction risk. A summary of progress in hatchery reform for lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS (2004b).

8.9.3.6 Recent Harvest Survival Improvements

Columbia River chum salmon are not caught incidentally in tribal fisheries above Bonneville Dam. Columbia River chum are incidentally caught occasionally in non-Indian fall season fisheries below Bonneville. There are no fisheries in the Columbia River that target hatchery or natural-origin chum salmon. The species' later fall return timing is such that they are vulnerable to relatively little potential harvest in fisheries that target Chinook and coho. Columbia River chum rarely take the kinds of sport gear that is used to target other species.

Harvest rates are difficult to estimate since NOAA Fisheries does not have good estimates of total run size. However, the incidental catch of chum amounts to a few tens of fish per year (TAC 2008). The harvest rate in proposed state fisheries in the lower river is estimated to be 1.6% per year and is almost certainly less than 5%.

8.9.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Gorge MPG

Completed consultations include road maintenance, culvert cleaning, treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Upper Gorge); and repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

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Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.9.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration

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Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

There projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; habitat restoration; tar remediation). Other projects, including road maintenance, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (habitat restoration with stormwater facilities; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.9.3.8 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. Factors affecting the conservation value of critical habitat in areas occupied by chum salmon vary from altered channel morphology and stability, loss of habitat diversity, high sediment loads, and altered/reduced streamflow, and elevated temperatures.

Spawning Areas

Chum salmon spawn in the lower and middle mainstem reaches of large streams and at several sites in the mainstem Columbia River between Bonneville Dam and the confluence of the Willamette River. The following are the major factors that have limited the functioning of PCEs and thus the conservation value of spawning habitat (i.e., substrate, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers [*low flows; culverts; dikes; tidegates*]
- Reduced riparian function [*urban and rural development; forest practices; agricultural practices; channel manipulations*]
- Loss of floodplain and side channel connectivity [*urban and rural development; past forest practices; agricultural practices; channel manipulations*]
- Excessive sediment in spawning gravel [*forest practices; agricultural practices*]
- Elevated water temperatures [*water withdrawals; urban and rural development; forest practices; agricultural practices*]

The functioning of mainstem spawning habitat has improved in recent years with operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in the mainstem just downstream from Bonneville Dam. The flow operation also supports access (i.e., removes a barrier) to spawning habitat in Hamilton and Hardy creeks.

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address some of factors limiting PCEs in tributary habitat. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile Rearing Areas & Migration Corridors

Factors that have limited PCEs in juvenile rearing areas and migration corridors (i.e., affecting substrate, water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage) are:

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- Entrapment and stranding during emergence from mainstem spawning areas [*power operations at Bonneville Dam*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

Short-term (daily) flow fluctuations at Bonneville Dam sometimes create a barrier (i.e., entrapment on shallow sand flats) for fry moving into the mainstem rearing and migration corridor. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of PCEs in the estuary, improving the functioning of cover/shelter, food, and riparian vegetation. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Adult Migration Corridors

Factors that have limited PCEs in the adult migration corridor (i.e., affecting safe passage) are:

- Reduced access to mainstem and tributary spawning areas [*construction of Bonneville Dam for habitat further upstream; FCRPS flow management for the mainstem in the Ives Island area; flood control operations at FERC-licensed dams on the Cowlitz, Lewis, and White Salmon rivers*]

Productive historical spawning areas were located in the lower reaches of tributaries in the upper Gorge. These were inundated when Bonneville pool was filled around 1938. Few adults have passed Bonneville Dam in recent years. Some of those that moved further upstream fall back below the dam.

Hydrosystem flow management operations have been altered since the species was first listed in 1998 to support access to mainstem habitat in the Ives Island area. Entry of adult chum into nearby tributary spawning areas (i.e., Hamilton and Hardy creeks and the constructed spawning channel at Hamilton Springs) depends on mainstem flows, but also on local rainfall during November and December.

Areas for Growth & Development to Adulthood

Although CR chum salmon spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.9.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions in the Washougal that will benefit the Lower Gorge population as well as actions that should generally be beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.² They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this ESU.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

² The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

8.9.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term, minor, adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Affects Appendix and in the section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.9.5.1 Effects of Hydro Operations & Configuration Prospective Actions

The overall mainstem hydro strategy will be to provide adequate surface water elevations for chum salmon in redds downstream from Bonneville Dam; ensure that voluntary spill does not result in unsafe TDG levels for fish in shallow water areas; and provide safe passage for adults that migrate past Bonneville Dam. Specifically, the Prospective Actions require that the Action Agencies:

- Provide a tailwater elevation of approximately 11.5 feet at Bonneville Dam beginning in the first week of November (or when chum arrive) and ending by December 31, if reservoir elevations and climate forecasts indicate this operation can be maintained through incubation and emergence
- Through TMT, if water supply is deemed insufficient to provide mainstem spawning or continuous tributary access, provide as appropriate sufficient mainstem flow intermittently to allow fish access to tributary spawning sites if spawning habitat is available in the tributaries
- Make adjustments to tailwater elevation through the TMT process consistent with the size of the spawning population and water supply forecasts
- After completion of spawning, use the TMT process to establish tailwater elevation needed to provide protection for mainstem chum redds through incubation and the end of emergence
- If the emergence period extends beyond April 10th and the decision is made to maintain the tailwater, TMT will discuss the impacts of TDG associated with spill for fish in the gravel (i.e., the start of spring spill could be delayed)
- Revisit chum protection level decision at least monthly through the TMT process to assure it is consistent with the need to provide spring flows for listed Columbia and Snake River stocks

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Based on PIT-tag detections for adult fall Chinook, NOAA Fisheries estimates an upstream passage survival rate of 96.9% for adult chum salmon at Bonneville Dam.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have shallow water, low velocity habitat, identified as a limiting factor in the estuary (Section 8.9.3.8).

Effects on Species Status

Prospective flow operations will maintain the current abundance, productivity, and spatial structure of the Lower Gorge population. Improvements at Bonneville Dam will increase the passage survival of adult chum salmon that migrate past the project (and of juvenile chum, if any are produced in the upper Gorge).

Effects on Critical Habitat

The flow management operation for mainstem habitat below Bonneville Dam will maintain the current water quantity and quality conditions and substrate supporting spawning, incubation and larval development. Prospective flow operations will also maintain the current access to spawning areas in Hamilton and Hardy creeks.

8.9.5.2 Effects of Tributary Habitat Prospective Actions

Under the Prospective Actions, the FCRPS Action Agencies' will consider funding habitat improvement projects for the historical Columbia River chum salmon population above Bonneville that has been significantly impacted by the FCRPS. Projects will be selected that are consistent with basin-wide criteria for prioritizing projects, including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

Effects on Species Status

Tributary habitat projects, if implemented, will be selected such that they also address limiting factors and thus would also be likely to increase the viability of the local population(s).

Effects on Critical Habitat

If implemented, the potential tributary habitat improvements would address limiting factors, improving the functioning of PCEs in tributary habitat used by the Lower or Upper Gorge populations.

8.9.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will carry out 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The expected survival benefit for CR chum salmon associated with these actions will be less than 2.3%. The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin Chinook populations, but will also provide survival benefits to Columbia River chum salmon (an estimated 6.7%). Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, reducing noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of CR chum salmon.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in rearing areas for subyearling chum salmon. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.9.5.4 Effects of Hatchery Prospective Actions

Under the Prospective Actions, the Action Agencies will continue to fund a hatchery program to reintroduce chum into Duncan Creek. The Washougal Hatchery program was designed to increase the number of naturally spawning chum salmon in Duncan Creek as part of a habitat improvement project. Adults are collected and transported to WDFW's Washougal Hatchery for broodstock to produce juveniles which are outplanted into Duncan Creek. All fish produced by the program are given an otolith mark so that researchers can determine whether using the hatchery program to boost egg-to-fry survival results in increased adult returns.

The Prospective Actions also require that the Action Agencies fund an assessment of habitat potential, the development of reintroduction strategies, implementation of a pilot supplementation projects in selected tributaries below Bonneville Dam.

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Under the RPA (Action 39), the FCRPS Action Agencies will adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Species Status

The ongoing Washougal Hatchery program and other prospective reintroduction pilot projects are expected to increase the abundance and productivity, as well as the spatial structure, of the Lower Gorge population.

Effects on Critical Habitat

The effects of prospective hatchery actions on PCEs and the conservation value of critical habitat will be evaluated in subsequent consultations on specific projects.

8.9.5.5 Effects of Harvest Prospective Actions

The 1999-2007, annual non-Indian commercial landings averaged 35 fish (TAC 2008, Table 32). Impacts in the recreational fishery (from non-retention mortalities) are expected to be zero fish in 2008-2017 (TAC 2008). The total impact rates on Columbia River chum for 2008-2017 are expected to average 1.6% (TAC 2008), but the incidental harvest rate is limited to no more than 5.0%. There are no records of chum harvest in tribal fisheries and no impacts are expected in treaty Indian fisheries in 2008-2017 (TAC 2008).

Effects on Species Status

The prospective harvest actions are not expected to affect the abundance or productivity of CR chum salmon.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for CR chum salmon.

8.9.5.6 Effects of Predation Prospective Actions

The prospective increase in incentives in the NPMP could result in an additional 1% survival if benefits are similar to those expected for subyearling Chinook salmon (see Section 8.10.5.6).

Effects on Species Status

Prospective actions that reduce predation on juveniles will support the increased abundance and productivity of CR chum salmon populations.

Effects on Critical Habitat

Continued implementation of the base Northern Pikeminnow Management Program and increased sport fishery reward structure could improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.9.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.9.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Columbia River Chum Salmon

This section summarizes the basis for conclusions at the ESU level.

8.9.6.1 Recent Status of the Columbia River Chum Salmon ESU

Columbia River chum salmon is a threatened species. There are only two populations in this ESU with more than a few spawners, the Grays River and Lower Gorge populations in the Coastal and Gorge MPGs, respectively. The construction of Bonneville Dam in the 1930s inundated spawning and early rearing habitat, so that the Upper Gorge population has been extirpated or nearly so. Most historical spawning tributaries below Bonneville are moderately or severely impaired in the lower reaches favored by chum salmon: access is limited by tide gates, dikes, and culverts and floodplains and side channels are no longer connected to the main channel. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. Prior to the 1950s, harvest rates were as high as 70%. Large-scale changes in freshwater and marine environments also had substantial effects on salmonid population numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in tributary spawning and estuary rearing areas. The

functioning of mainstem spawning habitat has improved in recent years with operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in the mainstem just downstream from Bonneville Dam. The flow operation also supports access to spawning habitat in Hamilton and Hardy creeks. However, daily flow fluctuations have sometimes created a barrier (i.e., entrapment on shallow sand flats) for fry moving into the mainstem rearing and migration corridor.

Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands, which may have downstream effects that improve conditions in the lower gradient reaches needed for the conservation of chum salmon. . Federal agencies are implementing numerous projects within the range of CR chum salmon including road and bridge repairs, dredging and dock maintenance, timber sales, and streambank stabilizations. The effects of these projects on population viability will be neutral or they will have short- or even long-term adverse effects.

8.9.6.2 Effects of the FCRPS, Upper Snake, U.S. v. Oregon Prospective Actions on the Columbia River Chum Salmon ESU

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the Columbia River, including those populations within the Columbia River chum salmon ESU.³ In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The Action Agencies' estuary habitat restoration projects will address this objective. Under the Prospective Actions, the Action Agencies will continue to implement the flow operations begun in recent years that provide spawning habitat in the mainstem and access to habitat in the tributaries just below Bonneville Dam and to fund a hatchery program to reintroduce chum into Duncan Creek. The Prospective Actions also require that the Action Agencies fund an assessment of habitat potential, the development of reintroduction strategies, implementation of a pilot supplementation projects in selected tributaries below Bonneville Dam. If projects are implemented, they could compensate for the loss of historical spawning habitat for the Upper Gorge population (inundated by Bonneville Dam) by improving the overall viability of the ESU.

The principal effects of the Prospective Actions on critical habitat will be an increase in the amount and quality of estuarine habitat (for the transitions between fresh- and saltwater and juvenile growth and development before entering the plume).

8.9.6.3 Cumulative Effects Relevant to the Columbia River Chum Salmon ESU

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that

³ The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

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affect instream habitat. These actions will primarily affect conditions within the tributary spawning and rearing areas, including the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile chum salmon.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.9.6.4 Effects of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Columbia River Chum Salmon ESU

Impacts of the FCRPS and Upper Snake projects on this ESU are most significant for the 2 (out of 16) populations within the ESU that once spawned above or currently spawn just below Bonneville Dam, and are limited relative to impacts from tributary hydropower and tributary habitat. The Upper Gorge population was extirpated the inundation of spawning habitat. The Lower Gorge population will continue to be affected by operations in the Bonneville tailrace, but for populations originating further downstream, only rearing habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington have identified tributary habitat actions that are reasonably certain to occur and that will be generally beneficial throughout the ESU. The State of Washington identified actions in the Washougal that will improve habitat conditions for that portion of the Lower Gorge population. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands, which may have downstream effects that improve conditions in the lower gradient reaches needed for the conservation of chum salmon.

The Action Agencies' prospective hydrosystem operation and estuary habitat improvements, by addressing the influence of their projects, will contribute to the viability of this ESU and thus to its survival with an adequate potential for recovery. Potential tributary habitat projects could further improve viability by compensation for the loss of populations in the Upper Gorge (above Bonneville Dam). The Prospective Actions will not further deteriorate this pre-action condition.

Long term (100 year) extinction risk is high or very high for almost all populations in the ESU. The only exception is the Lower Gorge population, at least on the Washington side of the river. In the short term, the species extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the Grays River and mainstem Columbia portion of the Lower Gorge population will continue to be preserved by ongoing hatchery actions as a hedge against the short-term risk of extinction.

8.9.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Columbia River Chum Salmon ESU

NOAA Fisheries designated critical habitat for CR chum salmon including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the White Salmon River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Cowlitz, Lower Columbia, and Grays/Elochoman. The environmental baseline within the action area, which includes the Middle Columbia/Hood and Lower Columbia/Sandy subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for CR chum salmon. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, riparian vegetation, and space in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions include habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary, which will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action Agencies' projects on the Columbia River chum ESU, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the

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species. The Proposed Action will not reduce the conservation value of this ESU's designated critical habitat. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Columbia River chum ESU nor result in the destruction or adverse modification of designated critical habitat.

Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

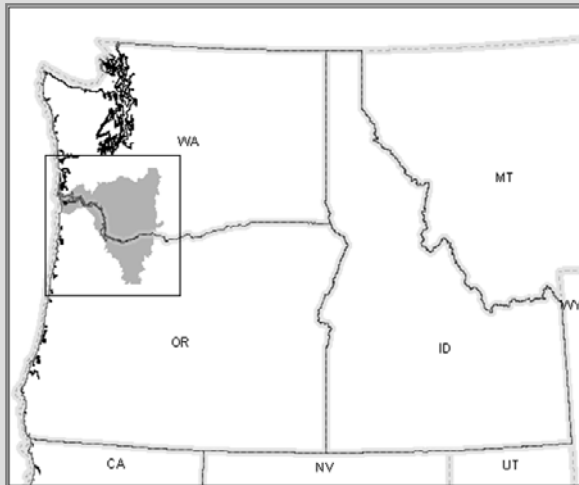
- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁴

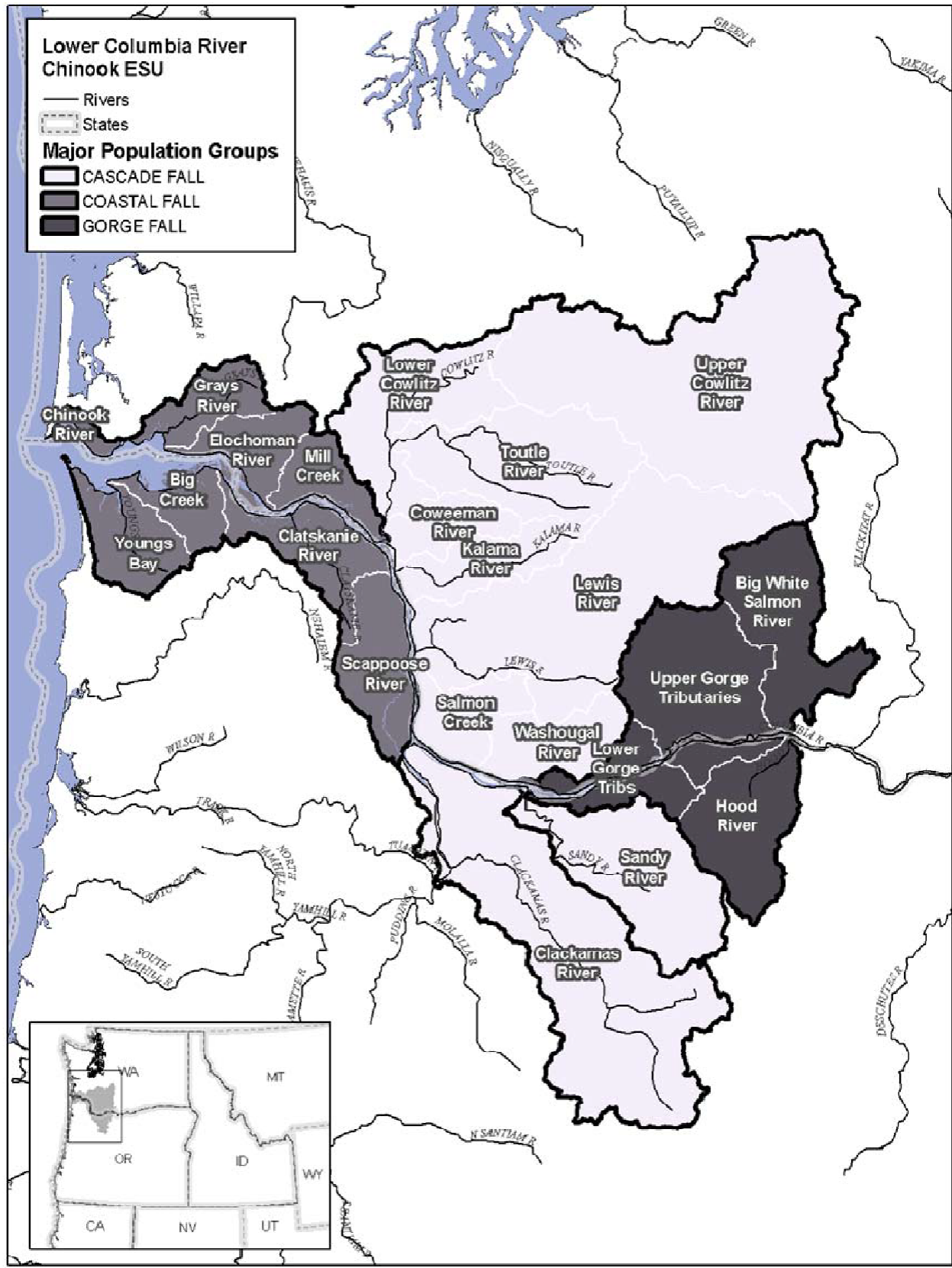
⁴ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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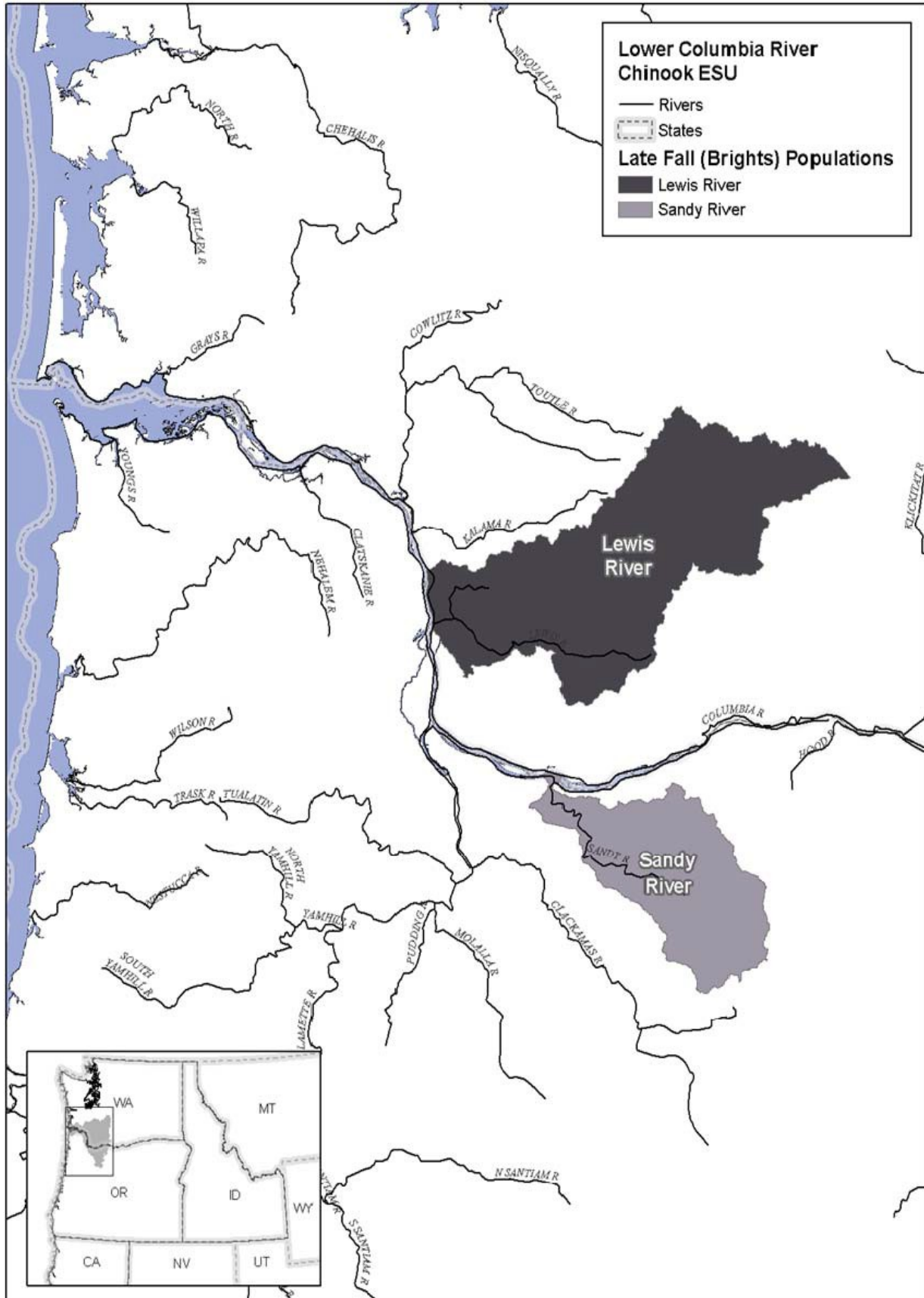
Lower Columbia River Chinook Salmon



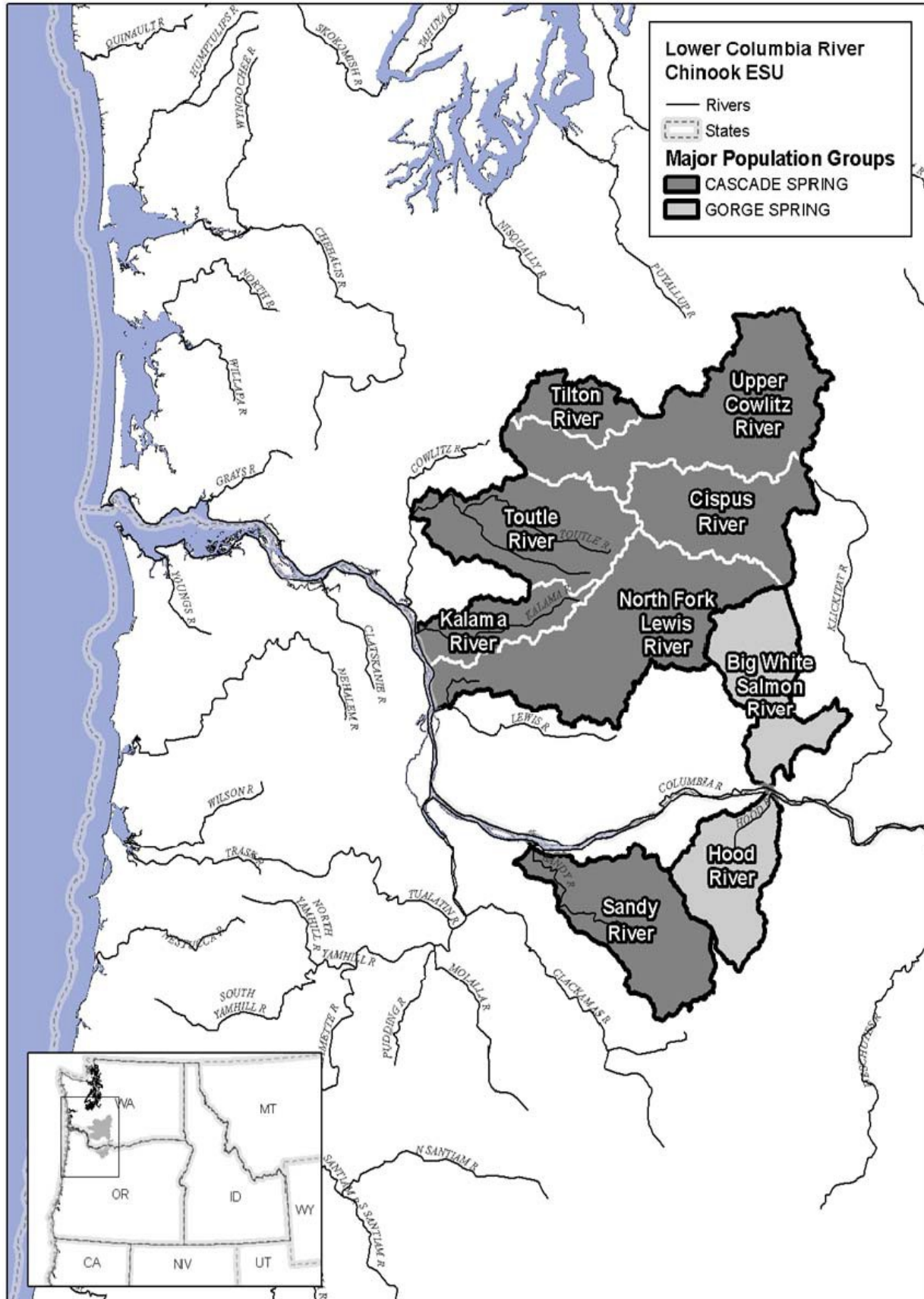
- 8.10.1 Species Overview**
- 8.10.2 Current Rangewide Status**
- 8.10.3 Environmental Baseline**
- 8.10.4 Cumulative Effects**
- 8.10.5 Effects of the Prospective Actions**
- 8.10.6 Aggregate Effects**



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Section 8.10

Lower Columbia River Chinook Salmon

Species Overview

Background

The Lower Columbia River (LCR) Chinook salmon ESU includes all naturally spawned populations from the mouth of the Columbia River upstream to and including White Salmon River in Washington and the Hood River in Oregon. Additionally, this ESU includes the Willamette River upstream to Willamette Falls (exclusive of the spring-run Chinook salmon in the Clackamas River), as well as 17 artificial propagation programs. There are six major population groups in this ESU, including 32 historical populations, seven of which are extirpated or nearly so. Lower Columbia River Chinook numbers began to decline by the early 1900s because of habitat degradation and harvest rates and were listed under the ESA as threatened in 1999. The listing was reaffirmed in 2005.

Designated critical habitat for this ESU includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

Many of the populations in this ESU currently have for which data are available have low abundances and many of the long- and short-term trends in abundance are negative, some severely so. Some of the natural runs largely have been replaced by hatchery production.

Limiting Factors

Human impacts and limiting factors for the LCR Chinook include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. Lower Columbia River Chinook populations began declining in the early 1900s because of habitat changes and harvest rates. FCRPS impacts have been limited, but are most significant for the five populations that spawn in tributaries above Bonneville Dam. These populations are affected by upstream and downstream passage and the inundation of spawning habitat for fall-run Chinook in the lower reaches of the tributaries to the reservoir. For populations originating in tributaries below Bonneville, migration and habitat conditions in the mainstem and estuary have been affected by hydrosystem flow operations. Tributary habitat degradation is pervasive due to development and other land uses, and FERC-licensed hydroelectric projects have blocked some spawning areas. Hatchery production for LCR Chinook has reduced the diversity and productivity of natural populations throughout the ESU. Predators take a significant number of juveniles and adults, particularly from spring-run populations.

Recent Ocean and Mainstem Harvest

Lower Columbia River spring Chinook populations are caught incidentally in ocean fisheries, primarily off the Washington coast and as far north as Alaska, and in spring season fisheries in the Columbia River mainstem and tributaries. In recent years, the total exploitation rates for the Cowlitz spring Chinook population (as a surrogate for all spring Chinook populations of the LCR Chinook ESU) were generally higher prior to the mid 1990s, averaging 50% through 1994. Total exploitation rates have averaged approximately 27% since 1995. The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 27% and 12% respectively.

Lower Columbia River fall-run (tule) Chinook populations are caught in ocean fisheries off the coasts of Oregon, Washington, and British Columbia. Total exploitation rates were generally higher through 1993 (averaging 69%), lower from 1994 to 1999 (averaging 34%), then increasing since 2000 (averaging 49%). From 2002 to 2006 fisheries were managed subject to a 49% exploitation rate limit. Total exploitation rates have been higher in some years but have averaged 49% from 2002 to 2006. The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 16%, 8% and 9% respectively.

Total exploitation rates estimates to the North Fork Lewis bright Chinook population (as a surrogate for all “bright” Chinook populations of the LCR Chinook ESU) were generally higher through 1989 (averaging 56%), declining during the decade of the 1990s (averaging 36%), and increased slightly since 2000 (averaging 38%). The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 25%, 14% and 16% respectively.

8.10.2 Current Rangelwide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.10.2.1 Current Rangelwide Status of the Species

Lower Columbia River Chinook display three life history types including early fall runs (“tules”), late fall run (“brights”) and spring-runs (Table 8.10.2.1-1). Both spring and fall runs have been designated as part of a Lower Columbia River Chinook ESU. This ESU includes populations in tributaries from the ocean to the Big White Salmon River in Washington and Hood River in Oregon. Fall Chinook salmon historically were found throughout the entire range, while spring Chinook salmon historically were only found in the upper portions of basins with snowmelt driven flow regimes (western Cascade Crest and Columbia Gorge tributaries). Late fall Chinook salmon were identified in only two basins in the western Cascade Crest tributaries. In general, late fall Chinook salmon also matured at an older average age than either lower Columbia River spring or fall Chinook salmon, and had a more northerly oceanic distribution. Currently, the abundance of fall Chinook greatly exceeds that of the spring component.

Table 8.10.2.1-1. Life history and population characteristics of Chinook salmon originating in Washington portions of the lower Columbia River.

Characteristic	Racial Features		
	Spring	Tule Fall	Late Fall Bright
Number of extant populations	7 (including 4 that are possibly extinct)	13	1
Life history type	Stream	Ocean	Ocean
River entry timing	March-June	August-September	August-October
Spawn timing	August-September	September-November	November-January
Spawning habitat type	Headwater large tributaries	Mainstem large tributaries	Mainstem large tributaries
Emergence timing	December-January	January-April	March-May
Duration in freshwater	Usually 12-14 months	1-4 months, a few up to 12 months	1-4 months, a few up to 12 months
Rearing habitat	Tributaries and mainstem	Mainstem, tributaries, sloughs, estuary	Mainstem, tributaries, sloughs, estuary
Estuarine use	A few days to weeks	Several weeks up to several months	Several weeks up to several months

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	Racial Features		
Characteristic	Spring	Tule Fall	Late Fall Bright
Ocean migration	As far North as Alaska	As far North as Alaska	As far North as Alaska
Age at return	4-5 Years	3-5 Years	3-5 Years
Estimated historical spawners	125,000	140,000	19,000
Recent natural Spawners	800	6,500	9,000
Recent hatchery adults	12,600 (1990-2000)	37,000 (1991-1995)	NA

The Lower Columbia River Chinook salmon ESU is composed of 32 historical populations. The populations are distributed through three ecological zones. The combination of life history types based on run timing, and ecological zones result in six major population groups (referred to as strata by the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) (Table 8.10.2.1-2 and Lower Columbia River Chinook maps). There are 23 (tule) fall- and (bright) late fall-run populations, and nine spring-run populations, some of which existed historically but are now extirpated or nearly so. Also included in the ESU are 17 hatchery programs. Excluded from the ESU are Carson spring Chinook and introduced bright fall Chinook occurring in the Wind and (Big) White Salmon rivers as well as spring Chinook released at terminal fishery areas in Youngs Bay, Blind Slough, and Deep River and in the mainstem Columbia. Populations of spring Chinook in the Willamette, including the Clackamas, are in a different ESU.

Fall Chinook enter freshwater typically in August through October to spawn in large river mainstems and the juvenile life history stage emigrates from freshwater as subyearlings (ocean type). Spring Chinook enter fresh water in March through June to spawn in upstream tributaries and generally emigrate from freshwater as yearlings (stream type). Listed populations of LCR Chinook salmon are stratified by biological, geographical, and ecological considerations into the six major population groups shown in Table 8.10.2.1-2, below.

Table 8.10.2.1-2 LCR Chinook salmon ESU description and major population groups (MPGs) (Sources: NMFS 2005a; Myers et al. 2006). The designations “(C)” and “(G)” identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).¹

ESU Description	
Threatened	Listed under ESA in 1999; reaffirmed in 2005
6 major population groups	32 historical populations
Major Population Group	Population
Cascade Spring	Upper Cowlitz (C,G), Cispus (C), Tilton, Toutle, Kalama, Lewis (C), Sandy (C,G)
Gorge Spring	White Salmon (C), Hood
Coastal Fall	Grays, Elochoman (C), Mill Creek, Youngs Bay, Big Creek (C), Clatskanie, Scappoose
Cascade Fall	Lower Cowlitz (C), Upper Cowlitz, Toutle (C), Coweeman (G), Kalama, Lewis (G), Salmon Creek, Washougal, Clackamas (C), Sandy
Cascade Late Fall	Lewis (C,G), Sandy (C,G)
Gorge Fall	Lower Gorge, Upper Gorge (C,G), White Salmon (C,G), Hood
Hatchery programs included in ESU (17)	Sea Resources Tule Chinook, Big Creek Tule Chinook, Astoria High School (STEP) Tule Chinook, Warrenton High School (STEP) Tule Chinook, Elochoman River Tule Chinook, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook, Kalama Tule Chinook, Washougal River Tule Chinook, Spring Creek NFH Tule Chinook, Cowlitz spring Chinook (2 programs), Friends of Cowlitz spring Chinook, Kalama River spring Chinook, Lewis River spring Chinook, Fish First spring Chinook, Sandy River Hatchery (ODFW stock #11)

Limiting Factors

Lower Columbia River Chinook salmon populations began to decline by the early 1900s because of habitat alterations and harvest rates that were unsustainable given these changing habitat conditions. Human impacts and limiting factors come from multiple sources: habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other types of land use. Fall Chinook spawning and rearing habitat in tributary mainstems has been adversely affected by sedimentation, increased temperatures, and reduced habitat diversity. Spring Chinook access to subbasin headwaters has been restricted or eliminated by the construction of non-Federal dams without fish passage. Five populations (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, White Salmon Spring Run, and Hood River Spring Run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Many naturally-spawning populations have

¹ Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU (WLCTRT 2003).

been subject to the effects of a high incidence of naturally-spawning hatchery fish. The species was subject to harvest rates of 50% or more until recent years. Preservation and recovery of this ESU will require significant efforts by many parties.

Summarized below (Table 8.10.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for LCR Chinook salmon.

Table 8.10.2.1-2. Key limiting factors for LCR Chinook salmon.

<p>Mainstem Hydro</p>	<p>Direct mainstem hydropower system impacts on LCR Chinook salmon are most significant for the five gorge tributary populations upstream from Bonneville Dam (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, White Salmon Spring Run, and Hood River Spring Run). These populations are affected by upstream and downstream passage at Bonneville Dam and spawning habitat in the lower reaches of the tributaries used by the Upper Gorge fall-run population were inundated by Bonneville pool. Federal hydrosystem impacts on populations originating in downstream subbasins are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.</p>
<p>Predation</p>	<p>Piscivorous birds including Caspian terns and cormorants, fishes including northern pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult salmon. Stream-type juveniles, especially yearling smolts from spring-run populations, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al 2005). However, recent research shows that subyearlings from the LCR Chinook ESU are also subject to tern predation, probably because of their long estuarine residence time (Ryan et al. 2006). In addition, spring Chinook are subject to pinniped predation when they return to the estuary as adults (NMFS 2006b). Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-type juveniles in the Columbia River basin [1998 data, from Bonneville Power Administration (BPA 2004) and 2006 data from Roby (2006) as cited in Corps et al. 2007a]. Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and the exclusion, hazing, and in some cases, lethal take of marine mammals near Bonneville Dam.</p>
<p>Harvest</p>	<p>LCR Chinook salmon are harvested in the Columbia River and its tributaries and in ocean fisheries off Oregon, Washington, and Canada. Historical harvest</p>

	<p>rates on some populations of Chinook salmon reached 80% or more. Permitted incidental harvest rate limits for fall-run Chinook salmon dropped from 65% just after listing to 42% in 2007. Incidental harvest rates on spring-run fish have been reduced from 50 to 25% (LCFRB 2004).</p>
<p>Hatcheries</p>	<p>Hatchery management practices have reduced the diversity and productivity of natural populations throughout the Columbia River Basin. The long-term domestication of hatchery fish has reduced the productivity of some wild stocks where significant numbers of hatchery fish spawn, especially for tule fall Chinook populations. Large numbers of hatchery fish have also contributed to more intensive mixed stock fisheries, which probably overexploited wild populations already weakened by habitat degradation. For spring Chinook, virtually all production in the Washington portion of the lower Columbia River is of hatchery origin, and Oregon populations of spring Chinook are also subject to significant hatchery influence. State and Federal hatchery programs throughout the lower Columbia River are currently the subject of a series of comprehensive reviews for consistency with the recovery needs of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.</p>
<p>Estuary</p>	<p>The estuary is a particularly important habitat for migrating salmonids from LCR Chinook populations. Alterations in flow and diking have resulted in the loss of shallow water, low velocity habitats: emergent marshes, tidal swamps, and forested wetlands. These habitats are used extensively by subyearling juveniles. The survival of larger (yearling) juveniles in the ocean can be affected by habitat factors in the estuary such as changes in food availability and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the Columbia basin have altered habitat-forming processes including the shape, behavior, size, and composition of the plume compared to historical conditions. Characteristics of the plume are thought to be significant to spring-run yearling migrants during transition to the ocean phase of their lifecycle (Fresh 2004). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006b).</p>
<p>Habitat</p>	<p>Widespread development and other land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats where fall Chinook salmon spawn and rear. Most of the significant mainstem spawning habitats in large previously-productive systems such as the Cowlitz River have been extensively diked and filled. In addition to cumulative habitat effects, the construction of non-Federal hydropower facilities on Columbia River tributaries has partially or completely</p>

	<p>blocked higher elevation spawning. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for Chinook by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.</p>
<p>Ocean & Climate</p>	<p>Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this ESU to some extent, future trends, especially during the period relevant to the Proposed Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCRFB 2004).</p>

Abundance, Productivity & Trends

The information in Table 8.10.2.1-3 was reported in NOAA Fisheries’ most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). Some of the natural runs (e.g., the Youngs Bay, Kalama River and Upper and Lower Gorge fall runs, and all of the spring-run populations) have been replaced largely by hatchery production. Quantitative data is only available for about half of the populations.

The majority of populations for which data are available have a long-term trend of less than 1.0, indicating the population is in decline. In addition, for most populations there is a high probability that the true trend/growth rate is less than 1.0 (Table 16 in Good et al. 2005). Assuming that the reproductive success of hatchery-origin fish has been equal to that of natural-origin fish, the analysis indicates a negative long-term growth rate for all of the populations except the Coweeman River fall run, which has had very few hatchery-origin spawners. The North Fork Lewis River late fall population is considered the healthiest and is significantly larger than any other population in the ESU. The data used for the analysis shown in Table 8.10.2.1-3 is current only through 2001 for Washington populations and 2004 for Oregon populations. More recent estimates of escapement along with available data for the time series are shown in Tables 8.10.2.1-4 and 8.10.2.1-6 through 8.10.2.1-8.

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Table 8.10.2.1-3. Abundance, productivity, and trends of LCR Chinook salmon populations (sources: Good et al. 2005 for Washington and McElhany et al. 2007 for Oregon populations).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend ^b		Median Growth Rate ^c	
			Years	Geo Mean	pHOS ^a	Years	Value	Years	λ
Cascade Spring	Cowlitz	W	na	na	na	80-01	0.994	na	na
	Cispus	W	2001	1,787	na	na	na	na	na
	Tilton	W	na	na	na	na	na	na	na
	Toutle	W	na	na	na	na	na	na	na
	Kalama	W	97-01	98	na	80-01	0.945	na	na
	NF Lewis	W	97-01	347	na	80-01	0.935	na	na
	Sandy	O	90-04	959	52%	90-04	1.047	90-04	0.834
Gorge Spring	White Salmon	W	na	na	na	na	na	na	na
	Hood	O	94-98	51	na	na	na	na	na
Coastal Fall	Grays	W	97-01	59	38%	64-01	0.965	80-01	0.844
	Elochoman	W	97-01	186	68%	64-01	1.019	80-01	0.800
	Mill	W	97-01	362	47%	80-01	0.965	80-01	0.829
	Youngs Bay	O	na	na	na	na	na	na	na
	Big Creek	O	na	na	na	na	na	na	na
	Clatskanie	O	90-04	41	15%	90-04	1.077	90-04	1.152
	Scappoose	O	na	na	na	na	na	na	na
Cascade Fall	Lower Cowlitz	W	96-01	463	62%	64-00	0.951	80-01	0.682
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Toutle	W	na	na	na	na	na	na	na
	Coweeman	W	97-01	274	0%	64-01	1.046	80-01	1.091
	Kalama	W	97-01	655	67%	64-01	0.994	80-01	0.818
	Lewis	W	97-01	256	0%	80-01	0.981	80-01	0.979
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	97-01	1,130	58%	64-01	1.088	80-01	0.815
	Clackamas	O	98-01	40	na	67-01	0.937	na	na
	Sandy	O	97-01	183	na	na	na	na	na

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Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend ^b		Median Growth Rate ^c	
			Years	Geo Mean	pHOS ^a	Years	Value	Years	λ
Gorge Fall	Lower Gorge	W/O	na	na	na	na	na	na	na
	Upper Gorge	W/O	97-01	109	13%	64-01	0.935	80-01	0.955
	White Salmon	W	97-01	218	21%	67-01	0.941	80-01	0.945
	Hood River	O	00-04	36	na	na	na	na	na
Cascade Late Fall	NF Lewis	W	97-01	6,818	13%	64-01	0.992	80-01	0.948
	Sandy	O	90-04	2,771	5%	81-04	0.983	81-04	0.997

The LCFRB Recovery Plan described a recovery scenario for Lower Columbia River Chinook. They identified each population's role in recovery as a primary, contributing, or stabilizing populations which generally refer to a desired viability level. The Recovery Plan also suggested viable abundance goals for each population (Table 8.10.2.1-4).

Table 8.10.2.1-4. The ecological zones and populations for the Lower Columbia River Chinook salmon ESU (LCFRB 2004). Primary populations identified for greater than high viability objectives are denoted with an asterisk.

Population/Strata	Status /Goal ¹	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
GORGE SPRING					
White Salmon (WA)	C	1,400	2,800	5,237	19
Hood (OR)	P	1,400	2,800		
CASCADE SPRING					
Upper Cowlitz (WA)	P*	2,800	8,100		
Cispus (WA)	P*	1,400	2,300		
Tilton (WA)	S	1,400	2,800		
Toutle (WA)	C	1,400	3,400		
Kalama (WA)	P	1,400	1,400		
NF Lewis (WA)	P	2,200	3,900		
Sandy (OR)	P	2,600	5,200		

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Population/Strata	Status /Goal ¹	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
CASCADE LATE FALL					
NF Lewis (WA)	P*	6,500	16,600		
Sandy (OR)	P	5,100	10,200		
COAST FALL (Tule)					
Grays/Chinook (WA)	P	1,400	1,400	336	78
Eloch/Skam (WA)	P	1,400	4,500	4,751	31
Mill/Aber/Germ (WA)	C	2,000	3,200	4,063	23
Youngs Bay (OR)	S	1,400	2,800		
Big Creek (OR)	S	1,400	2,800		
Clatskamie (OR)	P	1,400	2,800	179	43
Scapoose (OR)	S	1,400	2,800		
CASCADE FALL (Tule)					
Lower Cowlitz (WA)	C	3,900	33,200		
Upper Cowlitz (WA)	S	1,400	10,800		
Toutle (WA)	S	1,400	14,100		
Coweeman (WA)	P*	3,000	4,100	1,128	82
Kalama (WA)	P	1,300	3,200	12,680	7
EF Lewis/Salmon (WA)	P*	1,900	3,900	597	75
Washougal (WA)	P	5,800	5,800	5,334	39
Clackamas (OR)	C	1,400	2,800		
Sandy (OR)	S	1,400	2,800		
GORGE FALL (Tule)					
Lower Gorge (WA)	C	1,400	2,800		
Upper Gorge (WA)	S	1,400	2,400		
White Salmon (WA)	C	1,600	3,200		
Hood (OR)	S	1,400	2,800		

¹ Primary populations are those that would be restored to high or "high+" viability. At least two populations per strata must be at high or better viability to meet recommended TRT criteria. Primary populations typically, but not always, include those of high significance and medium viability. In several instances, populations with low or very low current viability were designated as primary populations in order to achieve viable strata and ESU conditions. In addition, where factors suggest that a greater than high viability level can be achieved, populations have been designated as High+. High+ indicates that the population is targeted to reach a viability level between High and Very High levels as defined by the TRT. Contributing populations are those for which some restoration will be needed to achieve a stratum-wide average of medium viability.

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Population/Strata	Status /Goal ¹	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
Contributing populations might include those of low to medium significance and viability where improvements can be expected to contribute to recovery. <i>Stabilizing populations</i> are those that would be maintained at current levels (likely to be low viability). Stabilizing populations might include those where significance is low, feasibility is low, and uncertainty is high.					

WLCTRT (2003) analyzed the number of stream kilometers historically and currently available to salmon populations in the lower Columbia River (Table 8.10.2.1-5). Stream kilometers usable by salmon are determined based on simple gradient cutoffs, as well as on the presence of impassable barriers. This approach overestimates the number of usable stream kilometers, because it does not account for aspects of habitat quality other than gradient. However, the analysis does indicate that the number of kilometers of stream habitat currently accessible is greatly reduced from the historical condition for some populations. Hydroelectric projects in the Cowlitz, Lewis, and White Salmon Rivers have greatly reduced or eliminated access to upstream production areas and therefore extirpated some of the affected populations.

Table 8.10.2.1-5. Current and historically available habitat located below barriers in the Lower Columbia River Chinook salmon ESU (WLCTRT 2003).

Population/Strata	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
GORGE SPRING			
White Salmon (WA)	0	232	0
Hood (OR)	150	150	99
CASCADE SPRING			
Upper Cowlitz (WA)	4	276	1
Cispus (WA)	0	76	0
Tilton (WA)	0	93	0
Toutle (WA)	217	313	69
Kalama (WA)	78	83	94
Lewis (WA)	87	365	24
Sandy (OR)	167	218	77
CASCADE LATE FALL			
NF Lewis (WA)	87	166	52
Sandy (OR)	217	225	96
COAST FALL (Tule)			

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Population/Strata	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Grays/Chinook (WA)	133	133	100
Eloch/Skam (WA)	85	116	74
Mill/Aber/Germ (WA)	117	123	96
Youngs Bay (OR)	178	195	91
Big Creek (OR)	92	129	71
Clatskamie (OR)	159	159	100
Scapoose (OR)	122	157	78
CASCADE FALL (Tule)			
Lower Cowlitz (WA)	418	919	45
Upper Cowlitz (WA)	-	-	-
Toutle (WA)	217	313	69
Coweeman (WA)	61	71	86
Kalama (WA)	78	83	94
Lewis/Salmon (WA)	438	598	73
Washougal (WA)	84	164	51
Clackamas (OR)	568	613	93
Sandy (OR)	227	286	79
GORGE FALL (Tule)			
Lower Gorge (WA)	34	35	99
Upper Gorge (WA)	23	27	84
White Salmon (WA)	0	71	0
Hood (OR)	35	35	100

As briefly addressed above, the return of spring Chinook to the Cowlitz, Kalama, Lewis, and Sandy river populations have all numbered in the thousands in recent years (Table 8.10.2.1-6). The Cowlitz and Lewis populations on the Washington side are managed for hatchery production since most of the historical spawning habitat is inaccessible due to hydro development in the upper basin. A supplementation program is now operated on the Cowlitz River that involves trap and haul of adults and juveniles. A supplementation program is also being developed on the Kalama with fish being passed above the ladder at Kalama Falls. Historically, the Kalama was a relatively small system compared to the other three (Table 8.10.2.1-5). A supplementation program is also being developed for the Lewis River, but the spring Chinook production is still dependent on hatchery production. These systems have all met their respective hatchery escapement goals in recent years, and are

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expected to do so again in 2008. The existence of the hatchery programs mitigates the risk to these populations. The Cowlitz and Lewis populations would have been extirpated if not for the hatchery programs.

The Sandy River is managed with an integrated hatchery supplementation program that incorporates natural-origin brood stock. There is some spawning in the lower river, but the area upstream from the old Marmot Dam location is preserved for natural-origin production. The return of natural-origin fish to this area (i.e., upstream from the old Marmot Dam site) has averaged almost 1,800 since 2000. This does not account for the additional spawning of natural-origin fish below the dam (prior to its removal). This tentative viable abundance goal for Sandy River spring Chinook is 2,600, although the goal is subject to reconsideration through Oregon’s ongoing recovery planning process. The total return of spring Chinook to the Sandy including hatchery fish has averaged more than 7,000 since 2000 (Table 8.10.2.1-6).

Table 8.10.2.1-6. Total annual escapement of Lower Columbia River spring Chinook populations (TAC 2008).

Year or Average	Cowlitz River ^a	Kalama River	Lewis River ^a	Sandy River (Total)	Sandy River (natural origin fish at Marmo Dam)
1971-1975	11,900	1,100	200	-	
1976-1980	19,680	2,020	2,980	975	
1981-1985	19,960	3,740	4,220	1,940	
1986-1990	10,691	1,877	11,340	2,425	
1991-1995	6,801	1,976	5,870	5,088	
1996	1,787	627	1,730	3,997	
1997	1,877	505	2,196	4,625	
1998	1,055	407	1,611	3,768	
1999	2,069	977	1,753	3,985	
2000	2,199	1,418	2,515	3,641	1,984
2001	1,649	1,784	3,777	5,329	2,445
2002	5,019	2,883	3,554	5,903	1,275
2003	15,890	4,528	5,104	5,600	1,151
2004	16,712	4,573	11,090	12,675	2,698
2005	9,200	3,100	3,400	7,475	1,808
2006	7,000	5,600	7,500	4,812	1,381

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Year or Average	Cowlitz River ^a	Kalama River	Lewis River ^a	Sandy River (Total)	Sandy River (natural-origin fish at Marmot Dam)^b
2007	3,700	7,300	6,700	3,400	790
^a Includes hatchery escapements, tributary recreational catch, and natural spawning escapement for 1975 to present. The years 1071-73 are based on using the 1975-76 Cowlitz River recreational fishery adult harvest rate ^b TAC (2008)					

There are two bright Chinook populations in the Lower Columbia River Chinook ESU in the Sandy and North Fork Lewis rivers. The Sandy population is currently the less robust. The escapement of natural-origin fish has been variable, but without apparent trend over the last 14 years and has averaged approximately 750 since 2002 (Table 8.10.1.1-7). The viable abundance goal is 5,100 from the LCFRB Recovery Plan, but this is likely high and is being reviewed as Oregon proceeds with its recovery planning process. The North Fork Lewis population is the principal indicator stock. It is a natural-origin population with little or no hatchery influence. The maximum sustained yield escapement goal is 5,700. The viable abundance goal is 6,500. The population has exceeded its escapement goal, often by a wide margin, in most years over the last twenty years or more, although not in 2007. This is consistent with a pattern of low escapements for other far north migrating bright populations including Oregon coastal stocks and upriver brights that return to the Hanford Reach area. This pattern of low escapements for a diverse range of stocks with similar migration pattern and life history suggests that they were all affected by poor ocean conditions.

Table 8.10.2.1-7. Annual escapement of Lower Columbia River bright fall Chinook populations (TAC 2008).

Year	Sandy River	North Fork Lewis
1993	1,314	6,429
1994	941	8,439
1995	1,036	9,718
1996	505	12,700
1997	2,001	8,168
1998	773	5,167
1999	447	2,639
2000	84	8,727
2001	824	11,272
2002	1,275	13,284
2003	619	13,433

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2004	601	14,165
2005	770	10,197
2006	1,130	10,522
2007	171	3,170

Table 8.10.2.1-8 shows escapements for several of the tule populations including estimates of the proportion of spawners that are natural-origin. The Coweeman, Grays, and East Fork Lewis populations are subject to less hatchery straying. The Cowlitz, Kalama, Washougal, Elochoman, and Mill/Abernathy/Germany populations are more strongly influenced by hatchery fish because of in-basin hatchery programs, or their close proximity to such programs. The natural-origin populations are generally below their viability abundance goals (Table 8.10.2.1-4). The hatchery origin fish are generally at or above their viability goals, but only because of the contribution of hatchery fish.

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Table 8.10.2.1-8. Annual escapement for several Lower Columbia River tule Chinook populations (TAC 2008)

Year	Coweeman		Grays		Lewis		Cowlitz		Kalama		Washougal		Elochoman		Ge/Ab/Mi	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1977	337	1.00	1,009	0.65	1,086		5,837	0.26	6,549	0.50	1,652	0.46	568			
1978	243	1.00	1,806	0.65	1,448		3,192	0.26	3,711	0.50	593	0.46	1,846			
1979	344	1.00	344	0.65	1,304		8,253	0.26	2,731	0.50	2,388	0.46	1,478			
1980	180	1.00	125	0.65	899	1.00	1,793	0.26	5,850	0.50	3,437	0.46	64	0.42	516	0.49
1981	116	1.00	208	0.65	799	1.00	3,213	0.26	1,917	0.50	1,841	0.46	138	0.42	1,367	0.48
1982	149	1.00	272	0.65	646	1.00	2,100	0.26	4,595	0.50	330	0.46	340	0.42	2,750	0.50
1983	122	1.00	825	0.65	598	1.00	2,463	0.26	2,722	0.50	2,677	0.46	1,016	0.42	3,725	0.51
1984	683	1.00	252	0.65	340	1.00	1,737	0.26	3,043	0.50	1,217	0.46	294	0.42	614	0.52
1985	491	0.95	532	0.65	1,029	1.00	3,200	0.26	1,259	0.50	1,983	0.46	464	0.42	1,815	0.53
1986	396	1.00	370	0.65	696	1.00	2,474	0.26	2,601	0.50	1,589	0.46	918	0.42	980	0.49
1987	386	1.00	555	0.65	256	1.00	4,260	0.26	9,651	0.50	3,625	0.46	2,458	0.42	6,168	0.59
1988	1,890	1.00	680	0.65	744	1.00	5,327	0.26	24,549	0.50	3,328	0.46	1,370	0.42	3,133	0.69
1989	2,549	1.00	516	0.65	972	0.78	4,917	0.26	20,495	0.50	4,578	0.46	122	0.42	2,792	0.69
1990	812	1.00	166	0.65	563	1.00	1,833	0.26	2,157	0.50	2,205	0.46	174	0.42	650	0.63
1991	340	1.00	127	0.94	470	1.00	935	0.26	5,152	0.54	3,673	0.47	196	0.09	2,017	0.85
1992	1,247	1.00	109	1.00	335	1.00	1,022	0.26	3,683	0.48	2,399	0.76	190	1.00	839	0.47
1993	890	1.00	27	1.00	164	1.00	1,330	0.06	1,961	0.89	3,924	0.52	288	0.78	885	0.71
1994	1,695	1.00	30	1.00	610	1.00	1,225	0.19	2,190	0.73	3,888	0.70	706	0.98	3,854	0.40

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Year	Coweeman		Grays		Lewis		Cowlitz		Kalama		Washougal		Elochoman		Ge/Ab/Mi	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1995	1,368	1.00	9	1.00	409	1.00	1,370	0.13	3,094	0.69	3,063	0.39	156	0.50	1,395	0.51
1996	2,305	1.00	280	0.48	403	1.00	1,325	0.58	10,676	0.44	2,921	0.17	533	0.66	593	0.54
1997	689	1.00	15	0.64	305	1.00	2,007	0.72	3,548	0.40	4,669	0.12	1,875	0.11	603	0.23
1998	491	1.00	96	0.41	127	1.00	1,665	0.37	4,355	0.69	2,971	0.24	228	0.25	368	0.60
1999	299	1.00	195	0.51	331	1.00	969	0.16	2,655	0.03	3,129	0.68	718	0.25	575	0.69
2000	290	1.00	169	0.96	515	1.00	2,165	0.10	1,420	0.19	2,155	0.70	196	0.62	416	0.58
2001	802	0.73	261	0.64	750	0.70	3,647	0.44	3,714	0.19	3,901	0.43	2,354	0.82	4,024	0.39
2002	877	0.97	107	1.00	1,032	0.77	9,671	0.76	18,952	0.01	6,050	0.47	7,581	0.00	3,343	0.05
2003	1,106	0.89	398	0.72	738	0.98	7,001	0.88	24,782	0.01	3,444	0.39	6,820	0.65	3,810	0.56
2004	1,503	0.91	766	0.90	1,388	0.29	4,621	0.70	6,680	0.10	10,597	0.25	4,796	0.01	6,804	0.02
2005	853	0.60	147	0.66	607	1.00	2,968	0.17	9,272	0.03	2,678	0.41	2,204	0.05	2,083	0.13
2006	561		383		427		2,944		10,386		2,600		317		322	

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Extinction Probability/Risk

The LCFRB Recovery Plan provides an overview of the status of populations in the ESU based on TRT recommendations for assessing viability. The risk of extinction category integrates abundance and other viability criteria (Table 8.10.2.1-9). The Recovery Plan also characterizes population status relative to persistence (which combines the abundance and productivity criteria), spatial structure, and diversity, and also habitat characteristics (Table 8.10.2.1-10). This overview for tule populations suggests that risk related to abundance and productivity are higher than those for spatial structure and diversity. Lower scores indicate higher risk. The scores for persistence for most populations range between 1.5 and 2.0. The scores for spatial structure generally range between 3 and 4, and for diversity between 2 and 3, respectively. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.10.2.1-9. Risk of extinction (in 100 years) categories for populations of LCR Chinook salmon (sources: Washington’s Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Cascade Spring	Cowlitz	W	H
	Cispus	W	H
	Tilton	W	VH
	Toutle	W	VH
	Kalama	W	VH
	NF Lewis	W	VH
	Sandy	O	M
Gorge Spring	White Salmon	W	VH
	Hood	O	VH
Coastal Fall	Grays/Chinook	W	H
	Elochoman/Skamokawa	W	H
	Mill/Abernathy/Germany	W	H
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	H
	Scappoose	O	VH
Cascade Fall	Lower Cowlitz	W	H
	Upper Cowlitz	W	VH
	Toutle	W	H

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Strata	Population	State	Extinction Risk Category
	Coweeman	W	M
	Kalama	W	H
	Lewis	W	M
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	VH
	Sandy	O	VH
Gorge Fall	Lower Gorge	W/O	H/VH
	Upper Gorge	W/O	H/VH
	White Salmon	W	H
	Hood River	O	VH
Cascade Late Fall	NF Lewis	W	M
	Sandy	O	L

Table 8.10.2.1-10. LCFRB status summaries for Lower Columbia River tule Chinook populations (LCFRB 2004)

Strata	State	Population	Persistence	Spatial Structure	Diversity	Habitat
Coast Fall	WA	Grays	1.5	4	2.5	1.5
	WA	Elochoman	1.5	3	2	2
	WA	Mill/Abern/Ger	1.8	4	2	2
	OR	Youngs Bay				
	OR	Big Creek				
	OR	Clatskanie				
	OR	Scappoose				
Cascade Fall	WA	Lower Cowlitz	1.7	4	2.5	1.5
	WA	Coweeman	2.2	4	3	2
	WA	Toutle	1.6	3	2	1.75
	WA	Upper Cowlitz	1.2	2	2	2

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Strata	State	Population	Persistence	Spatial Structure	Diversity	Habitat
	WA	Kalama	1.8	4	2.5	2
	WA	Lewis Salmon	2.2	4	3	2
	WA	Washougal	1.7	4	2	2
	OR	Sandy	1.7	4	2	2
	OR	Clackamas				
Gorge Fall	WA	Lower Gorge	1.8	3	2.5	2.5
	WA	Upper Gorge	1.8	2	2.5	2
	OR	Big White Salmon	1.7	2	2.5	1.5
	OR	Hood				

Notes:

Summaries are taken directly from the LCFRB Recovery Plan (Appendix E). All are on a 4 point scale, with 4 being lowest risk and 0 being highest risk.

Persistence: 0 = extinct or very high risk of extinction (0-40% probability of persistence in 100 years); 1 = Relatively high risk of extinction (40-75% probability of persistence in 100 years); 2 = Moderate risk of extinction (75-95% probability of persistence in 100 years); 3 = Low (negligible) risk of extinction (95-99% probability of persistence in 100 years); 4 = Very low risk of extinction (>99% probability of persistence in 100 years)

Spatial Structure: 0 = Inadequate to support a population at all (e.g., completely blocked); 1 = Adequate to support a population far below viable size (only small portion of historic range accessible); 2 = Adequate to support a moderate, but less than viable, population (majority of historical range accessible but fish are not using it); 3 = Adequate to support a viable population but subcriteria for dynamics or catastrophic risk are not met; 4 = Adequate to support a viable population (all historical areas accessible and used; key use areas broadly distributed among multiple reaches or tributaries)

Diversity: 0 = functionally extirpated or consist primarily of stray hatchery fish; 1 = large fractions of non-local hatchery stocks; substantial shifts in life-history; 2 = Significant hatchery influence or periods of critically low escapement; 3 = Limited hatchery influence with stable life history patterns. No extended intervals of critically low escapements; rapid rebounds from periodic declines in numbers; 4 = Stable life history patterns, minimal hatchery influence, no extended intervals of critically low escapements, rapid rebounds from periodic declines in numbers.

Habitat: 0 = Quality not suitable for salmon production; 1 = Highly impaired; significant natural production may occur only in favorable years; 2 = Moderately impaired; significant degradation in habitat quality associated with reduced population productivity; 3 = Intact habitat. Some degradation but habitat is sufficient to produce significant numbers of fish; 4 = Favorable habitat. Quality is near or at optimums for salmon.

The 100-year risk of extinction is high for almost all populations of fall-run Chinook salmon. Exceptions are:²

² See WLCTRT (2004)

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- Coweeman fall run (moderate)—abundance is low, but the trend has been increasing in recent years; population retains its genetic legacy; good habitat in the upper basin; habitat access only slightly impaired
- Lewis fall run (moderate)—abundance is low and trend is slightly negative; population retains its genetic legacy; habitat capacity has been limited by urbanization in the Salmon Creek and lower North and East Forks of the Lewis River and by passage impediments at the FERC-licensed hydroelectric project
- Lewis late-fall run (moderate)—long term high abundance levels (thousands of fish) with little hatchery contribution; long-term trend is slightly negative, although this may be expected for a population that is routinely exceeding its escapement goal; population retains its genetic legacy; habitat capacity has been limited by flow management operations at the FERC-licensed hydroelectric project, but these are addressed in new license (NMFS 2007f).
- Sandy late-fall run (low)—abundance has varied from several hundred to a few thousand in recent years; run has not been supplemented with hatchery fish and there is little chance of introgression from the fall-run programs in neighboring basins due to differences in run and spawn timing; most of the historical production area has remained accessible

Almost all of the spring-run populations of LCR Chinook are at very high risk of extinction. These have been excluded from much of their historical habitat above FERC-licensed dams. The exception is the Sandy River spring-run population, for which the risk of extinction is moderate. Large areas of productive high quality habitat have remained accessible in this watershed, particularly in the forested upper basin where production areas are distributed among several tributaries that drain Mt. Hood (McElhany et al. 2007).

Spatial Structure

The LCR Chinook salmon ESU consists of six MPGs made up of two to nine populations each. Currently, the spatial structures of populations in the Coastal and Cascade Fall Run MPGs are similar to their respective historical conditions. The following FERC-licensed projects soon will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run Hydroelectric Project, Little Sandy dam (Marmot dam removed in 2007) – removal by 2008 (NMFS 2003d) will improve access to the upper Sandy watershed for spring-run Chinook salmon (designated a Core and Genetic Legacy population by the McElhany et al. (2003))
- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the spring run (Core)
- Cowlitz River Hydroelectric Project - upstream and downstream passage facilities will be developed (NMFS 2004c), allowing restoration in the Cispus Spring Run (Core), Tilton Spring Run, and Upper Cowlitz Spring (Core and Genetic Legacy) and Fall Run population.

In contrast, spatial structure within the Upper Gorge Fall Run population is substantially limited by habitat inundation under Bonneville Pool and spatial structure within the Upper Gorge and Cascade Spring Run MPGs is limited by tributary barriers to migration. Historical tributary barriers include Condit Dam, built on the White Salmon River in the early 20th century, and injury and delay at the inadequate passage facilities, plus adverse effects on downstream habitat, at Powerdale Dam on the Hood River. However, (inefficient) passage was restored at Powerdale some years ago, which along with Condit Dam has been decommissioned and is scheduled for removal (Section 8.10.3.2).

Diversity

The diversity of the Coastal, Cascade and Gorge Fall Run major population groups (i.e., all except the Late Fall Run Chinook MPG) has been eroded by large hatchery influences, and periodically by low effective population sizes. In contrast, hatchery programs for spring Chinook salmon are preserving the genetic legacy of populations that were extirpated from blocked areas.

8.10.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for LCR Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia, Grays/Elochoman, Clackamas, and Lower Willamette (NMFS 2005b). There are 48 watersheds within the range of this ESU. Four watersheds received a low rating, 13 received a medium rating, and 31 received a high rating for their conservation value (i.e., for recovery). For more information, see Chapter 4. The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 1,655 miles of habitat eligible for designation, 1,311 miles of stream are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.10.3.8.

8.10.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR Chinook salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.10.2.1-3) will improve. The most significant actions involve reduced harvest rates for fall and spring Chinook in fresh water and ocean fisheries, which have significantly increased escapement to the spawning grounds.

8.10.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007b) estimated that hydropower configuration and operational improvements implemented in 2000 to 2006 have resulted in an 11.3% increase in survival for yearling juvenile LCR Chinook salmon from populations that pass Bonneville Dam. Improvements during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners at Powerhouse 1 (PH1) and of structures that improve fish guidance efficiency (FGE) at PH2. Spill operations have been improved and Powerhouse 2 is used as the first priority powerhouse for power production because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The bypass system screen was removed from PH1 because tests showed that turbine survival was higher than through the bypass system at that location.

8.10.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving passage by replacing culverts and by reintroducing fish into areas above FERC-licensed dams. The latter category includes two projects in tributaries above Bonneville Dam (i.e., within the action area for this consultation):

- Condit – removal in 2009 (NMFS 2006j) will support the restoration of the spring- and fall-run Chinook populations in the White Salmon River (both were designated Core populations by the WLC TRT (2003))

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- Powerdale – removal by 2012 (NMFS 2005o) will support the restoration of the spring- and fall-run populations in the Hood River

Both removals will greatly increase the abundance and productivity of the affected populations by increasing the amount of habitat available for spawning and rearing. Although there is some uncertainty regarding whether the affected populations will become reestablished, NOAA Fisheries has determined that these are the correct next steps toward their restoration.

The Grays River is designated as a priority population for the restoration of the Coastal Fall MPG. It is used as one of the indicator populations for harvest management purposes and was identified by the Lower Columbia Tule Chinook Working Group (2008) as the weakest. A comprehensive habitat assessment and restoration plan was conducted by the Pacific Northwest National Laboratory (PNNL) in cooperation with Washington Department of Fish and Wildlife (WDFW) and Pacific States Marine Fisheries Commission (PSMFC) for the Grays River in 2006. Several related projects have been implemented (see attachment to NOAA Fisheries' 2008 Guidance letter to the Pacific Fisheries Management Council PFMC; NMFS 2008i). These include habitat restoration in the upper (reducing excess sediment loads) and lower (reconnecting the river delta-estuarine habitat at Seal Slough, the tidal floodplain at Devils Elbow, estuarine wetlands at Seal Slough, adding large wood to the lower West Fork, reducing temperatures and improving habitat diversity near Grays RM 11.8, and replacing the Nikka tidegate to restore connectivity and increase fish passage) Grays River watersheds.

8.10.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimated 0.7% survival benefit for fall-run Chinook populations with an ocean-type juvenile life history (Corps et al. 2007b). The estimated survival benefit for spring-run Chinook (stream-type juvenile life history) is 0.3%.

8.10.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from a total of 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. Yearling Chinook are generally considered vulnerable to these predators based on PIT-tag data from upriver stocks (Ryan et al. 2006). However, these authors also determined that predation rates for subyearling fall Chinook from populations in the Lower Columbia River ESU were higher than for subyearlings from upriver locations (possibly due to their longer residence time in the estuary), indicating that recent reductions in tern predation have benefited lower Columbia fall Chinook populations as well as those with a yearling life history.

Piscivorous Fish Predation

Since its commencement in 1990, the Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality. The recent improvement in lifecycle survival

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attributed to the NPMP is estimated to be 2% for both yearling and subyearling juvenile salmonids (Friesen and Ward 1999; Corps et al. 2007b).

Marine Mammal Predation

In recent years, sea lion predation of adult spring-run Chinook in the Bonneville tailrace has increased from 0%, or sufficiently low that it was rarely observed, to about 8.5% (SCA Marine Mammal Appendix). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the survival of adult spring-run Chinook by 5.5%, so that the continuing negative impact will be approximately 3.0%.

8.10.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin Chinook salmon has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 20 programs that release Chinook salmon below Bonneville Dam, NOAA Fisheries has identified only one program (Cowlitz Spring Chinook) as improving population viability by increasing spatial distribution (NMFS 2004b). Fifteen programs were identified as reducing short-term extinction risk, helping to preserve genetic resources important to ESU survival and recovery.³ A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS (2004b).

Most salmonids returning to the region are primarily derived from hatchery fish. In 1987, for example, 70% of the spring Chinook salmon, 80% of the summer Chinook salmon, 50% of the fall Chinook salmon, and 70% of the steelhead returning to the Columbia River Basin originated in hatcheries (CBFWA 1991). Hatcheries have traditionally focused on compensating for impacts to fisheries and it is only recently that risks posed by hatchery programs to natural population viability have been demonstrated.

NOAA Fisheries identified four primary ways hatcheries may harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000b). In many areas, hatchery fish provide increased fishing opportunities. However, when natural-origin fish mix with hatchery stocks in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural-origin fish blend in the spawning grounds, the health of the natural-origin fish and the habitat's ability to support them can be overestimated. This potential overestimate exists because the hatchery fish mask the surveyors' ability to discern actual natural-origin run status, thus resulting in harvest objectives that were too high to sustain the naturally produced populations.

³ The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

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Over the last several years, the role hatcheries play in the Columbia Basin has been expanded from simple production to supporting species recovery. The evaluation of hatchery programs and implementation of hatchery reform in the lower Columbia River is occurring through several processes, including: (1) the Lower Columbia River Recovery and Fish and Wildlife Subbasin Plan; (2) Hatchery Genetic and Management Plan development for ESA compliance; (3) FERC-related plans on the Cowlitz and Lewis Rivers; and, (4) the federally mandated Artificial Production Review and Evaluation. More recently a National Environmental Policy Act (NEPA) review of all Mitchell Act funded hatchery facilities was initiated which will include many of those producing Lower Columbia River Chinook. Washington's Lower Columbia River recovery plan identifies strategies and measures to support recovery of naturally-spawning fish. The plan also includes associated research and monitoring elements designed to clarify interactions between natural and hatchery fish and quantify the effects artificial propagation has on natural fish. The objective is to rehabilitate depleted populations and provide for harvest, while minimizing impacts to wild fish. For more detail on the use of hatcheries in recovery strategies, see the Lower River Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2004).

The states of Oregon and Washington and other fisheries co-managers are currently engaged in a substantial review of hatchery management practices through the Hatchery Scientific Review Group (HSRG). The HSRG was established and funded by Congress to provide an independent review of current hatchery programs in the Columbia River Basin. The HSRG has largely completed their work on LCR tule populations and provided their recommendations. A general conclusion is that the current production programs are not consistent with practices that reduce impacts on naturally-spawning populations, and will have to be modified to reduce adverse effects on key natural populations identified in the Interim Recovery Plan, (i.e., necessary for broad sense recovery). The adverse effects are caused by hatchery-origin adults spawning with natural-origin fish or competing with natural-origin fish for spawning sites.

Early in 2007 NOAA Fisheries expressed the need to change current hatchery programs and anticipated that new direction for those programs would be given soon (NMFS 2007g). NOAA Fisheries followed with a letter to the states of Oregon and Washington in November 2007 that again highlighted the immediate need for decisions about hatchery programs (NMFS 2007h). In response and through their own initiative, the states have embraced the recommendations of the HSRG and have now initiated a comprehensive program of hatchery and associated harvest reforms (WDFW and ODFW 2008). The program is designed specifically to achieve HSRG objectives related to controlling the number of hatchery-origin fish on the spawning grounds and in the hatchery broodstock. The program will require mass marking of released hatchery fish, changing hatchery release strategies, reducing hatchery production at some facilities, and building a system of weirs and improved collection facilities to control the straying of hatchery fish. The program will also require development and implementation of more mark-selective fisheries and increasing the productivity of river basins through habitat management actions (i.e., see Section 8.10.3.2 for habitat projects in the Grays River). Overall, the program represents a comprehensive and integrated approach to recovery that will be advanced by substantive reforms in hatchery practices.

8.10.3.6 Recent Harvest Survival Improvements

Lower Columbia River Chinook are caught in both ocean and in-river fisheries. As discussed in Section 8.10.5.5, LCR tule Chinook in particular are managed subject to a total exploitation rate limit for the combined ocean and in-river fisheries. The necessary sharing between ocean and in-river fisheries is implemented by coordination and the close association between Pacific Fishery Management Council fisheries and the 2008 *U.S. v. Oregon* Agreement and related biological opinions.

Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the total exploitation rate limit. In 2008, the total exploitation rate limit is 41%. From 2002 to 2006, the limit was 49%. The exploitation rate limit was reduced to 42% in 2007. NOAA Fisheries' guidance to the Council for 2008 was that Council fisheries should be managed such that the total exploitation rate on Lower Columbia River Chinook tule populations, from all fisheries does not exceed 41%. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for tule Chinook through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council's Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and as they have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed subject to a total exploitation rate of 41% would not jeopardize the listed species (NMFS 2008e). The PFMC opinion provides the substantive foundation for the review of the management strategy for LCR Chinook.

Tables 8.10.3.6-1, -2, and -3 provide estimates of harvest impacts and their distribution across fisheries for spring, bright, and tule populations in the Lower Columbia River Chinook ESU. Table 8.10.3.6-1 provides estimates of harvest impacts to spring-run populations. Exploitation rates were generally higher prior to the mid 1990s, averaging 50%. Spring-run Chinook stocks in the Columbia River, including Upper Willamette River spring Chinook decreased significantly in the mid 1990s, which led to a significant reduction in harvest, particularly in-river. The abundance of these stocks was gradually restored, reaching another peak by the early part of the 2000s. Fishery impacts increased in response to higher abundance; but by 1999, both Upper Willamette River Chinook and Lower Columbia River Chinook ESUs had been listed under the ESA. As a consequence, fishery managers implemented mass-marking programs for hatchery-origin fish and phased in mark-selective fisheries. Beginning in 1995, total exploitation rates averaged approximately 27%, although actual exploitation rates on unmarked natural-origin fish were lower as a consequence of the implementation of mark-selective fisheries in-river. Those estimates were not immediately available. Fishery impacts reported under the heading of the Columbia River include those that occur in tributary sport fisheries. Tributary sport fisheries are not included in fisheries covered by the 2008 Agreement. Oregon and Washington manage their tributary sport fisheries separately subject to provisions of Fishery

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Management and Evaluation Plans (FMEPs). These FMEPs were considered for ESA purposes under limit #4 of the 4(d) Rule (NMFS 2000c).

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Table 8.10.3.6-1. Total adult equivalent exploitation rates for the Cowlitz spring Chinook population (as an example of exploitation rates for LCR spring Chinook) (Simmons 2008).

Year	Total Exploitation Rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian	India
			WCVI	Other Canada	PFMC	PgtSd	Exp Rate	Exp Rate
1980	52%	2%	5%	4%	17%	0%	24%	0%
1981	48%	3%	5%	4%	17%	0%	20%	0%
1982	55%	2%	5%	3%	15%	0%	30%	0%
1983	57%	2%	9%	5%	9%	0%	32%	0%
1984	54%	2%	11%	5%	4%	0%	31%	0%
1985	43%	1%	5%	3%	8%	0%	25%	0%
1986	52%	1%	5%	3%	12%	0%	31%	0%
1987	45%	1%	5%	3%	11%	0%	25%	0%
1988	49%	1%	5%	2%	16%	0%	26%	0%
1989	50%	1%	3%	3%	19%	0%	25%	0%
1990	57%	1%	5%	2%	23%	0%	26%	0%
1991	54%	1%	4%	3%	14%	0%	32%	0%
1992	46%	1%	5%	3%	19%	0%	19%	0%
1993	48%	1%	5%	3%	15%	0%	25%	0%
1994	45%	1%	4%	3%	3%	0%	35%	0%
1995	10%	1%	2%	1%	4%	0%	1%	0%
1996	11%	1%	0%	0%	7%	0%	2%	0%
1997	16%	1%	1%	2%	5%	0%	7%	0%
1998	12%	1%	0%	2%	9%	0%	0%	0%
1999	38%	1%	1%	1%	15%	0%	20%	0%
2000	38%	1%	3%	1%	9%	0%	25%	0%
2001	21%	1%	2%	1%	7%	0%	10%	0%
2002	43%	1%	2%	2%	13%	0%	24%	0%
2003	34%	1%	3%	2%	13%	0%	16%	0%
2004	31%	1%	3%	2%	13%	0%	11%	0%
2005	36%	1%	4%	2%	17%	0%	11%	0%
2006	34%	1%	4%	3%	16%	0%	11%	0%

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Table 8.10.3.6-2 provides estimates of harvest estimates to the North Fork Lewis bright Chinook population. Exploitation rates were generally higher through 1989 (averaging 56%), declining during the decade of the 1990s (averaging 36%), and increased slightly since 2000 (averaging 38%).

Table 8.10.3.6-2. Total adult equivalent exploitation rate for the North Fork Lewis bright Chinook population (Simmons 2008)

Year	Total exploitation rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian Exp Rate	Indian Exp Rate
			WCVI	Other Canada	PFMC	PgtSd		
1979	64%	9%	8%	6%	9%	2%	29%	0%
1980	68%	11%	8%	7%	8%	2%	33%	0%
1981	39%	11%	6%	6%	6%	2%	7%	0%
1982	43%	9%	6%	6%	8%	2%	12%	0%
1983	42%	10%	11%	6%	4%	3%	8%	0%
1984	58%	10%	15%	7%	2%	2%	22%	0%
1985	54%	6%	7%	6%	5%	3%	27%	0%
1986	64%	5%	8%	6%	6%	4%	35%	0%
1987	65%	5%	8%	5%	5%	3%	39%	0%
1988	68%	6%	10%	5%	7%	3%	38%	0%
1989	44%	7%	3%	4%	4%	1%	24%	0%
1990	38%	8%	6%	4%	7%	2%	12%	0%
1991	57%	7%	5%	5%	5%	2%	33%	0%
1992	57%	7%	9%	6%	7%	3%	25%	0%
1993	51%	7%	6%	4%	7%	3%	25%	0%
1994	38%	7%	11%	9%	1%	3%	7%	0%
1995	36%	7%	3%	2%	1%	1%	22%	0%
1996	16%	7%	0%	0%	2%	2%	3%	0%
1997	25%	11%	2%	3%	2%	2%	7%	0%
1998	23%	11%	0%	2%	1%	1%	8%	0%
1999	19%	6%	1%	2%	7%	2%	0%	0%
2000	24%	6%	5%	1%	5%	2%	5%	0%
2001	31%	7%	4%	1%	6%	3%	11%	0%

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Year	Total exploitation rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian Exp Rate	Indian Exp Rate
			WCVI	Other Canada	PFMC	PgtSd		
2002	41%	9%	3%	3%	7%	3%	15%	0%
2003	50%	11%	3%	4%	5%	2%	24%	0%
2004	40%	9%	2%	2%	3%	1%	22%	0%
2005	50%	8%	6%	5%	8%	3%	20%	0%
2006	32%	10%	2%	3%	3%	1%	13%	0%

Table 8.10.3.6-3 provides estimates of harvest impacts for tule Chinook populations based on an aggregate of coded wire tag indicator stocks. Exploitation rates were generally higher through 1993 (averaging 69%), lower through 1999 (averaging 34%), then increasing since 2000 (averaging 49%). From 2002 to 2006 fisheries were managed subject to a 49% exploitation rate limit. Total exploitation rates have been higher in some years but have averaged 49% from 2002 to 2006 (Table 8.10.3.6-3).

Table 8.10.3.6-3. Total adult equivalent exploitation rates for LCR tule populations (Simmons 2008).

Year	Ocean					Columbia River	
	Total Exp. Rate	SEAK Exp. Rate	Canada Exp. Rate	PFMC Exp. Rate	Pgt Snd Exp. Rate	Non-Treaty Exp. Rate	Treaty Exp. Rate
1983	69%	4%	34%	21%	3%	7%	0%
1984	70%	4%	40%	6%	3%	16%	1%
1985	66%	4%	35%	16%	3%	9%	0%
1986	82%	3%	38%	15%	4%	22%	0%
1987	82%	2%	27%	20%	4%	28%	0%
1988	81%	3%	25%	15%	2%	36%	0%
1989	59%	4%	19%	10%	3%	23%	0%
1990	60%	4%	26%	19%	3%	9%	0%
1991	63%	3%	28%	15%	4%	12%	0%
1992	65%	3%	31%	21%	4%	8%	0%
1993	61%	3%	27%	18%	3%	9%	0%
1994	33%	4%	26%	2%	1%	0%	0%
1995	36%	4%	21%	6%	2%	3%	1%
1996	26%	3%	4%	7%	1%	9%	0%

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Year	Ocean					Columbia River	
	Total Exp. Rate	SEAK Exp. Rate	Canada Exp. Rate	PFMC Exp. Rate	Pgt Snd Exp. Rate	Non-Treaty Exp. Rate	Treaty Exp. Rate
1997	35%	5%	12%	7%	2%	10%	0%
1998	33%	4%	13%	6%	0%	9%	0%
1999	42%	3%	10%	13%	0%	15%	0%
2000	48%	4%	23%	9%	0%	13%	0%
2001	51%	2%	29%	12%	0%	7%	0%
2002	51%	3%	24%	14%	0%	9%	0%
2003	47%	4%	21%	10%	0%	12%	0%
2004	45%	4%	25%	9%	0%	7%	0%
2005	51%	4%	28%	11%	0%	7%	0%
2006	51%	4%	28%	12%	0%	7%	0%

8.10.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Gorge Fall MPG

Completed consultations include repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge); road maintenance and culvert cleaning (Upper Gorge); treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS implemented two habitat restoration projects: improve 5 acres of riparian through thinning and improve 49 acres of riparian and one mile of stream by adding large woody debris (Hood population).

Gorge Spring MPG

Completed consultations include invasive plant treatment, a grazing allotment, and vegetation management in a transmission line right-of-way (Hood). The USFS implemented two habitat restoration projects: improve 5 acres riparian through thinning and improve 49 acres riparian and one mile of stream by adding large woody debris (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.10.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-

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Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (adding large woody debris; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.10.3.8 Status of Critical Habitat under the Environmental Baseline

Factors described in Section 8.10.2, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. Tributary habitat conditions vary widely among the various drainages occupied by LCR Chinook salmon. Factors affecting the conservation value of critical habitat vary from lack of adequate pool/riffle channel structure, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

The following are the major factors that have limited the functioning of primary constituent elements and thus the conservation value of tributary habitat used for spawning and both tributary and estuarine habitat used for rearing (i.e., spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers [*culverts; dams; water withdrawals*]
- Reduced riparian function [*urban and rural development; forest practices; agricultural practices; channel manipulations*]
- Loss of wetland and side channel connectivity [*urban and rural development; past forest practices; agricultural practices; channel manipulations*]
- Excessive sediment in spawning gravel [*forest practices; agricultural practices*]
- Elevated water temperatures [*water withdrawals; urban and rural development; forest practices; agricultural practices*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address these limiting factors. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. The dam removal actions at FERC-licensed hydroelectric projects in the White Salmon and Hood rivers (Section 8.10.3.2) are addressing most of the key limiting factors in those watersheds. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Pinniped predation on spring-run adults (Gorge Spring MPG) due to habitat changes in the lower river [*existence and operation of Bonneville Dam*] and increasing numbers of pinnipeds.
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*]

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Bonneville Dam has improved with the addition of the Bonneville PH2 corner collector. Reductions in piscivorous fish predation have increased the survival of both yearling and subyearling life history types in the estuary.

NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the survival of spring-run adults by 5.5%; reducing the continuing impact to approximately 3.0%.

The safe passage of both yearling and subyearling LCR Chinook salmon through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown during that same period. For populations with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. For populations with subyearling smolts, restoration projects in the estuary are improving the functioning of cover/shelter, food, and riparian vegetation required by this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although LCR Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.10.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the White Salmon and Hood spring-run and the Upper Gorge, White Salmon and Hood fall-run populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.⁴ They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this ESU.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these

⁴ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.10.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will continue to provide benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.10.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the six populations in the Gorge Fall and Spring Run MPGs. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of yearling (spring) and subyearling (fall) Chinook salmon that pass through Bonneville Dam (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, and Hood River Spring Run populations) by <1%. Spillway survival improvements during this time period are expected to increase the passage survival through Bonneville Dam of yearling (spring) Chinook salmon by an additional 0.5% and of subyearling (fall) Chinook salmon by an additional 3.9%.

As a result of this ten-year program of improvements, an estimated 95.5% of the yearling Chinook that migrate past Bonneville Dam will survive.⁵ A portion of the 4.5 % mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion on Remand, NOAA Fisheries estimated that 98% of the yearling Chinook would survive migration through a free-flowing reach of equal length (see Table 5.1 in NMFS 2004a). Therefore, approximately 35% (1.6%/4.5%) of the expected mortality experienced by in-river migrating yearling Chinook is probably due to natural factors.

⁵ NOAA Fisheries has not estimated the in-river survival of subyearling Chinook salmon.

The direct survival rate of adult Chinook at Bonneville Dam is already quite high. Based on PIT-tag detections of SR spring/summer and fall Chinook at Bonneville and later redetected at upstream dams, NOAA Fisheries estimates upstream passage survival rates of 98.6 and 96.9% for adult spring–and fall–run Chinook, respectively (i.e., relevant to the Gorge MPGs).⁶

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.10.3.3).

Effects on Species Status

Prospective passage improvements at Bonneville Dam will support increased abundance and productivity of the upper Gorge populations, thereby improving the overall spatial structure of the ESU.

Effects on Critical Habitat

Improvements at Bonneville Dam will increase the functioning of the PCE of safe passage in the juvenile and adult migration corridors.

8.10.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the spring Chinook population in that watershed (Table 6 of Attachment B.2.2-2 in Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the LCR Chinook populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

⁶ This estimate is adjusted to account for estimated harvest and straying rates of adults within the FCRPS migration corridor, but otherwise captures all other sources of mortality including those resulting from the existence and operation of the FCRPS and other potential sources, including natural mortality (i.e., that would occur without human influence).

Effects on Species Status

Prospective improvements in tributary habitat in the Hood River will support the increased abundance, productivity, and spatial structure of the spring-run population of LCR Chinook. Habitat projects in other tributaries, if implemented, will be selected such that they also address limiting factors and thus would increase the viability of the local population(s).

Effects on Critical Habitat

Prospective habitat improvements in the Hood River will improve the functioning of PCEs for spawning and rearing (spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space). Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale and some, such as the removal of barriers, will improve conditions at the watershed scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.10.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The estimated survival benefit for fall-run LCR Chinook salmon associated with these specific actions will be less than 2.3%. The estimated benefit for spring-run Chinook is 1.4%.

The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin Chinook populations, but will also provide benefits to those from the lower Columbia River. The estimated survival benefit for fall-run LCR Chinook salmon is 6.7%. The estimated survival benefit for spring-run Chinook is less than 4.3%. Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reducing of noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of spring- and fall-run populations of LCR Chinook.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for yearling Chinook migrants and in rearing areas for subyearling Chinook. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at

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the project scale, and persist for a short-time (no more than a few weeks and typically less). The positive effects on the functioning of PCEs and the conservation value of critical habitat will be long-term.

8.10.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.10.5.5 Effects of Harvest Prospective Actions

Lower Columbia River spring Chinook populations are caught in non-Treaty spring season fisheries in the Columbia River below Bonneville Dam, and in tributary fisheries targeting hatchery-origin fish. The tributary fisheries are not part of the Prospective Action, but have been considered separately for ESA compliance through the 4(d) Rule (NMFS 2000c). There are no specific harvest rate constraints in the 2008 Agreement that apply to LCR spring Chinook. However, management constraints for upriver spring Chinook stocks from the Snake and Upper Columbia ESUs (see Sections 8.3 and 8.6 of this document) that are part of the Agreement substantially limit impacts to natural-origin spring Chinook from the LCR populations. Non-treaty fisheries in the lower Columbia are subject to harvest rate limits under the 2008 Agreement on natural-origin upriver spring Chinook populations that range from 0.5 to 2.7%, depending on run size (see Section 8.3 of this document). Impacts to natural-origin LCR spring Chinook populations, subject to the 2008 Agreement, will be similar to those allowed for upriver spring Chinook. As described above, the spring populations are managed to meet escapement goals for hatchery programs being used for reintroductions and supplementation. Mark selective fisheries are used below Bonneville Dam during the spring season to limit impacts to natural-origin fish. Due to the collective conservation restrictions for several other Chinook populations, hatchery escapement goals have been met exceeded in recent years. NOAA Fisheries expects that escapement goals will be met in 2008 and for the duration of the Agreement.

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There are two extant natural-origin bright populations in the LCR Chinook ESU. Bright populations are caught in non-Treaty fall season fisheries in the Columbia River below Bonneville Dam. No specific harvest rate constraints in the 2008 Agreement apply directly to LCR bright Chinook, but fall season fisheries are constrained by limits set on Snake River fall Chinook, Lower Columbia River coho, and summer steelhead. The North Lewis River stock is used as a harvest indicator for ocean and in-river fisheries. The escapement goal used for management purposes for the North Lewis River population is 5,700 based on estimates of maximum sustained yield. The escapement was below goal in 2007 and the forecast for 2008 is for another low return, but escapements have otherwise exceeded the goal by a wide margin in every year but one since 1980. The escapement shortfall in 2007 is consistent with a pattern of low escapements for other far north migrating stocks in the region and can likely be attributed to poor ocean conditions. Given the long history of healthy returns, NOAA Fisheries does not anticipate the need to take specific management actions to protect the bright component of the Lower Columbia River Chinook ESU in 2008 or for the duration of the Agreement. NOAA Fisheries does expect that the states of Washington and Oregon will continue to take appropriate actions through their usual authorities, to ensure that the escapement goal continues to be met. NOAA Fisheries will monitor escapements for the bright populations, and trends for other far north migrating stocks, and take more specific action in the future if necessary.

The majority of harvest impacts to Lower Columbia River tule Chinook populations occur in ocean fisheries (Table 8.10.3.8-3). Since 2002 about 70% of harvest impacts have occurred in the ocean. In the Columbia River, tule populations are caught primarily in non-treaty fall season fisheries below Bonneville Dam. There are no specific harvest constraints in the 2008 *U.S. v. Oregon* Agreement that apply to Lower Columbia River tule Chinook. Non-treaty fall season fisheries are constrained by limits to Snake River fall Chinook, Lower Columbia River coho, and summer steelhead. NOAA Fisheries has, nonetheless, considered it necessary to define additional constraints for Lower Columbia River tule populations and has done so through its annual guidance letter to the Council (see for example Lohn and McInnis 2008).

For the last several years, NOAA Fisheries has limited Council and in-river fisheries by specifying a total exploitation rate limit. From 2002 to 2006, the limit was 49%. The exploitation rate limit was reduced to 42% in 2007. NOAA Fisheries' guidance to the Council for 2008 was that Council fisheries should be managed such that the total exploitation rate on Lower Columbia River Chinook tule populations, from all fisheries does not exceed 41%. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for tule Chinook through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council's Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed subject to a total exploitation rate of 41% would not jeopardize the listed species (NMFS 2008e). The

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PFMC opinion provides the substantive foundation for the review of the management strategy for LCR Chinook.

The anticipated exploitation rate on Lower Columbia River tule Chinook in Council fisheries is 9.8% (Table 8.10.5.5-1). The exploitation rate in Puget Sound fisheries, which included Fraser Panel fisheries, is 0.2%. Some additional harvest occurs in marine fisheries in the environmental baseline in ocean fisheries outside the Council area. The combined exploitation rate from all marine fisheries is 28.7%. The anticipated exploitation rate from all marine and freshwater fisheries in 2008 is 35.8%, and thus well below the 41% limit.

Table 8.10.5.5-1. Expected exploitation rates on Lower Columbia River tule Chinook in 2008 marine area fisheries (PFMC 2008).

Southeast Alaska	2.1
British Columbia	16.4
Puget Sound	0.3
PFMC	9.8
Total	28.7

Managers responsible for in-river fisheries took NOAA Fisheries' guidance (NMFS 2008i), along with the biological opinion on the Council fisheries (NMFS 2008e), into account when planning the 2008 in-river fishery. The prospective exploitation rate for tule Chinook in the in-river fisheries in 2008 is 7.1%, and thus, when combined with the anticipated exploitation rate from marine area fisheries, complies with the overall limit of 41%. The distribution of fishery impacts

between ocean and in-river fisheries, and among in-river fisheries, may be adjusted in-season so long as the total exploitation rate does not exceed 41% in 2008. Managers responsible for in-river fisheries propose to use NOAA Fisheries' guidance, along with the yearly biological opinion on the Council fisheries, into account when planning the 2009-17 in-river fishery seasons.

Effects on Species Status

Prospective improvements in harvest effects support the increased abundance and productivity of spring- and fall-run populations of Lower Columbia River chinook. Harvest levels have been considered in detail in the recent biological opinion for PFMC and Fraser Panel fisheries (NMFS 2008). NOAA Fisheries concluded in that opinion that the proposed total exploitation limit is consistent with the expectation the species' survival and recovery.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR Chinook salmon.

8.10.5.6 Effects of Predation Prospective Actions

Avian predation

The survival of yearling Chinook will increase 2.1% and that of subyearlings will increase at least 0.7% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45). Continued implementation and improvement of avian deterrence at Bonneville Dam (RPA Action 48) is also likely to increase juvenile Chinook survival.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The prospective continued increase in incentives in the NPMP (RPA Action 43) will result in an additional 1% survival during the period 2008 to 2018.

Effects on Species Status

Prospective improvements in predation will support the increased abundance and productivity of spring- and fall-run populations of LCR Chinook.

Effects on Critical Habitat

Prospective improvements in predation will improve the functioning of the PCE of safe passage in the migration corridor for yearling Chinook migrants and in rearing areas for subyearling Chinook.

8.10.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.10.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Chinook Salmon & Critical Habitat

This section summarizes the basis for conclusions at the ESU level and for the rangewide status of critical habitat.

8.10.6.1 Recent Status of the Lower Columbia River Chinook Salmon ESU

Lower Columbia River Chinook salmon is a threatened species. Many of the populations in this ESU currently have low abundance and many of the long-term trends in abundance for individual populations are negative, some severely so. Some of the natural runs (especially the spring Chinook populations in the Cascade and Gorge MPGs) have been replaced largely by hatchery production. The construction of Bonneville Dam in the 1930s inundated spawning and rearing habitat and impeded juvenile and adult migration, significantly limiting the viability of the Gorge Spring and Fall Run MPGs. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat

alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. These factors have affected populations in the Cascade Fall, Late Fall, and Spring Run and Coastal Fall Run MPGs as well as those above Bonneville Dam. The viability of natural-origin populations has been limited by hatchery practices and by harvest rates that were once as high as 80%. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Section 5.7 and 8.13.

In terms of the primary constituent elements of critical habitat, the ability to support the conservation of the species has been limited by barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development. In the Lewis, Cowlitz, White Salmon, Sandy, and Hood River watersheds, these problems are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.10.3.2). The functioning of mainstem habitat as a juvenile rearing and migration corridor has improved in recent years with habitat restoration projects in the estuary and with the development of the corner collector at Bonneville PH2, respectively. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands within the range of LCR Chinook salmon (Section 8.10.3.7). Some future Federal actions with completed section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Examples are the removal of Condit Dam on the White Salmon and Powerdale on the Hood River. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.10.6.2 Effects of FCRPS, Upper Snake, & U.S. v. Oregon Prospective Actions on Lower Columbia River Chinook & Critical Habitat

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River, including those populations within the LCR Chinook salmon ESU.⁷ In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The FCRPS Action Agencies' estuary habitat restoration projects and relocation of most of the Caspian terns to sites outside the Columbia basin will increase the survival of juvenile Chinook. Implementation of habitat improvement projects in the Hood River watershed will address the loss of historical spawning habitat for that fall-run population, which was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, and continued and improved avian

⁷ The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

deterrence at Bonneville Dam, and prospective juvenile and adult passage improvements at Bonneville Dam.

The principal effects of the Prospective Actions on critical habitat will be increases in passage survival at Bonneville Dam and in the estuary with the relocation of Caspian terns (juvenile and adult migration corridors free of obstructions); an increase in the amount and quality of estuarine habitat (for the transitions between fresh- and saltwater, juvenile growth and development before entering the plume, and the final development of adults before they migrate to upstream spawning areas); and an improvement in the functioning of PCEs for spawning, incubation, and rearing for the spring-run Chinook population in the Hood River.

8.10.6.3 Cumulative Effects Relevant to Lower Columbia River Chinook & Critical Habitat

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will improve the functioning of the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile Chinook.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.10.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Chinook ESU

Impacts of the FCRPS and Upper Snake projects are most significant for the 5 (out of 32) populations that spawn above Bonneville Dam and are limited relative to those from tributary hydropower; tributary habitat; harvest; hatcheries; and predation by birds, fish, and marine mammals. These populations are affected by upstream and downstream passage and, for the fall-run populations, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydro projects.

The states of Oregon and Washington have identified tributary habitat actions that are reasonably certain to occur and that will benefit the White Salmon and Hood spring-run and the Upper Gorge, White Salmon, and Hood fall-run populations, as well as actions that should be generally beneficial throughout the ESU. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood watersheds are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.10.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual

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improvement of habitat conditions on state forest lands within the range of Lower Columbia River Chinook (Section 8.10.3.7).

NOAA Fisheries considered the effects of harvest on the various life-history types and component populations of the LCR Chinook ESU. LCR spring Chinook populations are managed to meet hatchery escapement goals and to maintain the genetic legacy of populations and support supplementation efforts. Fisheries are managed generally to meet the escapement goals of the North Fork Lewis River “bright” population. This population was below goal in 2007, but has otherwise been well above its escapement goal in the past. The LCR tule Chinook populations are affected by ocean and inriver fisheries. Tule Chinook are managed subject to a total exploitation rate limit for all fisheries. In 2008 the total exploitation rate limit was set by NOAA Fisheries at 41% through its yearly guidance to PFMC. A portion of the total exploitation rate is allocated by the States through PFMC-related processes to the inriver fisheries which are managed subject to U.S. v Oregon.

The effect of this management strategy was recently reviewed through a section 7 consultation on PFMC and Fraser Panel fisheries (NNFS 2008e). NOAA Fisheries concluded that the proposed total exploitation rate was not likely to jeopardize the LCR Chinook salmon ESU. The underlying analysis assumed that the total exploitation rate in 2009 and thereafter would be no more than 41%, but NOAA Fisheries indicated that further reductions in harvest may be forthcoming as a consequence of ongoing review and subsequent ESA section 7 consultations. Future total exploitation rates will be set through NOAA Fisheries’ yearly guidance to Council and related consultations. Inriver fisheries will necessarily be managed subject to that guidance.

The FCRPS Action Agencies’ prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this ESU by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The prospective habitat work in the Hood River and potential funding for tributary projects for the populations above Bonneville is expected to support the restoration of specific populations within the ESU. The Prospective Actions will not further deteriorate the pre-action condition. Long term (100-year) extinction risk is high or very high for almost all populations in this ESU. Exceptions are the Lewis River fall- and late fall- and the Sandy late fall- and spring-run populations. In the short term, the species’ extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the nearly extirpated spring-run Chinook populations will continue to be preserved by ongoing hatchery actions as a hedge against short-term risk of extinction.

8.10.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for Lower Columbia River Chinook

NOAA Fisheries designated critical habitat for LCR Chinook salmon including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia,

Grays/Elochoman, Clackamas, and Lower Willamette. The environmental baseline within the action area, which includes the Middle Columbia/Hood and Lower Columbia/Sandy subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for LCR Chinook. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat Chinook in the tailrace of Bonneville Dam will do the same for spring-run adults. Habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action Agencies' projects on the Lower Columbia River Chinook ESU, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the species. The Proposed Action will not reduce the conservation value of this ESU's designated critical habitat. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Lower Columbia River Chinook ESU nor result in the destruction or adverse modification of designated critical habitat.

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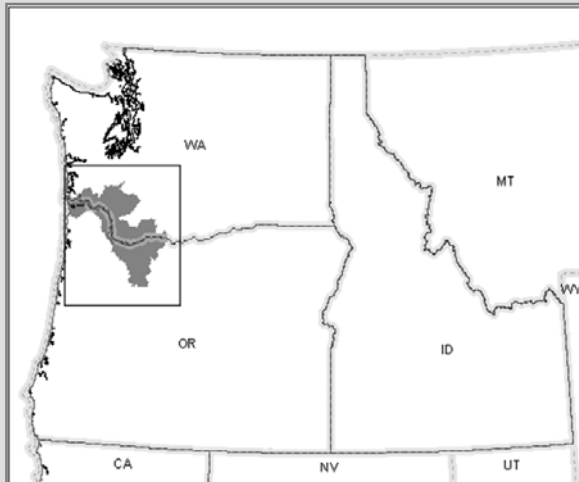
Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion includes further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁸

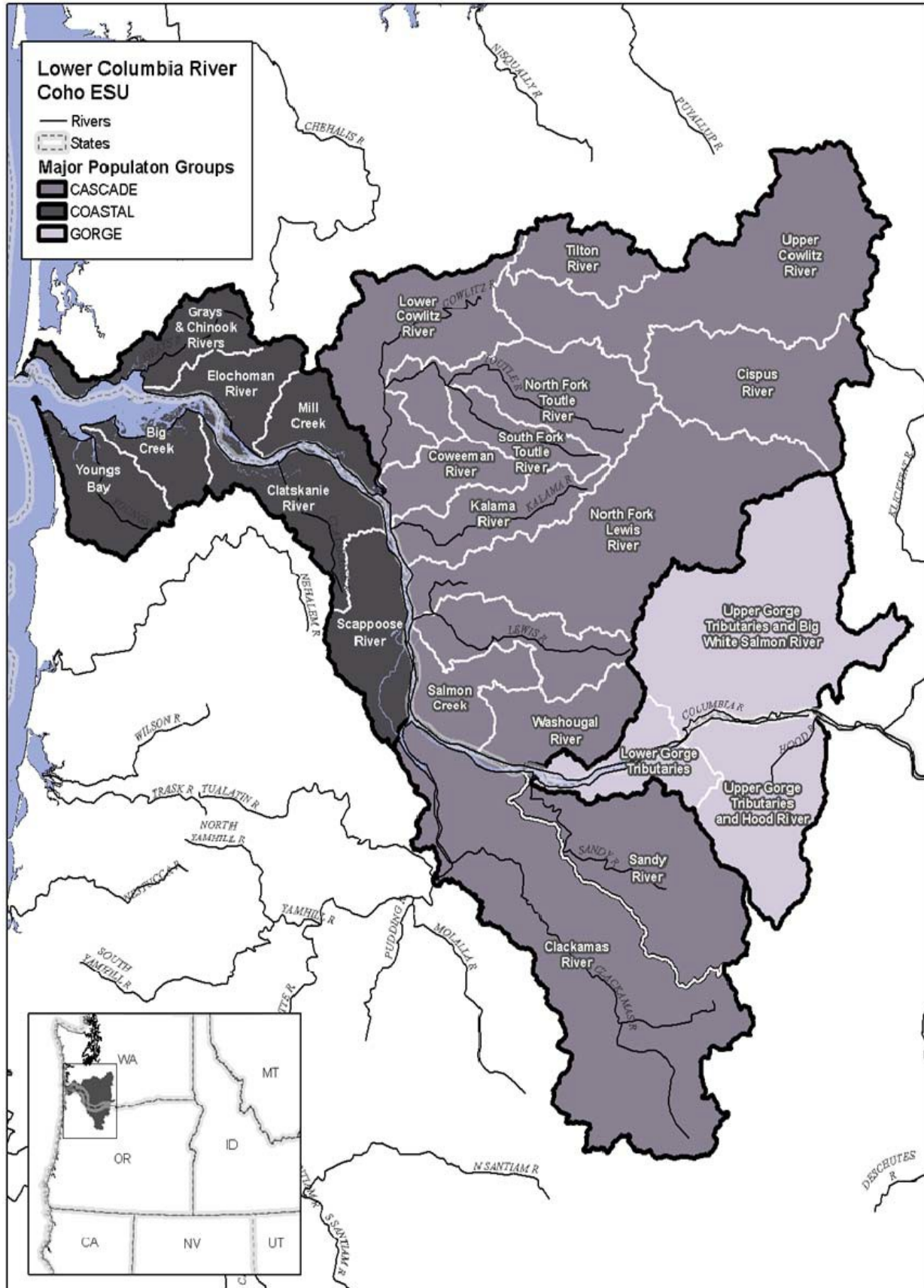
⁸ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

Section 8.11 Lower Columbia River Coho Salmon



- 8.11.1 Species Overview
- 8.11.2 Current Rangewide Status
- 8.11.3 Environmental Baseline
- 8.11.4 Cumulative Effects
- 8.11.5 Effects of the Prospective Actions
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Section 8.11

Lower Columbia River Coho Salmon

Species Overview

Background

The Lower Columbia River (LCR) coho salmon ESU includes all naturally spawned coho populations in stream and tributaries to the Columbia River in Washington and Oregon, from the mouth of the Columbia up to and including the White Salmon and Hood rivers, and includes the Willamette to Willamette Falls, Oregon, as well as 25 artificial propagation programs. The ESU includes 24 historical populations in three major population groups. The Lower Columbia River coho salmon ESU was listed as threatened under the ESA in 2005.

NOAA Fisheries has not yet designated critical habitat for this ESU.

Current Status & Recent Trends

Data on the status of natural-origin Lower Columbia River coho salmon are very limited. Most populations have low or very low numbers. Most of the natural runs largely have been replaced by hatchery production.

Limiting Factors

Human impacts and limiting factors for the Lower Columbia River coho salmon include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. Lower Columbia River coho populations have been in decline for the last 70 years. FCRPS impacts have been limited, but most significant for the two populations that spawn in tributaries above Bonneville Dam. These populations are affected by upstream and downstream passage and, for Oregon populations, by inundation of some historical habitat by Bonneville pool. For populations originating in tributaries below Bonneville, migration and habitat conditions in the mainstem and estuary have been affected by hydrosystem flow operations. Tributary habitat degradation is pervasive due to development and other land uses, and FERC-licensed hydroelectric projects have blocked some spawning areas. Coho populations in the lower Columbia River have been heavily influenced by extensive hatchery releases. While those releases represent a threat to the genetic, ecological, and behavioral diversity of the ESU, some of the hatchery stocks at present also protect a significant portion of the ESU's remaining genetic resources.

Recent Ocean and Mainstem Harvest

Lower Columbia River coho are caught in ocean fisheries and non-Treaty fisheries in the mainstem Columbia River below Bonneville Dam. Previously, Oregon Coast Natural coho were used as a surrogate for estimating ocean fisheries impacts to Lower Columbia River coho. In 2006, largely as a consequence of increased attention resulting from its listing, the methods for assessing harvest in ocean fisheries were changed so that these were more specific to natural-origin Lower Columbia River coho.

Until 1993 the exploitation rates in salmon fisheries on Lower Columbia River coho have been very high, contributing to their decline. The combined ocean and in-river exploitation rates for Lower Columbia River coho averaged 91% through 1983, averaged 68% from 1984-1993, and decreased to an average of 17% from 1994-2007. In 2006 and 2007 ocean and inriver fisheries were managed using an abundance-based harvest rate schedule that depends on brood-year escapement and marine survival. Based on the year-specific circumstances, total exploitation rates were limited to 15% and 20%, respectively. NOAA Fisheries will continue to seek to develop harvest schedules that are consistent with information being developed by the Willamette Lower Columbia Technical Recovery Team and through ongoing hatchery reform and recovery planning efforts.

8.11.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.11.2.1 Current Rangewide Status of the Species

The Lower Columbia River coho salmon ESU includes 24 historical populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Although run time variation is inherent to coho life history, the ESU includes two distinct runs: early returning (Type S) and late returning (Type N). Type S coho salmon generally migrate south of the Columbia once they reach the ocean, returning to fresh water in mid-August and to the spawning tributaries in early September. Spawning peaks from mid-October to early November. Type N coho have a northern distribution in the ocean, return to the Columbia River from late September through December and enter the tributaries from October through January. Most Type N spawning occurs from November through January, but some spawning occurs in February and as late as March (LCFRB 2004). Summary data for the ESU are shown in Table 8.11.2.1-1.

Table 8.11.2.1-1. Lower Columbia River coho ESU description and major population groups (MPGs). (Sources: NMFS 2005a; Myers et al. 2006)

ESU Description	
Threatened	Listed under ESA in 2005
3 major population groups	24 historical populations
Major Population Group	Population
Coast	Grays, Elochoman, Mill Creek, Youngs Bay, Big Creek, Clatskanie, Scappoose Creek
Cascade	Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon Creek, Washougal, Clackamas, Sandy
Gorge	Lower Gorge, Washington Upper Gorge and (Big)White Salmon River, Oregon Upper Gorge and Hood River
Hatchery programs included in ESU (25)	Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program,

ESU Description	
	Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Washougal River Type-N Coho Program, Eagle Creek NFH, Sandy Hatchery, and the Bonneville/ Cascade/Oxbow complex coho hatchery programs.

Human impacts and current limiting factors for this ESU come from multiple sources: habitat degradation, habitat blockage by FERC-licensed dams in several subbasins, harvest, hatchery effects, ecological factors including predation, and Bonneville Dam passage for some populations (see Table 8.11.2.1-2).

Limiting Factors

Summarized below (Table 8.11.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for Lower Columbia River coho.

Table 8.11.2.1-2. Key limiting factors for Lower Columbia River coho.

Mainstem Hydro	Direct mainstem hydro impacts on lower Columbia River ESUs are most significant for the two gorge tributary populations upstream from Bonneville Dam (WA Upper Gorge and [Big] White Salmon River; OR Upper Gorge and Hood River). These populations are affected by upstream and downstream passage at Bonneville Dam and by inundation of historical habitat at the lower ends of the smaller tributaries by the reservoir (WLCFRT 2004, McElhany et al. 2007). On the Oregon side of the gorge, the tributary streams are especially short and end at impassable waterfalls. Federal hydrosystem impacts on populations originating in downstream subbasins are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, and fishes including northern pikeminnow, take significant number of juvenile salmon. As stream-type juveniles, coho are probably vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid channel areas located near habitat preferred by piscivorous birds (Fresh et al 2005). PIT-tagged coho smolts (originating above Bonneville Dam) were second only to steelhead in predation rates at the East Sand Island colony in 2007 (Roby et al. 2008). Pikeminnow are significant predators of yearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas and a sport reward fishery to control numbers of pikeminnow.
Harvest	Lower Columbia River coho are harvested in the ocean and in Columbia

	<p>River and tributary freshwater fisheries of Oregon and Washington. Incidental take of coho salmon prior to the 1990s fluctuated from approximately 60 to 90%, but has been reduced since listing to 15 to 25% (LCFRB 2004). The exploitation of hatchery coho has remained approximately 50% through the use of selective fisheries.</p>
<p>Hatcheries</p>	<p>Coho hatchery programs in the lower Columbia have been tasked to compensate for impacts of fisheries. Important genetic resources can reside in hatcheries and 25 hatchery programs are included in the LCR coho ESU (NMFS 2005a). However, hatchery programs in the LCR have not operated specifically to conserve LCR coho, and these programs threaten the viability of natural populations. The long-term domestication of hatchery fish has eroded the fitness of these fish in the wild and has reduced the productivity of wild stocks where significant numbers of hatchery fish spawn with wild fish. Large numbers of hatchery fish have also contributed to more intensive mixed stock fisheries, which probably overexploited wild populations weakened by habitat degradation. Most LCR coho populations have been heavily influenced by hatchery production over the years. State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.</p>
<p>Estuary</p>	<p>The estuary is an important habitat for migrating juveniles from LCR coho populations. Due to a short residence time in the estuary, stream-type juveniles such as coho have limited mortality associated with a scarcity of habitat, changes in food availability, and the presence of contaminants. However, they are particularly vulnerable to bird predation in the estuary (see above). Coho are likely to be affected by flow and sediment delivery changes in the plume, although mechanisms have not been determined (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006b).</p>
<p>Habitat</p>	<p>Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for coho by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.</p>

Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this ESU to some extent, future trends, especially during the period relevant to the Proposed Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).
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Abundance, Productivity, and Trends

Data on the status of LCR coho salmon are very limited. As indicated in Table 8.11.2.1-3, population-specific abundance estimates are available for only five populations and trend estimates for only two. Base status information was reported in NOAA Fisheries’ most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). In many cases, populations have low current abundance and natural runs have been extensively replaced by hatchery production. Time series are not available for Washington coho populations.

Table 8.11.2.1-3. Abundance, productivity, and trends of LCR coho populations. (Sources: Good et al. 2005 and Myers et al. 2006)

Strata	Population	St.	Recent Abundance of Natural Spawners			Long-term trend		Median Growth Rate	
			Years ¹	No. ²	pHOS ³	Years	Value ⁴	Years	λ^5
Coast	Grays	W	na	na	na	na	na	na	na
	Elochoman	W	na	na	na	na	na	na	na
	Mill Creek	W	na	na	na	na	na	na	na
	Youngs Bay & Big Creek	O	2002	4,473	91%	na	na	na	na
	Clatskanie	O	na	na	na	na	na	na	na
	Scappoose	O	2002	458	0%	na	na	na	na
Cascade	Lower Cowlitz	W	na	na	na	na	na	na	na
	Coweeman	W	na	na	na	na	na	na	na
	SF Toutle	W	na	na	na	na	na	na	na
	NF Toutle	W	na	na	na	na	na	na	na

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Strata	Population	St.							
			Years		pHOS	Year	Value	Year	λ
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Cispus	W	na	na	na	na	na	na	na
	Tilton	W	na	na	na	na	na	na	na
	Kalama	W	na	na	na	na	na	na	na
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	na	na	na	na	na	na	na
	Clackamas	O	90-05	482	25%	90-05	1.029	90-05	1.01
	Sandy	O	90-05	482	17%	90-05	1.029	90-05	1.01
Gorge	Lower Gorge Tribs & White Salmon	O/W	na	na	na	na	na	na	na
	Upper Gorge Tribs & Hood River	O/W	2000	1,317 ⁶	>65 ⁷	na	na	na	na

Note:

Myers et al. (2006) identified Youngs Bay and Big Creek as demographically independent populations in the Coast MPG and described the following three populations in the Gorge MPG: Lower Gorge, Washington Upper Gorge and White Salmon, Oregon Upper Gorge and Hood River.

¹ Years of data for recent means

² Geometric mean of total spawners

³ Average recent proportion of hatchery-origin spawners

⁴ Long-term trend of total spawners

⁵ Long-term median population growth rate (including both natural- and hatchery-origin spawners)

⁶ Number of natural spawners for Hood River combined with Upper Gorge – Oregon, only

⁷ Contains an unknown (i.e., unmarked) additional fraction of hatchery-origin coho from upstream releases

Steel and Sheer (2003) as cited in WLCTRT 2003 analyzed the number of stream kilometers historically and currently available to salmon populations in the lower Columbia River (Table 8.11.2.1-4). Stream kilometers usable by salmon are determined based on simple gradient cutoffs and on the presence of impassable barriers. This approach overestimates the number of usable stream kilometers, because it does not account for aspects of habitat quality other than gradient. However, the analysis does indicate that the number of kilometers of stream habitat currently accessible is greatly reduced from the historical condition for some populations. Hydroelectric projects in the Cowlitz,

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North Fork Lewis, and White Salmon rivers have greatly reduced or eliminated access to upstream production areas and therefore extirpated some of the affected populations.

Table 8.11.2.1-4. Current and historically available habitat located below barriers in the Lower Columbia River coho salmon ESU.

Population	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Youngs Bay	178	195	91
Grays River	133	133	100
Big Creek	92	129	71
Elochoman River	85	116	74
Clatskanie River	159	159	100
Mill, Germany, Abernathy Creeks	117	123	96
Scappoose Creek	122	157	78
Cispus River	0	76	0
Tilton River	0	93	0
Upper Cowlitz River	4	276	1
Lower Cowlitz River	418	919	45
North Fork Toutle River	209	330	63
South Fork Toutle River	82	92	89
Coweeman River	61	71	86
Kalama River	78	83	94
North Fork Lewis River	115	525	22
East Fork Lewis River	239	315	76
Clackamas River	568	613	93
Salmon Creek	222	252	88
Sandy River	227	286	79
Washougal River	84	164	51
Lower Gorge Tributaries	34	35	99
Upper Gorge Tributaries	23	27	84
White Salmon River	0	71	0

Population	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Hood River	35	35	100
Total	3,286	5,272	62

The abundance of coho returning to the Lower Columbia River from 2001 to 2007 ranged from 318,600 to more than 1,108,300, with most of the abundance comprised of hatchery fish (PFMC 2008). At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term but is of uncertain contribution in the long term (NMFS 2004d).

Natural-origin fish are defined as those whose parents spawned in the wild, while hatchery-origin fish are defined as those whose parents were spawned in a hatchery. There is still significant coho production in the Clackamas and Sandy rivers. Good et al. (2005) reports that there appeared to be little natural production from other populations (References for abundance time series and related data are in Appendix C.5.2 in Good et al. (2005). More recent information indicates that there may have been more spawning and natural-origin production than previously thought.

Recent information from the WLC TRT describing methods used to assess species status and preliminary reports from application of these methods is contained in a review draft report on viability criteria (WLCTRT 2006). An additional review draft report related to the status of the Oregon populations of the Lower Columbia River coho salmon ESU has recently been released (June 2007) for public comment (McElhany et al. 2007).

Oregon Populations

Clackamas

Presently, the Clackamas River population above the North Fork Dam is one of only two populations in the ESU for which natural production trends can be estimated. The portion of the population above the dam has a relatively low fraction of hatchery-origin spawners, while they dominate the area below the dam. A 2002 stratified random survey by ODFW estimated a total of 2,402 coho spawning in the Clackamas River below North Fork Dam (WLCTRT 2003). The survey estimated that 78% of the fish observed were of hatchery origin. Counts at North Fork Dam in 2002 indicate a total of 998 coho went above the dam and 12% of those were of hatchery origin. Also, 100% of coho sampled in Clear Creek (a lower Clackamas River tributary) were of natural origin (Brown et al. 2003, cited Good et al. 2005).

The number of adult coho salmon returns to the North Fork Dam is shown in Figure 8.11.2.1-1 and Table 8.11.2.1-5. Prior to 1973, hatchery-origin adults and juveniles were released above North Fork Dam, and the time series from 1957-1972 contains an unknown fraction of hatchery-origin spawners.

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The adult return of coho to the North Fork Dam has been highly variable over the last 50 years, but without an apparent trend.

Figure 8.11.2.1-1. Clackamas North Fork Dam counts of adult (3-year-old) coho salmon, 1957–2007 (TAC 2008).

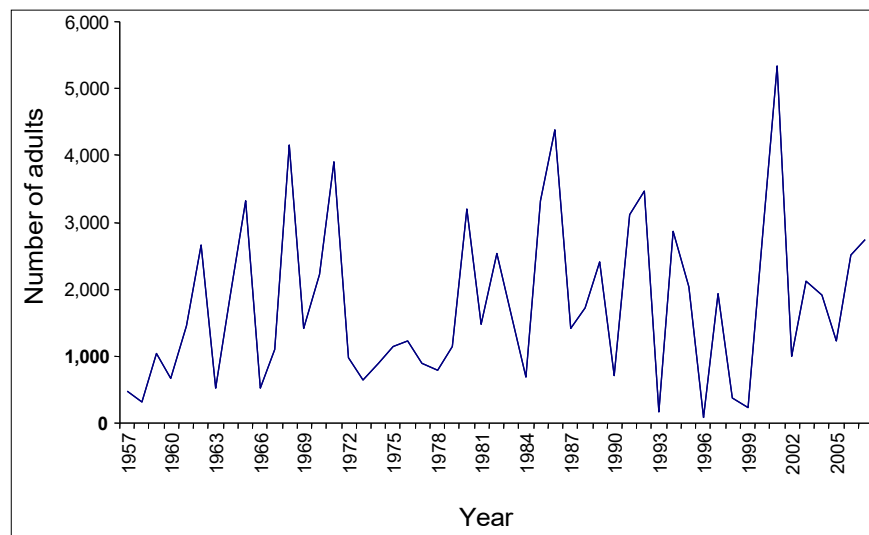


Table 8.11.2.1-5. Abundance of wild Clackamas coho, 1957-2007 (TAC 2008). 2007 data are only through December 31 and are preliminary. The run will not be complete until March 2008 (TAC 2008).

Year	Adult count	Jack count	Total count
1957	484	114	598
1958	309	213	522
1959	1,046	284	1,330
1960	670	1,515	2,185
1961	1,449	740	2,189
1962	2,665	454	3,119
1963	513	1,366	1,879
1964	1,879	597	2,476
1965	3,312	625	3,937
1966	527	250	777
1967	1,096	402	1,498
1968	4,154	542	4,696
1969	1,420	434	1,854
1970	2,220	531	2,751

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Year	Adult count	Jack count	Total count
1971	3,912	183	4,095
1972	978	116	1,094
1973	644	96	740
1974	901	36	937
1975	1,133	56	1,189
1976	1,215	19	1,234
1977	893	49	942
1978	790	57	847
1979	1,138	47	1,185
1980	3,192	50	3,242
1981	1,469	112	1,581
1982	2,543	405	2,948
1983	1,599	78	1,677
1984	683	83	766
1985	3,314	592	3,906
1986	4,373	214	4,587
1987	1,402	318	1,720
1988	1,714	210	1,924
1989	2,413	231	2,644
1990	709	162	871
1991	3,123	317	3,440
1992	3,476	210	3,686
1993	168	31	199
1994	2,873	54	2,927
1995	2,036	69	2,105
1996	88	1	89
1997	1,935	37	1,972
1998	367	15	382
1999	238	61	299
2000	2,833	146	2,979
2001	5,344	184	5,528
2002	998	139	1,137

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Year	Adult count	Jack count	Total count
2003	2,117	194	2,311
2004	1,915	124	2,039
2005	1,168	152	1,320
2006	2,505	176	2,681
2007	2,739	57	2,796

Since almost all Lower Columbia River coho females and most males spawn at 3 years of age, a strong cohort structure is produced. Figure 8.11.2.1-2 shows returns from the three adult cohorts on the Clackamas. Figure 8.11.2.1-2 also shows a pattern that is highly variable, but without an obvious or significant trend for the respective cohorts with the possible exception of cohort “C.”

Estimates of smolt out-migration measured at North Fork Dam on the Clackamas also indicate variable, but generally stable production. There was a recent period in the late 1990s where smolt production was reduced followed by higher counts in the first half of this decade (Figure 8.11.2.1-3).

Sandy

The Sandy River population above Marmot Dam is the only other population in the Lower Columbia River coho salmon ESU for which natural production trends can be estimated. The portion of the Sandy River population above Marmot Dam has almost no hatchery-origin spawners, while they dominate the area below the dam (Good et al. 2005). The number of adult coho salmon passing above Marmot Dam is shown in Figure 8.11.2.1-4 and Table 8.11.2.1-6. The abundance of Sandy River coho declined substantially through much of the decade of the 1990s. Returns over the last two brood cycles since 2000 have been substantially higher (Figure 8.11.2.1-4).

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Figure 8.11.2.1-2. Clackamas North Fork Dam counts of adult (3-year-old) coho salmon by cohort, 1957-2002. Cohort A, cohort B and cohort C (TAC 2008).

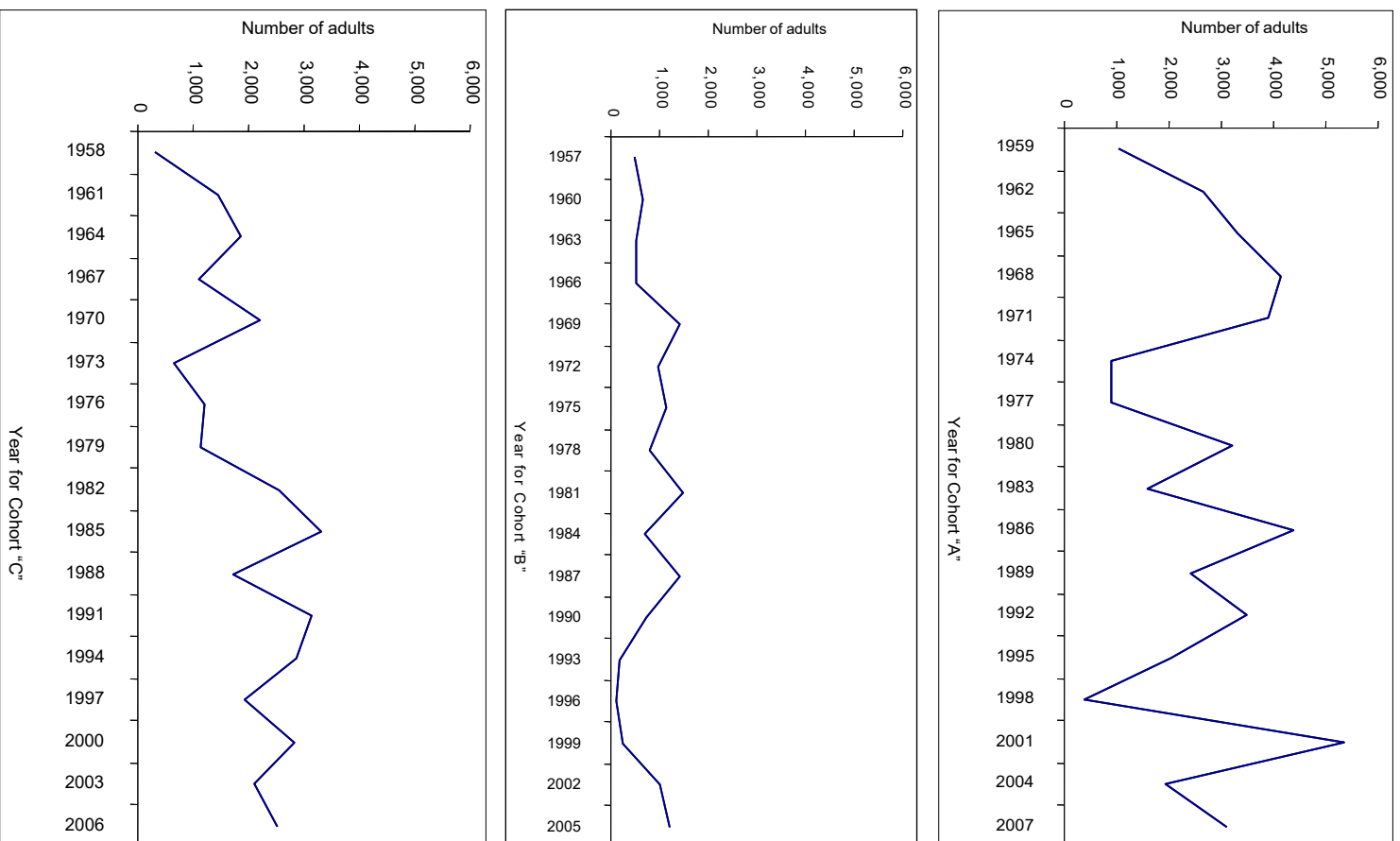


Figure 8.11.2.1-3 Total outmigrating juvenile coho passing Clackamas North Fork Dam (TAC 2008)

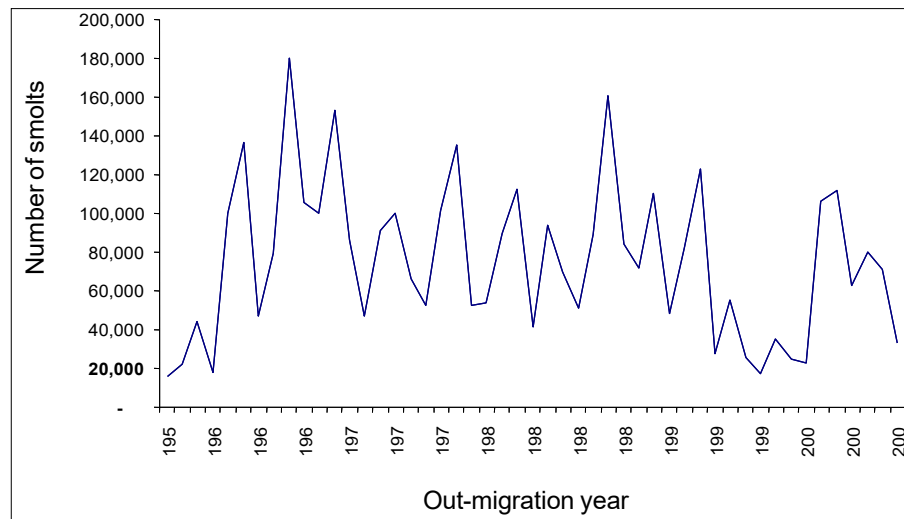


Table 8.11.2.1-6. Abundance of wild Sandy coho, 1957-2006. No data are available for some years. (TAC 2008).

Year	Adult count	Jack count	Total count
1957			264
1958			330
1959			68
1960			1670
1961			1733
1962			1458
1963			2199
1964			1126
1965			1018
1966	162	67	229
1967	386	283	669
1968	841	440	1281
1969	411	305	716
1970			
1971			
1972			
1973			

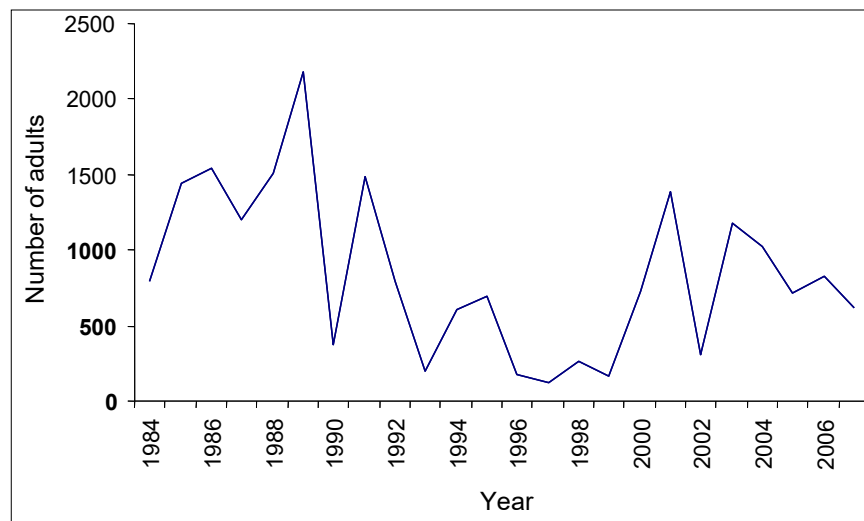
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Year	Adult count	Jack count	Total count
1974			
1975			
1976			
1977			283
1978			426
1979			682
1980			635
1981			620
1982	722	20	742
1983	26	34	60
1984	798	8	806
1985	1445	27	1472
1986	1546	48	1594
1987	1205	198	1403
1988	1506	84	1590
1989	2182	113	2295
1990	376	80	456
1991	1491	1	1492
1992	790	55	845
1993	193	27	220
1994	601	47	648
1995	697	19	716
1996	181	0	181
1997	116	0	116
1998	261	0	261
1999	162	19	181
2000	730	12	742
2001	1388	8	1396
2002	310	1	311
2003	1173	26	1199
2004	1025	7	1032
2005	717	28	745

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Year	Adult count	Jack count	Total count
2006	822	13	835
2007	617	0	617

Figure 8.11.2.1-4. Count of adult coho salmon at the Marmot Dam on the Sandy River. Almost all spawners above Marmot Dam are natural origin (TAC 2008).



Other Oregon Populations

ODFW recently initiated an effort to obtain abundance estimates for more Lower Columbia River coho populations using a random stratified sampling protocol (i.e., similar to that used to estimate abundance of Oregon Coastal coho salmon). Results from this survey are presented in Table 8.11.2.1-7. Information related to the proportion of these fish that are of hatchery origin is limited or completely unavailable. Estimates of percent hatchery in 2002 for the Scappoose, Clatskanie, Upper Gorge tributaries, and Youngs Bay and Big Creek are 0%, 60%, 65%, and 91%, respectively. These surveys suggest that hatchery-origin spawners dominate Lower Columbia River ESU coho populations in Oregon, but there are appear to be pockets of natural production.

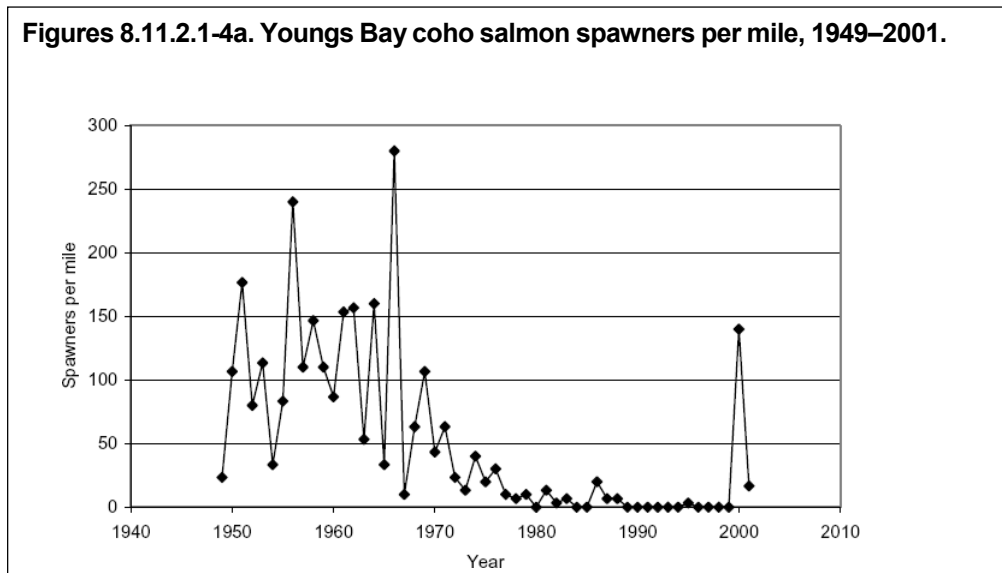
Prior to these recent intensive surveys, ODFW conducted coho salmon spawner surveys in the lower Columbia River. These surveys were combined to obtain spawners-per-mile information at the scale of the population units (Figures 8.11.2.1-4a-d) (Good et al. 2005). In many years over the last two decades, these surveys have reported no natural-origin coho salmon spawners. Based on the spawners-per-mile survey data, previous assessments have concluded that coho salmon in these populations are extinct or nearly so (ODFW 1999, Good et al. 2005). The estimates of a few hundred spawners in each of the Oregon-side populations in the recent years suggests that these areas have been recolonized or that prior spawning surveys missed fish that were nonetheless present.

Table 8.11.2.1-7. Recent abundance of wild coho in other Oregon population areas (TAC 2008).

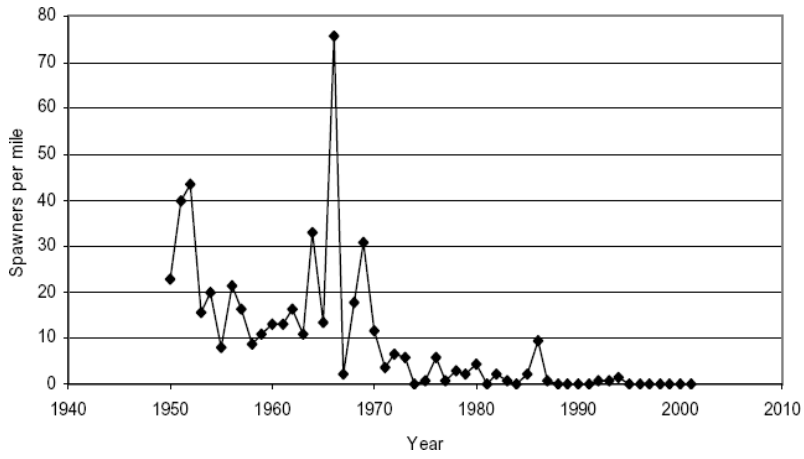
Year	Astoria Area		Clatskanie	Scappoose ¹	Gorge and Hood	
	Youngs Bay	Big Creek ¹			Lower Gorge	Hood ¹
1999	0		0	23	22	
2000	285		66	55	19	
2001	171		131	375	40	
2002	364	125	520	453	338	147
2003	45	190	357	317	NA	41
2004	128	124	758	719	NA	126
2005	77	240	348	336	263	1,262
2006	NA	252	747	689	226	373
2007	NA	216	357	333	NA	352

¹ Counts in Big Creek, Scappoose and Hood are a combination of weir/dam counts and spawning ground counts. Dam counts at the weirs/dams are of unmarked fish; spawning ground counts are wild fish based on mark and scale data.

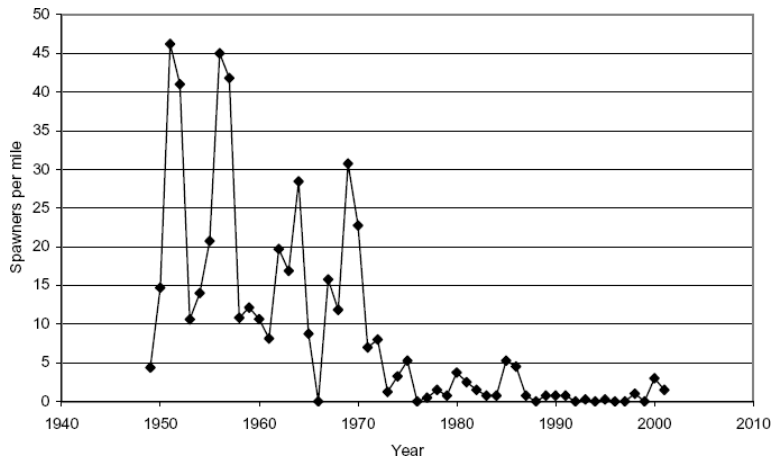
Figures 8.11.2.1-4a. Youngs Bay coho salmon spawners per mile, 1949–2001.



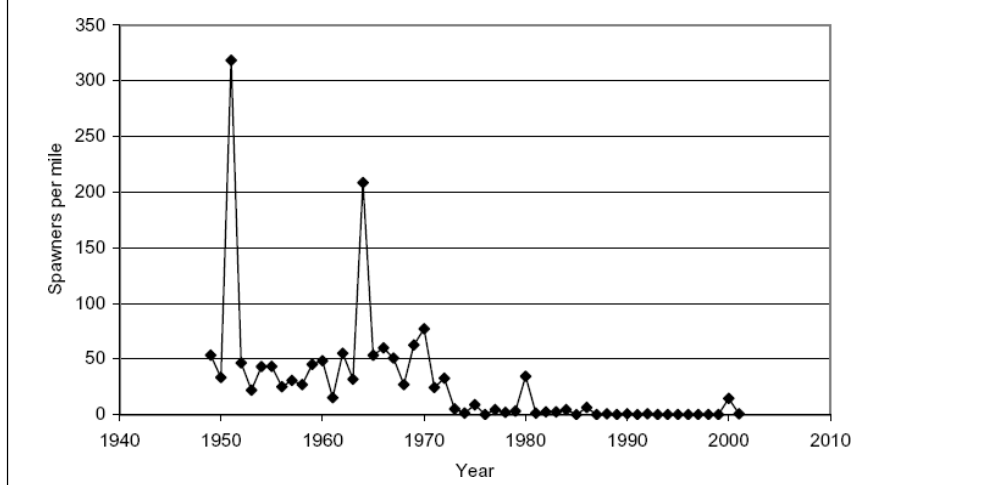
Figures 8.11.2.1-4b. Big Creek coho salmon spawners per mile, 1949–2001.



Figures 8.11.2.1-4c. Clatskanie River coho salmon spawners per mile, 1949–2001.



Figures 8.11.2.1-4d. Scappoose River spawners per mile, 1949–2001.



Abundance estimates for Oregon populations of the Lower Columbia River coho ESU can be compared to available abundance criteria. The WLC TRT defines a reproductive failure threshold (RFT) and quasi-extinction threshold (QET) (WLCTRT 2006). At very low abundance, populations may experience a decrease in reproductive success because of factors such as the inability to find mates, random demographic effects (the variation in individual reproduction become important), changes in predator-prey interactions, and other “Allee” effects. The reproductive failure threshold (RFT) is used to define an abundance below which no recruitment is assumed to occur.

The Interim Regional Lower Columbia Salmon Recovery Plan provides preliminary estimates of minimum abundance levels associated with viable status (LCFRB 2004). Table 8.11.2.1-8 lists the RFT/QET and viability abundance levels for Oregon population of the Lower Columbia River coho salmon ESU.

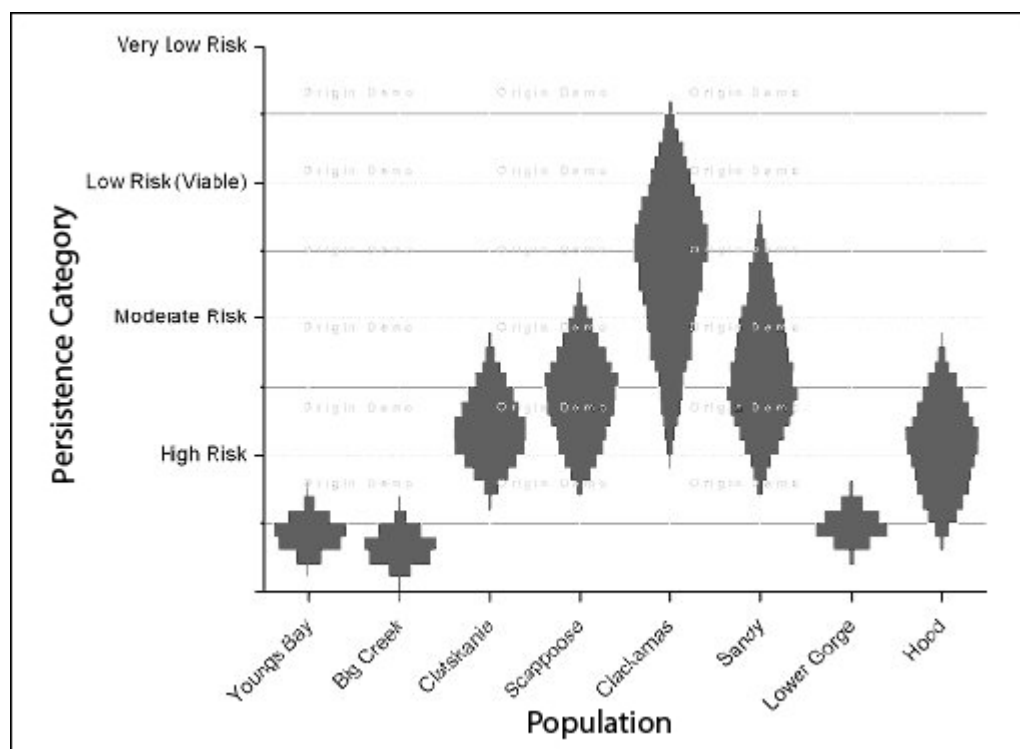
Table 8.11.2.1-8. RFT/QET and Minimum Viability Abundance Thresholds for Oregon population of the Lower Columbia River coho salmon ESU.

Population	RFT/QET WLCTRT (2006)	Minimum Viability Abundance LCFRB (2004)
Clackamas	200	600
Sandy	300	600
Big Creek	100	600
Youngs Bay	100	600
Clatskanie	200	600
Scappoose	200	600
Lower Gorge Tributaries	100	600
Hood River	200	600

In recent years at least, all the Oregon populations have been above the RFT/QET levels. The Clackamas has been well above the minimum viability abundance level; the Sandy has been above the viability abundance level at least in recent years.

The WLC TRT and ODFW recently reviewed the status of the Oregon population of the Lower Columbia River coho salmon ESU (WLCTRT 2006). They evaluated information related to measures of abundance, productivity, spatial structure and diversity criteria. The methods used are discussed in the draft report in some detail (WLCTRT 2006). The report provides an overall summary of population status for the Oregon population of the Lower Columbia River coho salmon ESU (Figure 8.11.2.1-5). The results generally indicate that many of the populations are currently at high risk with none being in a desirable low risk status.

Figure 8.11.2.1-5. Overall summary of population status for Oregon LCR coho populations.



Washington Populations

Hatchery production also dominates the Washington populations of Lower Columbia River coho; the majority of spawners believed to be hatchery strays. There are no estimates of spawner abundance for these populations, but WDFW began trapping outmigrating juvenile coho several years ago, and these data indicate that natural production (albeit of hatchery-origin fish) is occurring in several areas (Table 8.11.2.1-9).

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There is no direct way to determine whether these populations would be naturally self-sustaining in the absence of hatchery-origin spawners. WDFW suggests that juvenile outmigrant production seen in the monitored streams is typical of other Washington Lower Columbia River ESU streams and that a substantial number of natural-origin spawners may return to the lower Columbia River each year, but are not observed because there is no monitoring for coho on the Washington side.

Table 8.11.2.1-9. Estimates of natural coho salmon juvenile outmigrants from Washington Lower Columbia River streams (TAC 2008).

1997						3,700	700
1998	38,400					110,000	16,700
1999	28,000					15,100	9,700
2000	20,300				4,514-9,028	106,900	23,500
2001	24,200	6,300	6,500	8,200		334,700	82,200
2002	35,000	8,200	5,400	4,300		166,800	11,900
2003	36,700	10,500	9,600	6,200		403,600	38,900
2004	37,000	5,700	6,400	5,100		396,200	36,100
2005	58,300	11,400	9,000	4,900		766,100	40,900
2006	46,000	6,700	4,400	2,300		370,000	33,600
2007	29,300	7,000	3,300	2,300		277,400	34,200

Estimates are based on expansions from smolt traps, not total census. Cedar Creek is a tributary of the North Fork Lewis River population. Mill, Germany and Abernathy Creeks are combined into a single population unit for TRT analysis. The Cowlitz River above Cowlitz Falls is partitioned into three independent populations (Upper Cowlitz, Cispus, and Tilton Rivers). The East Fork Lewis River estimate shows a range based on uncertainties about trap efficiency.

The Washington Department of Fish and Wildlife used the estimates of smolt production from monitored streams to estimate the total smolt production from the Washington portion of the Lower Columbia River coho salmon ESU in 2007 (Volkhardt et al. 2008). The estimate of total natural-origin smolt production in 2007 was 476,100 (Table 8.11.2.1-10).

Table 8.11.2.1-10. Estimated smolt production from streams with hatcheries, streams without hatcheries, minimum abundance from monitored streams, and predicted smolt abundance for the Washington-side of the LCR ESU (Volkhardt et al. 2008).

Node	Smolt Abundance			Smolt Density (smolts/sq. mile)		
	5.00%	Median	95.00%	5.00%	Median	95.00%
Unmonitored H_streams	193,700	200,100	206,800	233	241	249
Unmonitored W_streams	79,460	82,520	85,810	128	133	138
Monitored Streams	191,200	193,400	195,800			
Natural-origin Smolt Prediction	467,900	476,100	484,900			

These smolt production estimates, in combination with estimates of marine survival, were used to develop estimates of adult returns of natural-origin Lower Columbia River coho of 9,500 to the Washington side of the ESU (PFMC 2008). This was combined with estimates of 3,900 natural-origin Lower Columbia River coho to the Oregon side of the ESU, for a total of 13,400 natural-origin adults returning in 2008 (PFMC 2008).

This natural-origin production includes a mix of fish from streams that have a substantial amount of hatchery-origin strays and others where hatchery straying is believed to be relatively limited. Information gathered over the last several years suggests there is more coho production on both the Washington and Oregon-side streams than previously believed and that coho production in the ESU is not limited to that which occurs in the Clackamas and Sandy rivers.

The populations above Cowlitz Falls on the Cowlitz River (Upper Cowlitz, Cispus, and Tilton Rivers) are also suitable for natural coho production (Table 8.11.2.1-9). However, these populations are not currently considered self-sustaining. Three dams block anadromous passage to the upper Cowlitz River. Currently, adult coho salmon (some of hatchery origin) are collected below the lower dam (Mayfield Dam) and trucked to the area above the upper dam (Cowlitz Falls Dam). There has been no appreciable downstream passage through the dams, so juvenile outmigrants were collected at Cowlitz Falls Dam and trucked below Mayfield Dam. The collection efficiency of outmigrating juveniles was 40–60% and spawners could replace themselves. Thus, hatchery production (in addition to the trap-and-haul operation) has maintained the populations. The new FERC license for the project requires the development of new passage facilities. Hatchery programs will be reformed, but production will continue (see “Spatial Structure,” below).

Preliminary viability and recovery goals have been established by WLC TRT (2004) and Lower Columbia Fish Recovery Board (LCFRB) and are presented in Table 8.11.2.1-10. The method used to establish recovery goals is described in LCFRB (2004). It should be noted that the viability goal

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assumes no hatchery fish presence, and average ocean conditions. Due to resource constraints, the recovery goals for coho salmon made assumptions that the spatial distribution of coho was the same as that of steelhead, which probably under-estimates the actual coho salmon distribution. WDFW and LCFRB are currently developing more specific information to be included in the recovery plan for the Lower Columbia River coho. The coho viability goals for abundance therefore should be considered preliminary.

Table 8.11.2.1-11. The ecological zones (strata) and populations for the Lower Columbia River coho salmon ESU(LCFRB 2004). Primary (P), contributing (C), and stabilizing (S) population designations for the recovery scenario. Respective target viabilities are high or better, medium, and no lower than current levels. Primary populations identified for greater than high viability objectives are denoted with an “*”.

Population/Strata	Status/Goal ¹	Abundance Range		Viability	
		Viable	Potential	Current	Goal
COASTAL					
Grays /Chinook (WA)	P	600	4,600	Low	High
Mill, Germany, Abernathy (WA)	C	600	3,700	Low	Med
Elochoman/Skamokawa (WA)	P	600	7,000	Low	High
Youngs Bay (OR))	S	600	1,200	na	Low
Big Creek (OR)	P	600	1,200	na	High
Clatskanie (OR)	S	600	1,200	na	Low
Scappoose (OR)	P	600	1,200	na	High
CASCADE					
Upper Cowlitz (WA)	P	600	28,800	V Low	Med
Lower Cowlitz (WA)	C	600	19,100	Low	High
Cispus (WA)	C	600	6,600	V Low	Med
Tilton (WA)	C	600	4,000	V Low	Low
South Fork Toutle (WA)	P	600	32,900	Low	High
North Fork Toutle (WA)	P	600	1,200	Low	High
Coweeman (WA)	P	600	7,600	Low	High
Kalama (WA)	C	600	1,300	Low	Med
North Fork Lewis (WA)	C	600	5,900	Low	High
East Fork Lewis (WA)	P	600	4,100	Low	High
Salmon Creek (WA)	S	600	5,700	V Low	V Low
Washougal (WA)	C	600	4,200	Low	Med

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Population/Strata	Status/Goal ¹	Abundance Range		Viability	
		Viable	Potential	Current	Goal
Sandy (OR)	P*	600	1,200	na	High+
Clackamas (OR)	P*	600	1,200	na	High+
GORGE					
Lower Gorge Tributaries (WA)	P	600	1,200	Low	High
Upper Gorge Tributaries (WA)	P	600	1,100	Low	High
White Salmon (WA)	C	600	1,200	V Low	Low
Hood River (OR)	C	600	1,200	na	Med

¹ **Primary populations** are those that would be restored to high or “high+” viability. At least two populations per strata must be at high or better viability to meet recommended TRT criteria. Primary populations typically, but not always, include those of high significance and medium viability. In several instances, populations with low or very low current viability were designated as primary populations in order to achieve viable strata and ESU conditions. In addition, where factors suggest that a greater than high viability level can be achieved, populations have been designated as High+. High+ indicates that the population is targeted to reach a viability level between High and Very High levels as defined by the TRT.

Contributing populations are those for which some restoration will be needed to achieve a stratum-wide average of medium viability. Contributing populations might include those of low to medium significance and viability where improvements can be expected to contribute to recovery.

Stabilizing populations are those that would be maintained at current levels (likely to be low viability).

Stabilizing populations might include those where significance is low, feasibility is low, and uncertainty is high.

Extinction Probability/Risk

The 100-year risk of extinction (8.11.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (WLCTRT 2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.11.2.1-12. Risk of extinction in 100 years categories for populations of LCR coho (sources: Washington’s Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Coast	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	H
	Youngs Bay	O	VH

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Strata	Population	State	
	Big Creek	O	VH
	Clatskanie	O	H
	Scappoose	O	H
Cascade	Lower Cowlitz	W	H
	Coweeman	W	H
	SF Toutle	W	H
	NF Toutle	W	H
	Upper Cowlitz	W	VH
	Cispus	W	VH
	Tilton	W	VH
	Kalama	W	H
	NF Lewis	W	H
	EF Lewis	W	H
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	L
	Sandy	O	H
Gorge	Lower Gorge	O/W	VH/H
	WA Upper Gorge and White Salmon River	W	VH
	OR Upper Gorge and Hood River	O	VH

Spatial Structure

The LCR coho ESU consists of three MPGs made up of three to 14 populations each. Spatial structure has been substantially reduced by the loss of access to the upper portions of some basins due to tributary hydro development. Examples are the complete barrier at Condit Dam on the (Big) White Salmon River and delay and injury associated with inadequate passage facilities at Powerdale Dam on the Hood River (FERC-licensed hydropower projects; see Section 8.11.3.2, Environmental Baseline, Tributary Habitat for effects of their scheduled removals). Key coho production areas in the Cowlitz and North Fork Lewis River have been taken out of production due to utility projects. In addition, inundation of historical habitat when Bonneville pool was filled diminished the spatial structure of the Gorge population spawning in the smaller tributary streams above Bonneville Dam.

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The following FERC-licensed projects, which although not in the action area do affect rangewide status, will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run (Little Sandy dam.) – removal by 2008 (NMFS 2003d) will improve passage for the coho population into the upper Sandy watershed (Marmot dam was removed in 2007.)
- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the North Fork Lewis River coho population
- Cowlitz River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2004c), supporting restoration of the Cowlitz, Cispus, and Tilton coho populations

The Federal Energy Regulatory Commission's (FERC) licenses for the Lewis and Cowlitz river hydroelectric projects require their respective owners/operators to operate hatchery programs. PacifiCorps and Cowlitz PUD operate a hatchery program to support a naturally-spawning, harvestable population of coho salmon throughout its historical range in the North Fork Lewis basin. Tacoma Power operates a conservation hatchery program that is supplementing natural origin and adult coho from naturally spawning hatchery fish now returning to the upper Cowlitz Basin. The North Fork Lewis program is in its very early stages and it is too early to conclude that it will increase overall abundance as well as the spatial structure coho in the Lewis Basin.

Diversity

The diversity of populations in all three MPGs has been eroded by large hatchery influences and periodically, low effective population sizes.

The genetic legacy of the Lewis and Cowlitz River coho populations is preserved in ongoing hatchery programs.

8.11.2.2 Current Rangewide Status of Critical Habitat

NOAA Fisheries has not yet designated critical habitat for this ESU.

8.11.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed

environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR coho salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend in Table 8.11.2.1-3 will improve.

8.11.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007a) estimated that hydropower configuration and operational improvements implemented in 2000 to 2006 have resulted in an 11.3% increase in survival for yearling Lower Columbia River coho that pass Bonneville Dam. Improvements during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners at Powerhouse 1 (PH1) and of structures that improve fish guidance efficiency (FGE) at PH2. Spill operations have been improved and Powerhouse 2 is used as the first priority for power production because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The bypass system screen was removed from PH1 because tests showed that turbine survival was higher than through the bypass system at that location.

8.11.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving passage by replacing culverts and by reintroducing fish into areas above FERC-licensed dams. The latter category includes two projects in the tributaries above Bonneville Dam (i.e., within the action area for this consultation):

- Condit – removal in 2009 (NMFS 2006j) will support the restoration of the White Salmon River portion of the WA Upper Gorge coho population
- Powerdale – removal by 2012 (NMFS 2005o) will support the restoration of the Hood River portion of the OR Upper Gorge coho population

Both removals will greatly increase the abundance and productivity of the affected populations by increasing the amount of habitat available for spawning and rearing. Although there is some uncertainty regarding whether the affected populations will become reestablished, NOAA Fisheries has determined that these are the correct next steps toward their restoration.

8.11.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimated 0.3% survival benefit for LCR coho (stream-type juvenile life history).

8.11.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown during the same period.

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for yearling juvenile salmonids (Friesen and Ward 1999).

8.11.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin coho salmon has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 29 programs that release coho salmon below Bonneville Dam, NOAA Fisheries identified only four programs as improving population viability by increasing spatial distribution (NMFS 2004b). Twenty-two were identified as reducing short-term extinction risk, helping to preserve genetic resources important to ESU survival and recovery.¹ A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS 2004b.

Most salmonids returning to the region are primarily derived from hatchery fish. The production of hatchery fish, among other factors, has contributed to the 90% reduction in natural-origin coho salmon runs in the lower Columbia River over the past 30 years (Flagg et al. 1995).

NOAA Fisheries identified four primary ways hatcheries may harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000b). In many areas, hatchery fish provide increased fishing opportunities. However, when natural-origin fish mix with hatchery stocks in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural-origin fish blend in the spawning grounds, the health of the natural-origin fish and the habitat's ability to support them can be overestimated. This potential overestimate exists because the hatchery fish mask the surveyors' ability to discern actual natural-origin run status, thus resulting in harvest objectives that were too high to sustain the naturally produced populations.

Over the last several years, the role hatcheries play in the Columbia Basin has been expanded from simple production to supporting species recovery. The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia River is occurring through several processes, including: (1) the Lower Columbia River Recovery and Fish and Wildlife Subbasin Plan; (2) Hatchery Genetic and Management Plan development for ESA compliance; (3) FERC-related plans on

¹ The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

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the Cowlitz and Lewis Rivers; and, (4) the federally mandated Artificial Production Review and Evaluation. More recently a National Environmental Policy Act (NEPA) review of all Mitchell Act funded hatchery facilities was initiated which will include many of those producing Lower Columbia River coho. Washington's Lower Columbia River Recovery Plan identifies strategies and measures to support recovery of naturally-spawning fish. The plan also includes associated research and monitoring elements designed to clarify interactions between natural and hatchery fish and quantify the effects artificial propagation has on natural fish. The objective is to rehabilitate depleted populations and provide for harvest, while minimizing impacts to wild fish. For more detail on the use of hatcheries in recovery strategies, see the Lower River Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2004).

The states of Oregon and Washington and other co-managers are currently engaged in a substantial review of hatchery management practices through the Hatchery Scientific Review Group (HSRG). The HSRG was established and funded by Congress to provide an independent review of current hatchery programs in the Columbia River Basin. The HSRG has largely completed their work on Lower Columbia River coho populations and provided their recommendations ([HSRG 2007]). A general conclusion from the information generated by the HSRG is that the current production programs are not consistent with practices that reduce impacts on naturally-spawning populations, and will have to be modified to reduce the adverse effects of hatchery fish on key natural populations identified in the Interim Recovery Plan, as necessary for broad sense recovery of the ESU. The adverse effects are caused in part by excess hatchery adults returning to natural spawning grounds.

Early in 2007 NOAA Fisheries expressed the need to change current hatchery programs and anticipated that decisions regarding the direction for those programs would be made soon (NMFS 2007g). NOAA Fisheries followed with a letter to the states of Oregon and Washington in November 2007 that again highlighted the immediate need for decisions about hatchery programs (NMFS 2007h). In response and through their own initiative, the states have embraced the recommendations of the HSRG and have now initiated a comprehensive program of hatchery and associated harvest reform (WDFW and ODFW 2008). The program is designed specifically to achieve HSRG objectives related to controlling the relative abundance of hatchery fish on the spawning grounds and in the hatchery broodstock. The program will require mass marking of released hatchery fish, changing hatchery release strategies, reducing hatchery production at some facilities, and building a system of weirs and improved collection facilities to control the straying of hatchery fish. The program will also require development and implementation of more mark selective fisheries and increasing the productivity of river basins through habitat management actions. Overall, the program represents a comprehensive and integrated approach to recovery that will be advanced by substantive reforms in hatchery practices.

Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

8.11.3.6 Recent Harvest Survival Improvements

Lower Columbia River coho are caught in both ocean and in-river fisheries. As discussed in Section 8.11.5.5, LCR coho are managed subject to a total exploitation rate limit for the combined ocean and in-river fisheries. The necessary sharing between ocean and in-river fisheries is implemented by coordination and the close association between Pacific Fishery Management Council fisheries and the 2008 *U.S. v. Oregon* Agreement and related biological opinions.

Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the total exploitation rate limit. In 2008, the total exploitation rate limit is 8% based on the year specific circumstances. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for LCR coho through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council’s Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and as they have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed in 2008 subject to a total exploitation rate of 8% would not jeopardize the listed species (NMFS 2008e). The PFMC opinion provides the substantive foundation for the review of the management strategy for LCR coho.

Table 8.11.3.6-1 includes the available information on exploitation rates of Lower Columbia River coho in ocean and freshwater fisheries. Previously, Oregon Coast Natural coho were used as a surrogate for estimating ocean fisheries impacts to Lower Columbia River coho. In 2006, largely as a consequence of increased attention resulting from its listing, the methods for assessing harvest in ocean fisheries were changed so that these were more specific to Lower Columbia River coho.

Until 1993 the exploitation rates in salmon fisheries on Lower Columbia River coho have been very high, contributing to their decline (Table 8.11.3.6-1). The combined ocean and inriver exploitation rates for Lower Columbia River coho averaged 91% through 1983, averaged 69% from 1984-1993, and decreased to an average of 16.7% from 1994-2007.

Table 8.11.3.6-1. Estimated Ocean (all marine area fisheries) and Inriver Exploitation Rates on Lower Columbia River Natural Coho, 1970-2007 (TAC 2008).

Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
1970	65.2%	28.4%	93.6%
1971	82.5%	9.9%	92.4%
1972	84.3%	8.6%	92.9%
1973	81.9%	11.2%	93.1%

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Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
1974	83.5%	9.2%	92.7%
1975	81.4%	10.1%	91.5%
1976	89.9%	5.5%	95.4%
1977	88.8%	5.3%	94.1%
1978	82.5%	7.9%	90.4%
1979	79.4%	9.5%	88.9%
1980	73.1%	24.5%	97.6%
1981	81.1%	6.8%	87.9%
1982	61.6%	20.8%	82.4%
1983	78.7%	3.9%	82.6%
1984	31.9%	27.0%	58.9%
1985	43.2%	22.3%	65.5%
1986	33.5%	39.7%	73.2%
1987	59.5%	19.4%	78.9%
1988	56.4%	20.3%	76.7%
1989	55.3%	22.7%	78.0%
1990	68.9%	7.5%	76.4%
1991	45.4%	19.1%	64.5%
1992	50.9%	8.7%	59.6%
1993	42.3%	10.5%	52.8%
1994	7.0%	3.5%	10.5%
1995	12.0%	0.3%	12.3%
1996	8.0%	4.4%	12.4%
1997	12.0%	1.6%	13.6%
1998	8.0%	0.2%	8.2%
1999	9.0%	18.5%	27.5%
2000	7.0%	17.5%	24.5%
2001	7.0%	6.4%	13.4%
2002	12.0%	2.1%	14.1%
2003	14.0%	8.9%	22.9%

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Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
2004	15.0%	9.3%	24.3%
2005	11.0%	6.5%	17.5%
2006	6.8%	6.5%	13.3%
2007	11.9%	6.7%	18.6%

8.10.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Gorge MPG

Completed consultations include road maintenance (Washington Upper Gorge and White Salmon); repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge), culvert cleaning, treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Oregon Upper Gorge and Hood populations). The USFS implemented two habitat restoration projects: improve 5 acres of riparian through thinning and improve 49 acres of riparian and one mile of stream by adding large woody debris (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid “double counting,” NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.11.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

8.11.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the Oregon Upper Gorge and Hood River, Washington Upper Gorge and White Salmon, and Washougal populations, as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.² They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve the conditions for this ESU. It is not possible to quantify the extent of these positive effects, however.

² The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.11.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Releasing a portion of the flow augmentation water from the Upper Snake Project in May (NMFS 2008b) will provide minor benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.11.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the two populations in the Gorge MPG. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of yearling coho that pass through Bonneville Dam (i.e., from the 1) Washington Upper Gorge and White Salmon and 2) Oregon Upper Gorge and Hood River) by 1%. Spillway survival improvements during

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this time period are expected to increase the passage survival through Bonneville Dam of yearling coho salmon by an additional 0.5%.

As a result of this ten-year program of improvements, an estimated 95.5% of the yearling coho that migrate past Bonneville Dam will survive. A portion of the 4.5% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling coho would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling LCR coho in a hypothetical unimpounded Columbia River would be 95% (Table 5.1 in NMFS 2004a). Therefore, approximately 57.8% ($2.6\%/4.5\%$)³ of the expected mortality experienced by in-river migrating juvenile coho is probably due to natural factors.

Based on PIT-tag detections of SR fall Chinook at Bonneville and redetected at upstream dams, NOAA Fisheries estimates an upstream passage survival rate of 96.9% for adult coho salmon that pass Bonneville Dam (i.e., relevant to the Gorge MPG).

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat in the lower Columbia River below Bonneville Dam.

8.11.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the coho population in that watershed (Table 6 in Attachment B.2.2-2; Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow and thus is likely to increase the abundance, productivity, and spatial structure of the Hood River coho salmon population. Adverse effects to habitat during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on habitat (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the Lower Columbia River coho populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is

³ LCR coho salmon are found in the Klickitat River about 56 km upstream of Bonneville Dam.

uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

8.11.5.3 Effects of Estuary Prospective Actions

The Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA. The estimated survival benefit for yearling coho associated with these specific actions will be 1.4%.

The RPA requires Action Agencies will implement projects that achieve an additional survival benefit for LCR coho salmon of 4.3% during the period 2010 to 2018. Prospective Actions will include protection and restoration of riparian areas, the protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

8.11.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to hatchery-specific ESA § 7(a)(2) consultation, implementation of hatchery reform principles will: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation and are pending completion of future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.11.5.5 Effects of Harvest Prospective Actions

Under the Prospective Action the harvest of Lower Columbia River coho will vary from year-to-year using the ocean portion of Oregon's harvest matrix (Table 8.11.5.5-1) (NMFS 2008i). Lower Columbia River coho are caught in non-Treaty fall season fisheries in the Columbia River below Bonneville Dam. The states propose to manage Columbia River salmon fisheries each year during 2008 through 2017 with an associated total exploitation rate (ER) on Lower Columbia River natural-origin coho equivalent to the remainder of the ocean portion of Oregon's harvest matrix after ocean fisheries are accounted for. The total ER for each year will be determined using the ocean portion of Oregon's harvest matrix (Table 8.11.5.5-1), which will be described in NMFS's yearly guidance letter to PFMC. For 2008, NMFS guidance to PFMC is to manage fisheries with a total ER for natural-

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origin Lower Columbia River coho of 8% and the expected preseason exploitation rate for inriver fisheries is 2.1% (NMFS 2008e). The ER for natural-origin Lower Columbia River coho ESU in 2008 through 2017 will be estimated as a combined ER for early and late stocks for ocean and inriver fisheries.

Table 8.11.5.5-1. Harvest management matrix for Lower Columbia River coho salmon showing maximum allowable Ocean fishery mortality rate.

Parental Escapement ¹		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<0.0008)	Low (< 0.0015)	Medium (< 0.0040)	High (> 0.0040)
High	> 0.75 full seeding	< 8.0%	< 15.0%	< 30.0%	< 45.0%
Medium	0.75 to 0.50 full seeding	< 8.0%	< 15.0%	< 20.0%	< 38.0%
Low	0.50 to 0.20 full seeding	< 8.0%	< 15.0%	< 15.0%	< 25.0%
Very Low	0.20 to 0.10 of full seeding	< 8.0%	< 11.0%	< 11.0%	< 11.0%
Critical	< 0.10 of full seeding	0 – 8.0%	0 – 8.0%	0 – 8.0%	0 – 8.0%

¹ Full Seeding: Clackamas River = 3,800, Sandy River = 1,340

The ER is estimated as the sum of total mortalities divided by the total ocean abundance. The ER for natural-origin Lower Columbia River coho is assumed to be equivalent to the ER for unmarked coho. The total ocean abundance of Columbia River unmarked coho is provided by the ocean FRAM model. The FRAM model estimates the exploitation rate for all ocean fisheries and for the Buoy 10 sport fishery. For Columbia River fisheries upstream of Tongue Point, the ER is estimated separately for the mainstem sport fishery, SAFE commercial fisheries and mainstem commercial fisheries.

The states of Oregon and Washington have developed two preseason models: one to allocate in-river impact rates among fisheries and one to monitor harvest to maintain the total ER at or below the allowable combine ER for unmarked coho each year. The preseason model used in fishery planning to estimate catch per statistical week in mainstem and SAFE fisheries uses average harvest rates from historical data. The preseason model will be used to structure coho seasons each year and to allocate coho catch among in-river fisheries while remaining within the prescribed yearly ER limit for unmarked fish.

Effects on Hatchery-Origin coho

Although proposed fisheries are being managed primarily to meet ER limits for natural-origin fish, the status of hatchery-origin fish and associated hatchery programs provide secondary consideration. For the time being, achieving hatchery escapement goals, particularly for programs used for supplementation or conservation purposes is desirable.

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Lower Columbia River coho hatchery program management requires that these programs are self-sustaining, restricting the practice of using production from other programs to back-fill shortfalls in production goals (NMFS 2004b). This has not been a concern with the abundant returns in recent years. This is particularly the case for those programs involved in supplementation or re-introduction of natural production. Fishery management plans in 2008 also incorporate conservative expectations of coho abundance in order to maximize the prospect of meeting hatchery escapement goals (Table 8.11.5.5-2).

Table 8.11.5.5-2. Lower Columbia River coho hatchery programs, escapement goals and escapement, by program for the last 10 years. Shaded areas/Italic type highlights programs that are used, at least in part, to support supplementation or reintroduction activities. Numbers in bold indicate years in which the escapement goal was not met for that program.

Facility		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Big Creek	Goal	828	828	700	700	700	700	525	700	700	700
	Escapement	1,949	1,684	4,034	10,047	8,365	7,946	3,545	6,555	6,175	3,938
Bonneville	Goal	8,751	8,751	6,000	6,000	5,143	6,074	6,074	6,074	6,000	6,000
	Escapement	6,076	4,512	18,116	45,163	25,888	36,318	24,438	25,609	38,001	33,954
Sandy	Goal	1,382	1,382	1,300	1,300	1,207	1,000	1,000	1,200	1,300	1,300
	Escapement	5,476	1,013	12,506	20,454	6,979	8,921	16,126	10,015	8,507	7,555
Grays R.	Goal	861	1,362	1,246	1,341	1,341	1,341	1,341	1,341	600	600
	Escapement	62	710	12,910	6,483	600	683	1,676	4,838	835	969
Elochoman early	Goal	669	876	510	823	823	823	823	823	420	420
	Escapement	19	2,131	6,851	11,729	7,953	7,738	5,124	2,784	2,652	2,113
Elochoman late	Goal	496	788	788	997	997	997	776	450	450	450
	Escapement	567	2,693	4,536	7,401	4,161	2,800	1,024	761	324	979
Cowlitz	Goal	7,483	7,438	7,483	5,740	4,715	3,000	3,000	4,200	2,700	2,700
	Escapement	18,378	40,321	50,395	75,744	82,876	31,165	44,622	33,655	54,283	37,111
Toutle	Goal	1,250	1,250	1,480	1,168	1,168	1,168	1,168	1,168	700	700
	Escapement	6,506	12,508	28,774	15,730	18,828	30,207	25,462	8,055	6,523	17,680
Kalama Complex early	Goal	477	638	700	460	460	460	460	460	350	350
	Escapement	4,274	6,726	4,289	15,680	4,774	4,697	1,487	1,694	3,354	5,130
Kalama Complex late	Goal	1,405	1,310	1,533	671	671	671	671	671	300	300
	Escapement	282	1,095	10,110	15,522	4,351	3,198	3,156	1,233	5,344	1,768
Lewis Complex early	Goal	2,713	2,937	1,526	1,583	1,583	1,583	1,583	1,583	1,583	900
	Escapement	6,882	17,466	17,037	38,656	17,316	37,904	21,853	19,686	18,451	17,163
Lewis	Goal	2,517	2,517	4,954	5,968	4,756	5,000	5,000	3,257	2,000	2,000

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Facility		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Complex late	Escapement	16,130	17,717	23,199	60,812	6,170	20,803	10,750	16,164	18,071	15,818
Washougal late	Goal	4,565	4,906	742	748	748	748	748	748	2,450	2,450
	Escapement	1,605	2,581	5,597	18,457	19,282	6,085	4,023	3,277	11,016	5,175
Eagle Creek	Goal	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300
	Escapement	12,612	11,779	33,106	30,146	6,285	4,812	7,776	8,921	14,153	11,128

All hatcheries have exceeded their broodstock goals in at least 5 of the most recent 10 years (1998-2007). The five programs marked for supplementation or re-introduction met their goals in all of the last 10 years, except for the Sandy River program, which met the goal in 8 of the last 10 years (Table 8.11.5.5-3). Based on the preseason run size and expected ocean and in-river fisheries, the expected hatchery escapement are: 57,800 early coho to Washington hatcheries compared to the escapement goal of 3,000; 95,500 early coho to Oregon hatcheries compared to the escapement goal of 11,300; and 32,300 late coho to Washington hatcheries compared to the escapement goal of 24,400 (TAC 2008). As a consequence, there is a high likelihood that all hatchery broodstock needs will be met as they have in recent years.

Effects on Species Status

Prospective improvements in harvest effects support the increased abundance, productivity, diversity, and spatial structure of spring- and fall-run populations of LCR coho. Harvest levels have been considered in detail in the recent biological opinion for PFMC and Fraser Panel fisheries (NMFS 2008e). NOAA Fisheries concluded in that opinion that the proposed total exploitation limit is consistent with the expectation the species' survival and recovery.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR coho.

8.11.5.6 Effects of Predation Prospective Actions

Prospective Actions that reduce predation on juvenile coho will support the increased survival and therefore abundance and productivity of LCR coho salmon.

Avian predation

The survival of yearling coho will increase 7.8% with the relocation of most of the Caspian terns to sites outside the Columbia River basin, management of cormorant predation at East Sand Island, and improved avian deterrence at Bonneville Dam.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The Prospective Action to continue the increase in incentives in the NPMP will result in an additional 1% survival.

8.11.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.11.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Coho Salmon

This section summarizes the basis for conclusions at the ESU level.

8.11.6.1 Recent Status of the Lower Columbia River Coho ESU

Lower Columbia River coho salmon is a threatened species. Although there is little quantitative information, it is likely that many of the populations in this ESU have low abundance. Long-term trends and lambda for the Clackamas and Sandy River populations are just over 1.0. The Youngs Bay and Big Creek populations are sustained by hatchery production. The viability of the species has been limited by habitat degradation, habitat blockage by FERC-licensed dams in several subbasins, harvest, hatchery effects, and ecological factors including predation as well as the effects of the existence and operation of the FCRPS and Upper Snake projects. The historical role of the FCRPS and Reclamation projects was the loss of habitat for the Oregon Upper Gorge and Hood River population under Bonneville pool and passage delay and mortality at Bonneville Dam for the two populations in the Gorge MPG. Coho smolts are vulnerable to bird predation in the estuary. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Section 5.7 and 8.1.3.

8.11.6.2 Effects of the FCRPS, Upper Snake & U.S. v. Oregon Prospective Actions on the Lower Columbia River Coho ESU

In the LCFRB's recovery plan,⁴ one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The Action Agencies' estuary habitat restoration projects and relocation of Caspian terns to reduce predation on juvenile coho will address this objective. Implementation of habitat improvement projects in the Hood watershed will address limiting factors that remain after the FERC-licensed dam is removed. The potential funding for additional habitat projects could address the loss of historical spawning habitat for the Oregon Upper Gorge and Hood River and the Upper Gorge Washington and White Salmon populations, including some habitat that was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, and continued and improved avian deterrence at Bonneville Dam, and prospective juvenile passage improvements at Bonneville Dam.

Some adverse impacts from hatchery practices will continue, and allowable harvest rates will vary according to the year-specific guidance letter from NMFS to Council. In 2009 and thereafter, the Council is required to manage fisheries subject to the ocean portion of the Oregon harvest matrix (Table 8.11.5.1.5-1). Exploitation rates are therefore likely to vary based on year specific circumstances.

The effect of this management strategy was recently reviewed through a section 7 consultation on PFMC and Fraser Panel fisheries (NMFS 2008e). NOAA Fisheries concluded that managing fisheries subject to the ocean portion of the Oregon harvest matrix was not likely to jeopardize the Lower Columbia River coho salmon ESU. The underlying analysis assumed that the total exploitation rate in 2009 and thereafter would be no more than to the ocean portion of the Oregon harvest matrix. Inriver fisheries will necessarily be managed subject to that guidance.

8.11.6.3 Cumulative Effects Relevant to the Lower Columbia River Coho ESU

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will improve the functioning of habitat needed for successful spawning, incubation, and the growth and development of juvenile coho.

⁴ The LCFRB recovery plan addresses Lower Columbia River coho salmon, but because this species was not listed under the ESA at the time NOAA Fisheries evaluated the plan, the agency did not approve the LCFRB's plan as an interim regional recovery plan for the Washington portion of the Lower Columbia River coho ESU. The LCFRB is updating the coho portion of its plan, and Oregon is developing a recovery plan for the Oregon portion of the ESU. NOAA Fisheries will review and evaluate these plan elements for adequacy as the ESA recovery plan for LCR coho salmon.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia River and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.11.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Coho ESU

Impacts of the FCRPS and Upper Snake projects on this ESU are most significant for the two (out of 24) populations that spawn above Bonneville Dam and are limited relative to those from tributary hydropower, tributary habitat, harvest, hatcheries, and predation by birds and fish. These populations are affected by upstream and downstream passage and, for the Oregon Upper Gorge and Hood River population, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington identified tributary habitat actions that are reasonably certain to occur and that will benefit the Oregon Upper Gorge and Hood River, Washington Upper Gorge and White Salmon, and Washougal populations, as well as actions that should be generally beneficial throughout the ESU. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood watersheds are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.11.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement of habitat conditions on state forest lands within the range of Lower Columbia River coho (Section 8.11.3.7).

The FCRPS Action Agencies' prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this ESU and thus to its survival with an adequate potential for recovery. The Action Agencies' prospective habitat work in the Hood River and additional potential funding for tributary projects for the populations above Bonneville, plus actions at FERC-licensed dams in the Cowlitz, Lewis, White Salmon, Hood, and Sandy subbasins are expected to support the restoration of specific populations within the ESU. The Prospective Actions will not further deteriorate the pre-action condition.

Long term (100 year) extinction risk is high or very high for almost all populations in this ESU. The only exception is the Clackamas population. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the Lewis and Cowlitz River coho populations will continue to be preserved by ongoing hatchery actions as a hedge against short-term risk of extinction.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action

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Agencies' projects on the Lower Columbia River coho ESU, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the species. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Lower Columbia River coho ESU.

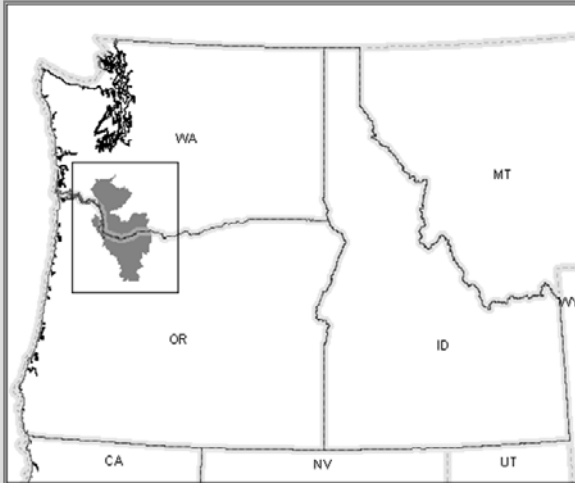
Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion include further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Prospective Actions considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁵

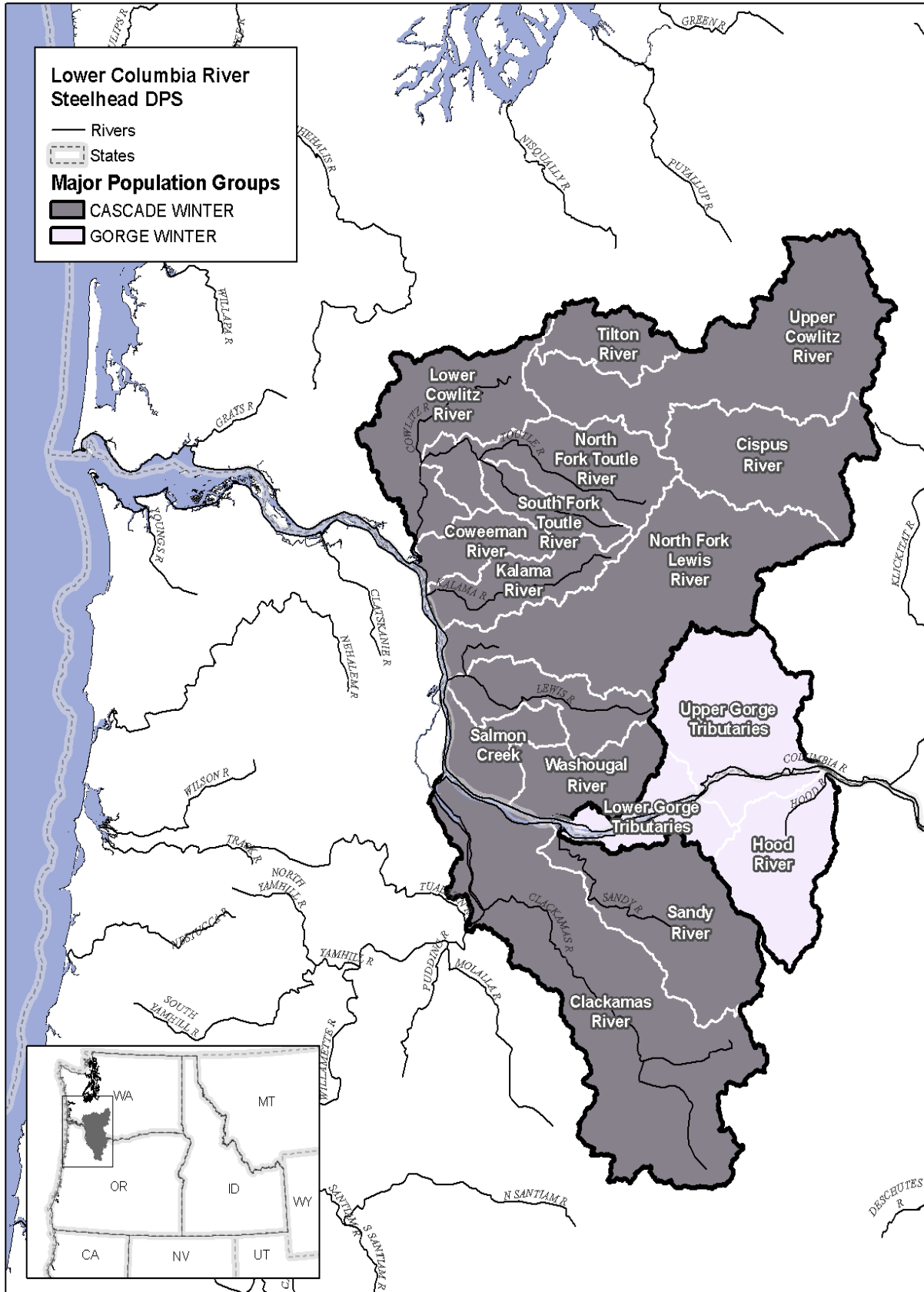
⁵ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

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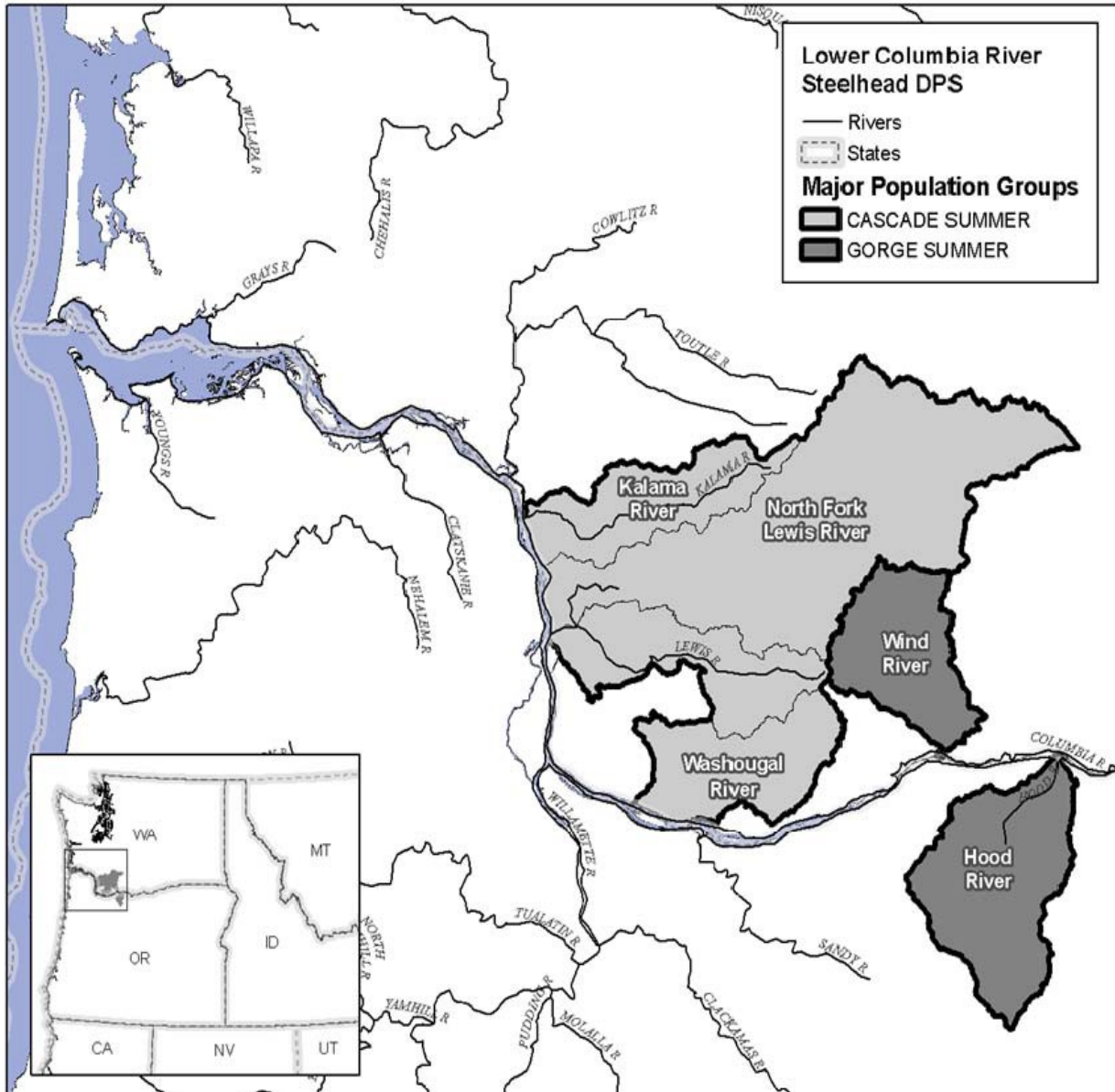


- 8.12.1 Species Overview
- 8.12.2 Current Rangewide Status
- 8.12.3 Environmental Baseline
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Section 8.12

Lower Columbia River Steelhead

Species Overview

Background

The Lower Columbia River steelhead DPS includes 23 historical anadromous populations in four major population groups. This DPS includes both summer- and winter-run types. The Lower Columbia River steelhead DPS was listed as threatened under the ESA in 1998, reaffirmed in 2006.

Designated critical habitat for LCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

Many of the populations comprising this DPS are small and many of the long- and short-term trends in abundance of individual populations are negative, some severely so. In addition, for most populations the probability is high that the trend in natural-origin spawners is less than one. A number of the populations have a substantial fraction of hatchery-origin spawners. Exceptions are the Kalama, North and South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning in natural spawning areas. These populations have relatively low recent abundance estimates; the largest is the Kalama River with 726 spawners.

Limiting Factors

Human impacts and limiting factors include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other effects of changing land use. This has adversely affected stream temperatures and reduced the habitat diversity needed for steelhead spawning, incubation, and rearing. Steelhead access to tributary headwaters has been restricted or blocked by FERC-licensed dams built without passage facilities or facilities that were inadequate and have caused injury and delay. Four populations (Wind summer-run, Hood summer-run, Upper Gorge winter-run, and Hood winter-run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will require significant efforts by many parties.

Recent Ocean and Mainstem Harvest

The Lower Columbia River steelhead DPS includes both winter and summer-run populations. Ocean fishing mortality on LCR steelhead is assumed to be zero. In recent years, non-Treaty mainstem winter and spring season fisheries have been managed subject to a 2% harvest rate limit on natural-origin winter steelhead. Treaty Indian fisheries only affect those populations above Bonneville Dam. LCR winter steelhead are not caught in non-Treaty summer or fall season fisheries. The harvest rate in non-Treaty fisheries has been limited to a maximum of 2%.

8.12.2 Current Rangewide Status

With this first step of the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.12.2.1 Current Rangewide Status of the Species

Lower Columbia River steelhead is a threatened species composed of 23 historical anadromous populations in four major population groups (called strata by the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) (Table 8.12.2.1-1 and Lower Columbia River Steelhead Map).

Table 8.12.2.1-1. Lower Columbia River steelhead DPS description and major population groups (MPGs) (Sources: NMFS 2006a; Myers et al. 2006). The designations “(C)” and “(G)” identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).¹

DPS Description	
Threatened	Listed under ESA in 1999; reaffirmed in 2006
4 major population groups	23 historical populations
Major Population Group	Population
Cascade Summer	Kalama (C), NF Lewis, EF Lewis (G), Washougal (C,G)
Gorge Summer	Wind (C), Hood
Cascade Winter	Lower Cowlitz, Coweeman, NF Toutle (C), SF Toutle, Coweeman, Upper Cowlitz (C,G), Lower Cowlitz, Cispus (C), Tilton, Kalama, NF Lewis (C), EF Lewis, Salmon Creek, Washougal, Clackamas (C), Sandy (C)
Gorge Winter	Lower Gorge, Upper Gorge, Hood (C,G)
Hatchery programs included in DPS (10)	Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers), Kalama River Wild (winter- and summer-run), Clackamas Hatchery, Sandy Hatchery, and Hood River (winter- and summer-run) steelhead hatchery programs

This DPS includes both summer and winter type steelhead. Summer steelhead return to freshwater from May to November, entering the Columbia River in a sexually immature condition and requiring several months in fresh water before spawning. Winter steelhead enter fresh water from November to April. They are close to sexual maturation and spawn shortly after arrival in their natal streams.

¹ Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the DPS (WLCTRT 2003).

Where both races spawn in the same stream, summer steelhead tend to spawn at higher elevations than the winter forms. Juveniles rear in fresh water (stream type life history).

Limiting Factors

Human impacts and limiting factors come from multiple sources: habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other effects of changing land use. This has adversely affected stream temperatures and reduced the habitat diversity needed for steelhead spawning, incubation, and rearing. Steelhead access to tributary headwaters has been restricted or blocked by FERC-licensed dams built without passage facilities or facilities that were inadequate and have caused injury and delay. Four populations (Wind summer-run, Hood summer-run, Upper Gorge winter-run, and Hood winter-run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will require significant efforts by many parties.

Summarized below (Table 8.12.2.1-2) are key limiting factors for this DPS and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for LCR steelhead.

Table 8.12.2.1-2. Key limiting factors for LCR steelhead.

<p>Mainstem Hydro</p>	<p>Direct mainstem hydropower system impacts on LCR steelhead are most significant for the four gorge tributary populations upstream from Bonneville Dam (Wind River Summer Run, Hood River Summer Run, Upper Gorge Winter Run, and Hood River Winter Run). These populations are affected by upstream and downstream passage at Bonneville Dam and in the case of the Upper Gorge winter steelhead population, by the inundation of historical habitat under the reservoir (WLCTRT 2004). Impacts on populations originating in subbasins below Bonneville Dam are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.</p>
<p>Predation</p>	<p>Piscivorous birds including Caspian terns and cormorants, fishes including northern pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult winter steelhead. Stream-type juveniles, especially steelhead smolts, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al 2005). Steelhead are also subject to pinniped predation when they return to the estuary as adults (NMFS 2006b). Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-</p>

	<p>type juveniles in the Columbia River basin (Corps et al. 2007a). Pikeminnow are significant predators of both juvenile and subjuvenile juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and the exclusion and hazing of marine mammals near Bonneville Dam.</p>
Harvest	<p>Harvest includes direct and indirect fishery mortality. Lower Columbia River steelhead are harvested in Columbia River and tributary freshwater fisheries of Oregon and Washington. Fishery impacts on wild LCR steelhead have been limited to less than 10% since the implementation of mark-selective fisheries during the 1980s.</p>
Hatcheries	<p>The long-term domestication of hatchery fish has eroded the fitness of these fish in the wild and has reduced the productivity of wild stocks where significant numbers of hatchery fish spawn with wild fish. Until selective fisheries were instituted in the early 1990s, large numbers of hatchery fish contributed to intensive mixed stock fisheries, overexploiting wild populations already weakened by habitat degradation. State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.</p>
Estuary	<p>The estuary is an important habitat for migrating juveniles from LCR steelhead populations. Due to a short residence time in the estuary, stream-type juveniles such as steelhead have limited mortality associated with a scarcity of habitat, changes in food availability, and the presence of contaminants. However, they are particularly vulnerable to bird and pinniped predation in the estuary (Fresh et al. 2005). Furthermore, steelhead are believed to be affected by flow and sediment delivery changes in the plume (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006b).</p>
Habitat	<p>Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. Winter steelhead populations have been blocked from higher elevation spawning habitats by construction of FERC-licensed hydropower facilities. Major hydro projects in the Cowlitz and Lewis basins have blocked access to approximately 80% of the historical steelhead spawning and rearing habitat within both basins (LCFRB 2004). In addition to cumulative habitat effects, the construction of non-Federal hydropower</p>

	<p>facilities on Columbia River tributaries has partially or completely blocked higher elevation spawning. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for steelhead by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.</p>
<p>Ocean & Climate</p>	<p>Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this DPS to some extent, future trends, especially during the time period relevant to the Prospective Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).</p>

Abundance, Productivity & Trends

The information in Table 8.12.2.1-3 was reported in NOAA Fisheries’ most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). Long-term averages were used where available, although some of the time series are relatively recent. Many of the populations comprising this DPS are small and many of the long- and short-term trends in abundance of individual populations are negative, some severely so. In addition, for most populations the probability is high that the true trend/growth rate is less than one (Table 43 in Good et al. 2005). A number of the populations have a substantial fraction of hatchery-origin spawners. Exceptions are the Kalama, North and South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning in natural spawning areas. These populations have relatively low recent mean abundance estimates; the largest is the Kalama River with a geomean of 726 spawners.

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Table 8.12.2.1-3. Abundance, productivity, and trends of LCR steelhead populations (Sources: Good et al. 2005 for Washington and McElhany et al. 2007 for Oregon populations).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend ^b		Median Growth Rate ^c	
			Years	Geo. Mean	pHOS ^a	Years	Value	Years	λ
Cascade Summer	Kalama	W	99-03	474	32%	77-03	0.928	77-03	0.712
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	99-03	434	25%	na	na	na	na
	Washougal	W	99-03	264	8%	86-03	0.991	86-03	0.996
Gorge Summer	Wind	W	99-03	472	5%	na	na	na	na
	Hood	O	93-05	195	11.4%	93-05	0.995	93-05	0.811
Cascade Winter	Lower Cowlitz	W	na	na	na	na	na	na	na
	Coweeman	W	98-02	466	50%	87-02	0.916	87-02	0.782
	SF Toutle	W	98-02	504	2%	84-02	0.917	84-02	0.933
	NF Toutle	W	98-02	196	0%	89-02	1.135	89-02	1.062
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Cispus	W	na	na	na	na	na	na	na
	Tilton	W	2002	2,787	73%	na	na	na	na
	Kalama	W	98-02	726	0%	77-02	0.998	77-02	0.916
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	98-02	323	0%	na	na	na	na
	Clackamas	O	90-05	1168	16.2%	90-05	1.03	90-05	0.976
	Sandy	O	90-05	1040	11%	90-05	0.95	90-05	0.923
Gorge Winter	Lower Gorge	W	na	na	na	na	na	na	na
	Upper Gorge	W	na	na	na	na	na	na	na
	Hood River	O	96-00	756	52%	na	na	na	na

Extinction Probability/Risk

The risk of extinction over 100 years (Table 8.12.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and

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diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

The 100-year risk of extinction is high or very high for most populations of LCR steelhead. Exceptions are:

- Wind summer run (moderate)—abundance is low; hatchery fish contribute to a small portion of escapement and genetic analyses indicate that introgression has been limited; habitat access only slightly impaired
- South Fork Toutle winter run (moderate)—abundance is moderate; hatchery fish contribute to a small portion of escapement; much of the upper basin is recovering from the effects of the Mt. St. Helens eruption; much of the historical range is accessible
- Kalama winter run (moderate)—abundance is moderate; hatchery fish contribute to a small portion of escapement; much of the historical range is accessible
- Clackamas winter run (low)—average abundance is near 1,000 fish; hatchery fish contribute to escapement but the broodstock is largely native in origin; upstream and downstream passage through the North Fork Dam may be partially blocked or delayed—lower elevation habitat is degraded, but headwater areas appear to be in good condition
- Hood winter run (moderate)—abundance is moderate; hatchery fish contribute about half of the run; the hatchery stock was reestablished in 1991 using what are presumed to be native fish, although there may have been some introgression, especially from naturally-produced Big Creek fish; blockages are limited to a few headwater reaches that were not significant historical production areas; lower elevation habitat is degraded

Table 8.12.2.1-4. Risk of extinction categories for populations of LCR steelhead (sources: Washington’s Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strat	Populatio	Stat	
Cascade Summer	Kalama	W	H
	NF Lewis	W	VH
	EF Lewis	W	H
	Washougal	W	H
Gorge Summer	Wind	W	M
	Hood	O	VH
Cascade Winter	Lower Cowlitz	W	H

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Strat	Populatio	Stat	
	Coweeman	W	H
	NF Toutle	W	H
	SF Toutle	W	M
	Upper Cowlitz	W	H
	Cispus	W	H
	Tilton	W	VH
	Kalama	W	M
	NF Lewis	W	H
	EF Lewis	W	H
	Salmon	W	H
	Washougal	W	H
	Clackamas	O	L
	Sandy	O	H
Gorge Winter	Lower Gorge	W/O	H/H
	Upper Gorge	W/O	H/M
	Hood	O	M

Spatial Structure

Spatial structure has been substantially reduced by the loss of access to the upper portions of some basins due to tributary hydro development. For example, since the early 20th century the spatial structure of the summer- and winter-run populations in the Hood River has been limited by delay and injury at the inadequate trap-and-haul facility at Powerdale Dam (see Section 8.12.3, Environmental Baseline, for information about the scheduled removal of this FERC-licensed hydropower project). The following FERC-licensed projects affecting rangewide status soon will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run (Marmot Dam) – removal by 2008 (NMFS 2003d) will improve passage (i.e., eliminate delay and injury) for the winter-run steelhead population (designated a Core population by the WLC TRT (2003)) into the upper Sandy River watershed
- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the North Fork Lewis winter-run steelhead population

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- Cowlitz River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2004c), supporting the restoration of the Upper Cowlitz, Tilton, and Cispus winter-run steelhead populations

The FERC licenses for the Lewis and Cowlitz River hydroelectric projects require their respective owners/operators to operate hatchery programs. PacifiCorps and Cowlitz PUD operate a hatchery program to support a naturally-spawning, harvestable population of steelhead throughout its historical range in the North Fork Lewis basin. Tacoma Power is planning to operate a conservation hatchery that will produce steelhead for reintroduction into the upper Cowlitz basin. Combined with the new passage facilities at each project, the hatchery programs are expected to increase the number of natural spawners as well as the spatial structure of their respective populations.

Diversity

Before the early 1990s, the diversity of some populations was likely eroded by large hatchery influences. Periodically, many populations have been vulnerable to genetic drift and other effects on diversity associated with low effective population sizes. At present, the role for most steelhead hatchery programs in the lower Columbia River is to compensate for impacts to fisheries. Operations at these hatcheries are designed to minimize competition with and predation upon natural-origin fish by managing the size of juveniles at release and by locating release points below spawning and rearing areas. Adult hatchery fish should not spawn naturally to avoid impacts to population diversity. Some hatchery programs (e.g., the Skamania hatchery program in Washington) outplant non-local steelhead into various areas and attempt to isolate adult returns and prevent them from spawning with natural fish. There is little information available to determine how effective these programs are at avoiding impacts to population diversity.

The genetic legacy of several populations (Hood River summer – and winter – run and the Cowlitz, Sandy, and Clackamas late winter – run populations) is preserved in ongoing hatchery programs.

8.12.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for LCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette (NMFS 2005b). There are 32 watersheds within the range of this DPS. Two watersheds received a low rating, 11 received a medium rating, and 29 received a high rating of conservation value to the DPS (for more information, see Chapter 4). The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 2,673 miles of habitat eligible for designation, 2,324 miles of stream are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004; ODFW 2006; PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.12.3.8.

8.12.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR steelhead. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.12.2.1-3) will improve.

8.12.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007) estimated that hydropower configuration and operational improvements implemented at Bonneville Dam between 2000 and 2006 have resulted in an increase in survival for juvenile LCR steelhead that pass Bonneville Dam, although it was unable to quantify the improvement. Actions during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners (MGR) at Powerhouse I (PH1) and structures that improved Fish Guidance Efficiency (FGE) at PH2. Spill operations have improved and PH2 is given the first priority for powerhouse operations because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The juvenile bypass system screen was removed from PH1 because testing showed that survival through the turbines was higher than through the bypass system.

8.12.3.2 Recent Tributary Habitat Improvements

Actions since 2000 have ranged from beneficial land management practices through improvement in access due to culvert replacement through improved fish passage into areas above FERC-licensed dams. The latter category refers to the upcoming removal of Powerdale Dam on the Hood River above Bonneville (i.e., within the action area for this consultation) by 2012 (NMFS 2005o). This action is

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expected to support the restoration of the summer-and winter-run steelhead populations. Hood River winter steelhead were designated a Core and Genetic Legacy (and Hood River summer steelhead a Core) population by the WLCTRT (2003). Although there is some uncertainty that these populations will become reestablished, NOAA Fisheries has determined that this is the correct next step toward their restoration.²

8.12.3.3 Recent Estuary Habitat Improvements

The Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimate 0.3% survival benefit for LCR steelhead (stream-type juvenile life history).

8.12.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the estuary was reduced from a total of 13,790,000 smolts to 8,201,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown during the same period. Juvenile steelhead are highly vulnerable to these predators based on PIT-tag data from the upriver stocks (Ryan et al. 2006).

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for larger juvenile salmonids (Friesen and Ward 1999).

Marine Mammal Predation

In recent years, sea lion predation of adult winter steelhead (Gorge Winter Run MPG) in the Bonneville tailrace has increase from 0%, or sufficiently low that it was rarely observed, to a mortality rate of about 21.8% (SCA Marine Mammal Appendix). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on winter-run steelhead in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the relative survival of winter-run steelhead by 18.2%, so that the continuing negative impact will be approximately 7.6%.

8.12.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin steelhead has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 25 programs that release steelhead below Bonneville Dam, NOAA Fisheries identified only one program as improving population viability by increasing spatial distribution (NMFS 2004b). Four were identified as reducing short-term extinction risk, helping to preserve genetic resources important to DPS survival

² The steelhead population in the (Big) White Salmon River is part of the Mid-Columbia River DPS. Thus, removal of Condit Dam will not affect the status of the Lower Columbia River steelhead DPS.

and recovery.³ A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS 2004 b.

8.12.3.6 Recent Harvest Survival Improvements

Fisheries in the mainstem Columbia River are currently managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007 in a manner that ensures a limited incidental take of ESA-listed LCR steelhead. In recent years, non-Indian mainstem fisheries have been managed subject to a 2% harvest rate limit on winter steelhead, including the winter populations of the LCR steelhead DPS. The yearly incidental take of winter-run steelhead populations in non-Indian fisheries has averaged 1.9% and has ranged from 0.2-9.3% since 2001 (Table 8.12.3.6-1). The non-Indian harvest rate in 2002 was an anomaly and corrective actions were taken to avoid harvest rates over 2%. The yearly incidental take of winter-run steelhead populations in non-Indian fisheries, excluding 2002, has averaged 0.7% since 2001. The yearly incidental catch of winter-run steelhead populations in tribal fisheries, which is limited to winter populations above Bonneville Dam, has averaged 2.2% and has ranged from 0.8-5.8% since 2001 (Table 8.12.3.6-2).

Table 8.12.3.6-1. Non-Indian harvest rates for winter-run steelhead expressed as a proportion of the total winter-run steelhead run size (TAC 2008, Table 16).

Year	Non-Indian
2001	0.6%
2002	9.3%
2003	1.0%
2004	0.9%
2005	0.6%
2006	0.2%
2007	0.6%
Average 2001-2007	1.91%

Table 8.12.3.6-2. Treaty Indian harvest rates for winter-run steelhead expressed as a proportion of the unmarked winter-run steelhead counts at Bonneville Dam in the winter season (TAC 2008).

Year	Treaty Indian
2001	3.40%

³ The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

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Year	Treaty Indian
2002	0.30%
2003	5.80%
2004	0.80%
2005	0.80%
2006	1.80%
2007	2.30%
Average 2001-2007	2.17%

In recent years, non-Indian mainstem winter, spring and summer season fisheries have been managed subject to a 2% harvest rate limit on summer steelhead, including summer steelhead populations of the LCR steelhead DPS. Treaty fisheries are managed for a range of expected impacts on the summer-run component of the LCR steelhead DPS. Actual harvest impacts on summer steelhead populations of the LCR steelhead DPS associated with non-Indian fisheries have generally been lower than the 2% limit; recent actual harvest rates have ranged from 0.2 to 0.5% (Table 8.12.3.6-3). Recent harvest rates on summer steelhead populations of the LCR steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.3% (Table 8.12.3.6-3). The harvest rates in Table 8.12.3.6-3 for Treaty and non-Indian fisheries are not additive. Harvest impacts to the summer-run populations of the LCR steelhead DPS associated with Treaty fisheries in Table 8.12.3.6-3 is the same as for A-run summer steelhead. However, impacts to the summer-run populations of the LCR steelhead DPS would be less than for the other A-run DPS' because its upstream boundary is within the Bonneville Pool and much tribal fishing occurs upstream of this boundary. For the purposes of this analysis however, the harvest impacts on summer steelhead populations of the LCR steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.4% (Table 8.12.3.6-3).

Table 8.12.3.6-3. Treaty Indian and non-Indian harvest rates for summer-run populations of the LCR steelhead DPS (Treaty and non-Indian harvest rates are not additive because these are calculated using a different denominator).

Year	Treaty *	Non-Indian**
1998	12.4%	
1999	7.4%	0.5%
2000	5.1%	0.4%
2001	6.0%	0.3%
2002	4.6%	0.4%

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Year	Treaty *	Non-Indian**
2003	5.4%	0.4%
2004	7.0%	0.2%
2005	6.0%	0.3%
2006	6.0%	0.3%
2007	4.1%	0.3%
* TAC 2008		
** TAC 2008		

8.12.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Gorge Summer MPG

Completed consultations include removal of Hemlock Dam, a road maintenance project, and a project to clean culverts and a stream channel (Wind) and treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS consulted on habitat restoration projects: improve 2 miles of riparian by removing noxious weeds and planting native vegetation (Wind) and improve 5 acres riparian through thinning and 49 acres riparian and 1 mile of stream by adding large wood (Hood population).

Gorge Winter MPG

Completed consultations include repairing a creek bank next to a road, parking lot maintenance at Oneonta Gorge, and stormwater drainage maintenance along the Columbia River Highway (Lower Gorge) and treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS consulted on habitat restoration projects: improve 2 miles of riparian by removing noxious weeds and planting native vegetation (Upper Gorge) and improve 5 acres riparian through thinning and 49 acres riparian and 1 mile of stream by adding large wood (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes,

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increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.12.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the DPS. The effects of some on population viability will be positive (removal of Hemlock Dam; removing invasive weeds and planting native vegetation; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on safe passage/access (removing Hemlock Dam), water quality (adding large woody debris; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.12.3.8 Status of Critical Habitat under the Environmental Baseline

Factors described in Section 8.12.2, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. Salmon habitat has been altered through activities such as urban development,

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logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. Tributary habitat conditions vary widely among the various drainages occupied by LCR steelhead. Factors affecting the conservation value of critical habitat vary from lack of adequate pool/riffle channel structure, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

The following are the major factors that have limited the functioning of primary constituent elements and thus the conservation value of tributary habitat used for spawning and both tributary and estuarine habitat used for rearing (i.e., spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers [*culverts; dams; water withdrawals*]
- Reduced riparian function [*urban and rural development; forest practices; agricultural practices; channel manipulations*]
- Loss of wetland and side channel connectivity [*urban and rural development; past forest practices; agricultural practices; channel manipulations*]
- Excessive sediment in spawning gravel [*forest practices; agricultural practices*]
- Elevated water temperatures [*water withdrawals; urban and rural development; forest practices; agricultural practices*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address these limiting factors. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. The dam removal action at the FERC-licensed hydroelectric project in the Hood River (Section 8.12.3.2) is addressing most of the key limiting factors in that watershed. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

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- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Pinniped predation on winter-run adults (Gorge Winter MPG) due to habitat changes in the lower river [*existence and operation of Bonneville Dam*] and increasing numbers of pinnipeds.
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*]

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Bonneville Dam has improved with the addition of the Bonneville PH2 corner collector. Reductions in piscivorous fish predation have increased the survival of juvenile steelhead in the estuary.

NOAA Fisheries has completed Section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult winter-run steelhead in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the survival of winter-run adults so that the continuing impact is reduced to approximately 7.6%.

The safe passage of juvenile LCR steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown during that period. Projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although LCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.12.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the Wind and Hood summer-run and the Upper Gorge and Hood winter-run populations, as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.⁴ They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this DPS.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have

⁴ The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.12.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Releasing a portion of the flow augmentation water from the Upper Snake Project in May (NMFS 2008b) will provide some minor benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.12.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the five populations in the Gorge Summer and Winter Run MPGs. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of juvenile steelhead that pass through Bonneville Dam by 1%. Spillway survival improvements during this time period are expected to increase juvenile passage survival through Bonneville Dam by an additional 2.8%.

As a result of this ten-year program of improvements, an estimated 90.8% of the juvenile steelhead that migrate past Bonneville Dam will survive. A portion of the 9.2% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion on Remand, NOAA Fisheries estimated that 99% of the juvenile steelhead would survive migration through a free-flowing reach of equal length (see Table 5.1 in NMFS 2004a). Therefore, approximately 10% (0.9%/9.2%) of the expected mortality experienced by migrating LCR steelhead from above Bonneville Dam is probably due to natural factors.

The direct survival rate of adult steelhead at Bonneville Dam is already quite high. Based on PIT-tag detections at Bonneville and later at The Dalles Dam, NOAA Fisheries estimates an upstream passage survival rate of 98.5% for adult LCR steelhead (i.e., relevant to the Gorge MPGs).⁵ The Action

⁵ This estimate is adjusted to account for estimated harvest and straying rates of adults within the FCRPS migration corridor, but otherwise captures all other sources of mortality including those resulting from the existence and

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Agencies will evaluate the use of the second powerhouse corner collector as a potential means to provide a safer downstream passage route for kelts from March 1 to April 9 (prior to spill).

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some of the flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.12.3.3).

Effects on Species Status

Prospective passage improvements at Bonneville Dam will support increased abundance and productivity of the Gorge populations, thereby improving the overall spatial structure of the DPS.

Effects on Critical Habitat

Improvements at Bonneville Dam will increase the functioning of the PCE of safe passage in the juvenile and adult migration corridors.

8.12.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the summer and winter steelhead populations in that watershed (Table 6 of Attachment B.2.2-2 in Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow. A second project, removal of Hemlock Dam in Trout Creek (a tributary to the Wind River), will provide access to historical habitat for the Wind River summer-run and Upper Gorge winter-run populations in that watershed.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the LCR steelhead populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

Effects on Species Status

Prospective improvements in tributary habitat in the Hood and Wind rivers will support the increased abundance, productivity, and spatial structure of the summer and winter-run populations in those

operation of the FCRPS and other potential sources, including natural mortality (i.e., that would occur without human influence).

watersheds. Habitat projects in other tributaries, if implemented, will be selected such that they also address limiting factors and thus would also increase the viability of the local population(s).

Effects on Critical Habitat

Prospective habitat improvements in the Hood and Wind rivers will improve the functioning of PCEs for spawning and rearing (spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space). Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale and some, such as the removal of barriers, will improve conditions at the watershed scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008 III). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long term.

8.12.5.3 Effects of Estuary Prospective Actions

The FCRPS Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The estimated survival benefit for juvenile steelhead is 1.4%.

The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin steelhead populations, but will also provide benefits to those from the lower Columbia River. The estimated survival benefit for juvenile steelhead is 4.3%. Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reducing of noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of summer- and winter-run populations of LCR steelhead.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for juvenile steelhead migrants. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). The positive effects on the functioning of PCEs and the conservation value of critical habitat will be long-term.

8.12.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.12.5.5 Effects of Harvest Prospective Actions

Prospective non-Indian fisheries will be managed subject to 2% harvest rate limits on natural-origin steelhead from the Lower Columbia River. However, the expected incidental harvest impacts on the winter-run and summer-run components of the LCR Steelhead DPS associated with proposed non-Indian fisheries (TAC 2008; Table 29a) are expected to be less than ESA-prescribed limits (TAC 2008; Table 29). The incidental catch of winter-run steelhead in non-Indian fisheries has averaged 1.9% since 1999 (Table 8.12.3.6-1). The yearly incidental catch of summer-run steelhead in non-Indian fisheries has averaged 0.3% since 1999 (Table 8.12.3.6-3). Harvest rates associated with non-Indian fisheries are not expected to change over the course of this Agreement (TAC 2008).

There are no specific incidental harvest rate limits for tribal fisheries on the LCR steelhead DPS (TAC 2008; Table 29). The expected incidental harvest impacts on the winter-run and summer-run components of the LCR Steelhead DPS associated with prospective tribal fisheries is the same as the range observed in recent years (TAC 2008; Table 29a). The harvest rate for tribal fisheries on the winter-run populations of the LCR steelhead DPS from 2001 to 2007 averaged 2.2% and ranged from 0.8% to 5.8% (Table 8.12.3.6-2). The harvest for tribal fisheries on the summer-run populations of the LCR steelhead DPS are considered the same as for A-run summer steelhead in general. However, harvest impacts to the summer-run populations of the LCR steelhead DPS are in reality less than for A-run as a whole because the upstream boundary of LCR steelhead DPS is within the Bonneville Pool and much tribal fishing impacting A-run fish occurs upstream of this boundary. However, for the purposes of this analysis, the incidental harvest rates on summer steelhead populations of the LCR

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steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.4% (Table 8.12.3.6-3). Incidental harvest rates for winter-run and summer-run associated with prospective tribal fisheries are not expected to change over the course of this Agreement (TAC 2008).

Effects on Species Status

Prospective harvest effects will be less than or equal to recent harvest effects and thus are expected to support the increased abundance and productivity of winter-run populations of Lower Columbia River steelhead.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR steelhead.

8.12.5.6 Effects of Predation Prospective Actions

Avian predation

The survival of juvenile steelhead will increase 3.4% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45). Continued implementation and improvement of avian deterrence at Bonneville Dam (RPA Action 48) is also likely to increase juvenile steelhead survival.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The prospective continued increase in incentives in the NPMP will result in an additional 1% survival during the period 2008 to 2018 (RPA Action 43).

Effects on Species Status

Prospective improvements in predation will support the increased abundance and productivity of summer- and winter-run populations of LCR steelhead.

Effects on Critical Habitat

Prospective improvements in predation will improve the functioning of the PCE of safe passage in the migration corridor for juvenile steelhead migrants.

8.12.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.12.6 Aggregate Effects of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.12.6.1 Recent Status of the Lower Columbia River Steelhead DPS

Lower Columbia steelhead is a threatened species. Many of the populations in this DPS currently have low abundance and many of the long-term trends in abundance for individual populations are negative, some severely so. The historical role of the FCRPS and Upper Snake projects in limiting viability was the loss of historical habitat for the Upper Gorge Winter Run population under Bonneville pool and passage delay and mortality at Bonneville Dam for two populations of summer and two of winter steelhead. Stream-type juveniles, especially steelhead smolts, are vulnerable to bird predation in the estuary and adult winter-run steelhead are subject to pinniped predation at Bonneville Dam. The long-term domestication of hatchery fish eroded the fitness of these populations in the wild. Until selective fisheries were instituted in the early 1990s, intensive mixed-stock fisheries overexploited wild steelhead populations already weakened by habitat degradation. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid population numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this DPS. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by barriers to some tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary areas used for spawning, incubation, and larval growth and development. In the Lewis, Cowlitz, Sandy, and Hood River watersheds, these problems will be addressed by actions taken at FERC-licensed hydroelectric projects (Sections 8.12.2.1 and 8.12.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands within the range of LCR steelhead (Section 8.12.3.2). Some future Federal actions with completed Section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Examples are the removal of Hemlock Dam in the Wind River subbasin and Powerdale on the Hood River. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.12.6.2 Effects of the FCRPS, Upper Snake & U.S. v. Oregon Prospective Actions on the Lower Columbia River Steelhead DPS

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River, including those populations within the LCR steelhead DPS.⁶ In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume," (2004). The Action Agencies' estuary habitat restoration projects and relocation of most of the Caspian terns to sites outside the Columbia basin will increase the survival of juvenile steelhead. Juvenile steelhead will also experience an estimated 2.8% increase in passage survival at Bonneville Dam. Implementation of habitat improvement projects in the Hood and Wind River watersheds will address the loss of historical spawning habitat for the Upper Gorge Winter Run population that was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, continued and improved avian deterrence at Bonneville Dam, and prospective juvenile and adult passage improvements at Bonneville Dam. Harvest rates will be less than or equal to those in recent years.

The principal effects of the Prospective Actions on critical habitat will be the increase in juvenile passage survival at Bonneville Dam and in the estuary with the relocation of Caspian terns (juvenile and adult migration corridors free of obstructions); an increase in the amount and quality of estuarine habitat for the transitions between fresh- and saltwater, juvenile growth and development before entering the plume, and the final development of adults before they migrate to upstream spawning areas; an improvement in the functioning of PCEs for spawning, incubation, and rearing in the Hood and Sandy rivers; and an increase in the amount of spawning and rearing habitat (space) in the Lewis and Cowlitz watersheds.

8.12.6.3 Cumulative Effects Relevant to the Lower Columbia River Steelhead DPS

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will primarily affect conditions within the tributary spawning and rearing areas, including the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile steelhead.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

⁶ The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

8.12.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Steelhead DPS

Impacts of the FCRPS and Upper Snake projects are most significant for the 4 (out of 23) populations within the DPS that spawn above Bonneville Dam and are limited relative to impacts from tributary hydropower, tributary habitat, hatcheries, and predation by birds, fish, and marine mammals. These populations are affected by upstream and downstream passage and, for the Upper Gorge winter-run population, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington identified tributary habitat actions that are reasonably certain to occur and that will benefit the Wind and Hood summer-run and the upper Gorge and Hood winter-run populations, as well as actions that should be generally beneficial throughout the DPS. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood subbasins are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.12.2.1). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement of habitat conditions on state forest lands within the range of Lower Columbia River steelhead (Section 8.12.3.7).

NOAA Fisheries considered the effects of harvest on the various life-history types and component populations of the LCR steelhead DPS. Prospective non-Indian fisheries will be managed subject to 2% harvest rate limits on winter and summer natural-origin steelhead populations from the LCR steelhead DPS. There are no specific harvest rate limits for tribal fisheries on LCR steelhead DPS. However, the prospective harvest rates associated with tribal fisheries in the Columbia River over the course of the 2008-2017 *U.S. v. Oregon* Management Agreement are expected to be similar to those observed in recent years. The expected harvest rate for tribal fisheries on winter-run populations of the LCR steelhead DPS is the same as the 2.2% harvest rate average observed from 2001 to 2007 (Table 8.12.3.6-2). The expected harvest rate for tribal fisheries on summer-run populations of the LCR steelhead DPS is the same as the 6.4% harvest rate average observed from 2001 to 2007 (Table 8.12.3.6-3).

The Action Agencies' prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this DPS by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The Action Agencies' prospective habitat projects in the Hood and Wind rivers and additional potential funding of tributary projects above Bonneville are expected to support the restoration of specific populations within the DPS. The Prospective Actions will not further deteriorate the pre-action condition.

The full scope of needed improvements in tributary habitat will be outlined in the final recovery plan for the lower Columbia River, but this plan is not complete. Some adverse impacts from hatchery practices will continue, and harvest rates may be as high as 10% unless reduced as a result of ongoing reviews and subsequent section 7 consultations.

Long term (100 year) extinction risk is high or very high for almost all populations in this DPS. Exceptions are the Wind summer- and South Fork Toutle, Kalama, Clackamas, and Hood winter-run populations. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of several populations (Hood River summer- and winter- and the Cowlitz, Sandy, and Clackamas late-winter populations) will continue to be preserved by ongoing hatchery actions as a hedge against the short-term risk of extinction.

8.12.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Lower Columbia River Steelhead DPS

NOAA Fisheries designated critical habitat for LCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette. The environmental baseline within the action area, which encompasses the Middle Columbia/Hood, Lower Columbia/Sandy, and Lower Columbia/Clatskanie subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for LCR steelhead. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat steelhead in the tailrace of Bonneville Dam will do the same for winter-run adults. Habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the

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product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action Agencies' projects on the Lower Columbia River steelhead DPS, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the species. The Proposed Action will not reduce the conservation value of this DPS' designated critical habitat. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Lower Columbia River steelhead DPS nor result in the destruction or adverse modification of designated critical habitat.

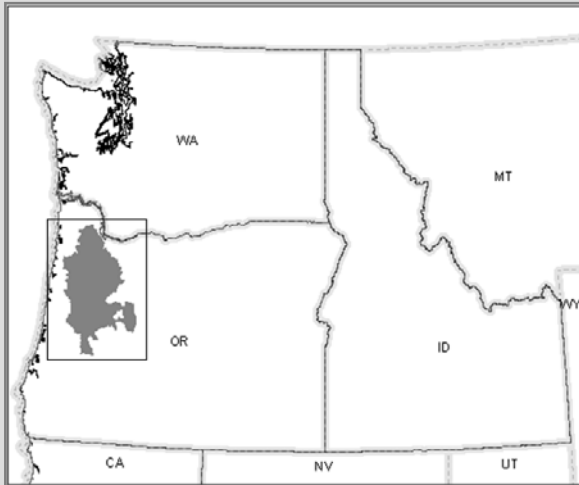
Several of the analyses presented above are projections of DPS health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in DPS health demonstrated above have been accompanied by regional efforts to protect and restore this DPS, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion include further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this DPS.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

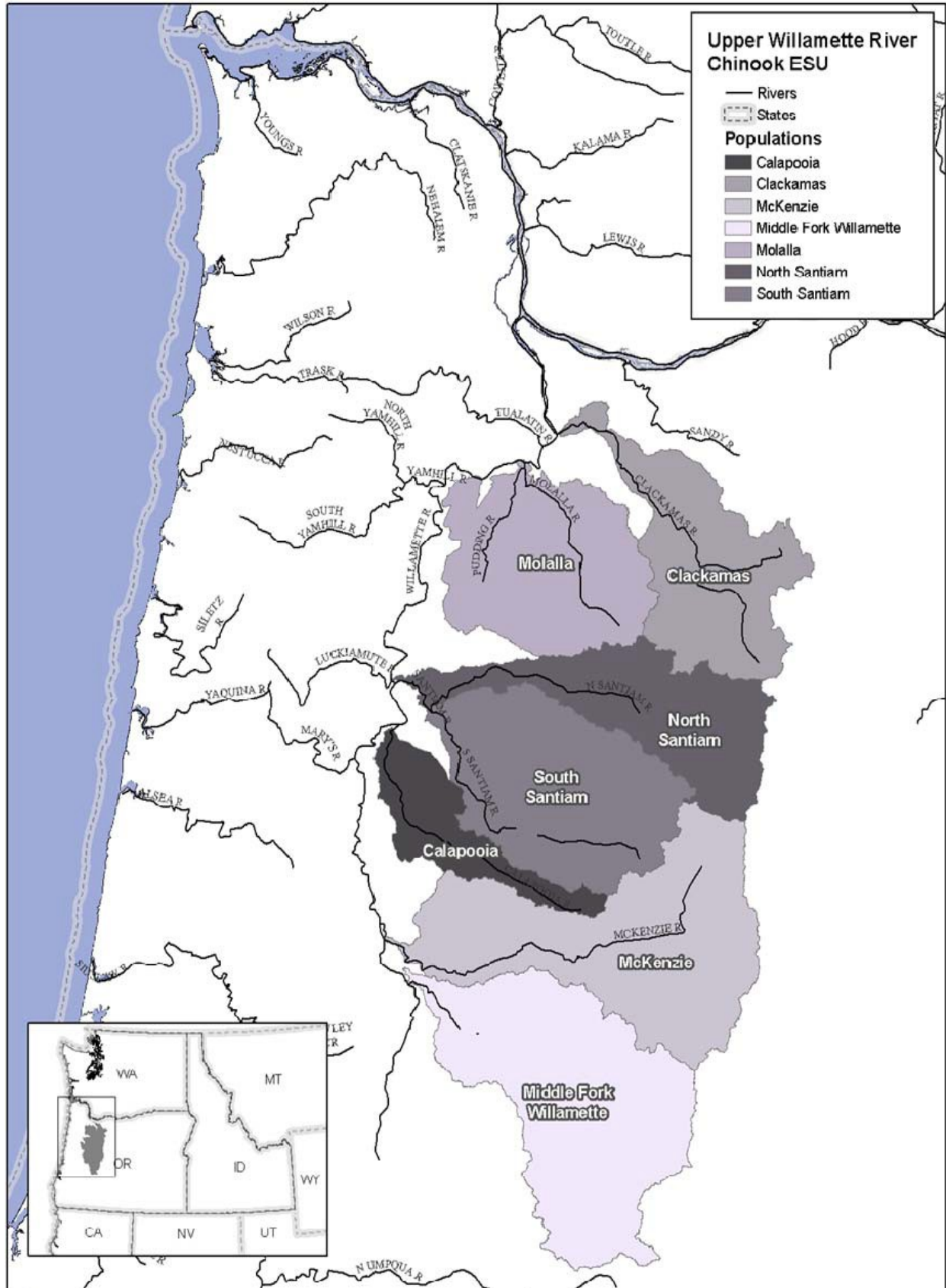
Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this DPS will continue to improve.⁷

⁷ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

Section 8.13 Upper Willamette River Chinook Salmon



- 8.13.1 Species Overview
- 8.13.2 Current Rangewide Status
- 8.13.3 Environmental Baseline
- 8.13.4 Cumulative Effects
- 8.13.5 Effects of the Prospective Actions
- 8.13.6 Aggregate Effects



Section 8.13

Upper Willamette River Chinook Salmon

Species Overview

Background

The Upper Willamette River (UWR) Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon residing in the Clackamas River and in the Upper Willamette River above Willamette Falls, but below impassable natural barriers, as well as seven artificial propagation programs. There is only one major population group in this ESU, comprised of seven historical demographically independent populations. Significant natural production occurs only in the Clackamas and McKenzie rivers. Upper Willamette River Chinook were listed under the ESA as threatened in 1995. This listing was reaffirmed in 2005.

Designated critical habitat for spring-run Upper Willamette River Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in a number of subbasins.

Current Status & Recent Trends

Historically the Upper Willamette supported large numbers (perhaps exceeding 275,000 fish) of spring Chinook. Current abundance of natural-origin fish is estimated to be less than 10,000, with significant natural production occurring only in two populations—the Clackamas and McKenzie. While counts of hatchery- and natural-origin adult spring Chinook salmon over Willamette Falls since 1946 have increased, approximately 90% of the return is now composed of hatchery fish. The majority of the natural-origin populations in this ESU have very low current abundances (less than a few hundred fish). Many of the natural runs largely have been replaced by hatchery production.

Limiting Factors

Human impacts and limiting factors for Upper Willamette River Chinook include habitat loss and degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. FCRPS impacts are limited to habitat conditions in the mainstem below the confluence of the Willamette and in the estuary, which have been affected by hydrosystem flow operations. Habitat degradation has been pervasive in the Willamette mainstem and the lower reaches of its tributaries and both Corps and FERC-licensed hydroelectric projects have blocked some spawning areas. Habitat loss due to blockages has been especially severe in the North Santiam, Calapooia, and Middle Fork Willamette subbasins.

Recent Ocean and Mainstem Harvest

Upper Willamette Chinook migrate far north and are caught incidentally in ocean fisheries, particularly off southeast Alaska and northern Canada, and in spring season fisheries in the mainstem Columbia and Willamette rivers. These fisheries target harvestable hatchery and natural-origin fish. The total adult equivalent exploitation rate on Upper Willamette Chinook in ocean fisheries has averaged 11% in recent years. The harvest rate on natural-origin fish in freshwater fisheries in the lower Columbia and Willamette rivers has ranged from 5.0 to 11.0% in recent years. The total recent exploitation rate for ocean and in-river fisheries combined has averaged approximately 18%.

8.13.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.13.2.1 Current Rangewide Status of the Species

All naturally spawned populations of spring-run Chinook salmon residing in the Clackamas River and in the Willamette River above Willamette Falls, but below impassable natural barriers (e.g., long-standing, natural waterfalls) are considered to be members of the UWR Chinook salmon ESU, as well as seven artificial propagation programs. Seven historical demographically independent populations have been identified (Table 8.13.2.1-1), but significant natural production now occurs only in the Clackamas and McKenzie subbasins. The other naturally spawning populations are small and are mostly composed of hatchery-origin fish.

Upper Willamette River Chinook salmon are different from other Columbia basin Chinook salmon according to both genetic and life history data (Schreck et al. 1986; Utter et al. 1989; Shaklee 1991; Waples et al. 1991; Myers et al. 1998). For example, UWR Chinook salmon exhibit an earlier time of entry into the Columbia River and estuary than other spring Chinook salmon ESUs (Myers et al. 1998). And although juveniles from interior spring Chinook populations reach the mainstem migration corridor as yearlings, some juvenile Chinook salmon in the lower Willamette River are subyearlings (Friesen et al. 2004).

Table 8.13.2.1-1. Upper Willamette River ESU description. (Sources: Myers et al. 2006, NMFS 2005a) The designations “(C)” and “(G)” identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).¹

ESU Description	
Threatened	Listed under ESA in 1995, reaffirmed in 2005
Major Population Group	Population
UWR	Clackamas (C), Molalla, North Fork Santiam (C), South Fork Santiam, Calapooia, McKenzie (C, G), and Middle Fork Willamette (C)
Hatchery programs included in ESU	McKenzie River Hatchery (Oregon Department of Fish and Wildlife (ODFW stock #24), Marion Forks/North Fork Santiam River (ODFW stock #21), South Santiam Hatchery (ODFW stock #23) in the South Fork Santiam River, South Santiam Hatchery in the Calapooia River, South Santiam Hatchery in the Molalla River, Willamette Hatchery (ODFW stock #22), and Clackamas hatchery (ODFW stock #19)

¹ Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU (WLCTRT 2003).

Limiting Factors

Summarized below (Table 8.13.2.1-2) are the key limiting factors for this ESU and recovery strategies to address factors in the mainstem Columbia River (including the estuary) as described in the Washington Lower Columbia River Recovery and Subbasin Plan (LCRFB 2004). Oregon is currently engaged in the recovery planning process for UWR Chinook salmon, which will identify management actions to address factors in the Willamette Basin.

Table 8.13.2.1-2. Key limiting factors for UWR Chinook salmon.

<p>Hydropower</p>	<p>The Corps operates 13 dams in the largest five Willamette tributaries for flood control, irrigation, and hydropower. Major habitat blockages for UWR Chinook salmon resulted circa 1952 from Big Cliff and Detroit dams on the North Fork Santiam River, Cougar Dam on the McKenzie, Hills Creek and Dexter/Lookout Point on the Middle Fork Willamette, and circa 1967 from Green Peter Dam on the South Fork Santiam River (Foster Dam on the South Fork Santiam was built with trap and haul fish passage facilities). Historically, fish spawned in habitat above these dams. In addition to blocking spring Chinook access to historical habitat, these dams affect flows, water quality, sediment transport, and channel structure in the mainstem and in the South and North Santiam, McKenzie, and Middle Fork Willamette rivers where spring Chinook are present. Flow storage and release operations and, to a lesser extent, irrigation withdrawals have also altered temperatures and channel-forming processes. Upper Willamette River Chinook also pass by several smaller hydropower projects: Willamette Falls on the lower mainstem Willamette; City of Albany/Lebanon Dam on the South Santiam; Stayton, Water Street, and Fery projects on the North Santiam; the decommissioned Thompson Mills on the Calapooia; and the Eugene Water and Electric Board's (EWEB) Leaburg-Waltermville Project on the McKenzie. Except for the Stayton project, which is currently shutdown, all of these FERC projects have recently or will soon install improved fish screens, ladders, and in some cases, tailrace barriers, thereby reducing adverse effects on UWR Chinook. EWEB is currently engaged with NOAA Fisheries and others in the FERC relicensing process for the Carmen-Smith Hydroelectric Project, which blocks access to historical habitat. It is highly unlikely that fish from this ESU encounter FCRPS mainstem projects. Impacts on Upper Willamette River populations from those projects are limited to effects on migration and habitat conditions in the lower Columbia River (below the confluence of the Willamette) including the estuary.</p>
<p>Hatcheries</p>	<p>Hatcheries have been used as a management tool in the Willamette River basin for over 100 years. For example, hatchery production has been used to mitigate lost production due to blocked access to historical spawning habitat. Hatchery-origin fish now outnumber natural-origin spawners in nearly all populations.</p>

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	<p>Even though all of the existing hatchery stocks were derived within the ESU, hatchery management intermixed the various stocks among the populations. All six of the Chinook populations above Willamette Falls and to a lesser degree, the Clackamas population, are potentially at risk for genetic introgression, leading to homogenization and a loss of fitness. The impacts occur at the adult spawner stage—specifically, hatchery fish that interbreed with wild fish create a risk of genetic introgression.</p>
<p>Habitat</p>	<p>Habitat in all tributaries, particularly the lower reaches, and in the mainstem Willamette River is moderately to severely degraded, and some tributaries have numerous small passage barriers. Specific habitat concerns vary by subbasin but include reduced habitat complexity, reduced access to off-channel habitat, reduced floodplain function and connectivity, loss of holding pools, elevated water temperatures, insufficient streamflows, toxic water pollutants, and fine sediments in spawning gravel. Causes of these conditions include the impacts of widespread development, as well as the habitat impacts of large hydropower and flood control dams, smaller passage barriers, and bank hardening. Conditions in most upper tributary subbasins, although not pristine, are relatively good for salmon. Recent improvements include the removal of Brownsville Dam (2007) and the improvements described above (Hydropower) at the FERC-licensed projects.</p>
<p>Harvest</p>	<p>Upper Willamette Chinook are far north migrating and caught incidentally in ocean fisheries, particularly off southeast Alaska and northern Canada, and in spring season fisheries in the mainstem Columbia and Willamette rivers. The total adult equivalent incidental exploitation rate on Upper Willamette Chinook in ocean fisheries has averaged 11% in recent years. All freshwater fisheries are managed subject to the terms of a Fishery Management and Evaluation Plan submitted by the Oregon and approved by NOAA Fisheries under ESA Section 4(d). The total allowable rate of incidental take in all freshwater fisheries is 15%. However, the goal has been to keep impacts to natural-origin fish to substantially less than 15%, a goal that has been achieved primarily through implementation of mass marking and mark selective fisheries. The harvest rate on natural-origin fish in freshwater fisheries in the lower Columbia and Willamette rivers have ranged from 5.0% to 11.0% in recent years.</p>
<p>Predation</p>	<p>Piscivorous birds including Caspian terns and cormorants and fishes including northern pikeminnow take significant numbers of juvenile salmon. Stream-type juveniles, especially yearling smolts from spring-run populations, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al. 2005). Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-type</p>

	<p>juveniles in the Columbia River basin (Corps et al. 2007a). Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas and a sport reward fishery to harvest pikeminnow</p>
Estuary	<p>The estuary is an important habitat for migrating salmonids from the UWR Chinook salmon ESU. Alterations in flow and diking have resulted in the loss of shallow water, low velocity habitats: emergent marshes, tidal swamps, and forested wetlands. These habitats are used extensively by subyearling juveniles. The survival of larger (yearling) juveniles in the ocean can be affected by habitat factors in the estuary such as changes in food availability and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the Columbia basin have altered habitat-forming processes including the shape, behavior, size, and composition of the plume compared to historical conditions. Characteristics of the plume are thought to be significant to spring-run yearling migrants during transition to the ocean phase of their lifecycle (Fresh et al. 2005). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006b).</p>
Ocean & Climate	<p>Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this ESU to some extent, future trends, especially during the period relevant to the Prospective Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).</p>

Abundance, Productivity & Trends

Historically the Upper Willamette supported large numbers (perhaps exceeding 275,000 fish) of spring Chinook (Myers et al. 2006). Current abundance of wild fish is estimated to be less than 10,000, with significant natural production occurring only in two populations—the Clackamas and the McKenzie (McElhany et al. 2007). While counts of hatchery- and natural-origin adult spring Chinook salmon over Willamette Falls since 1946 have increased, approximately 90% of the return is now composed of hatchery fish. Most of the natural-origin populations in this ESU have very low current abundances (less than a few hundred fish) and many largely have been replaced by hatchery production. Long- and short-term trends are approximately 1.0 or are negative, depending on the

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metric examined (i.e., long-term trend [regression of log-transformed spawner abundance] or lambda [median population growth rate]) (Table 8.13.2.1-3).

Table 8.13.2.1-3. Abundance, productivity, and trends of UWR Chinook populations (Source: Good et al. 2005 and McElhany et al. 2007).

Population	Recent Natural Spawners			Long-Term Trend		Median Growth Rate	
	Years ¹	No. ²	pHOS ³	Years	Value ⁴	Years	λ^5
Clackamas	90-05	1656	47%	58-05	1.044	58-05	0.967
Molalla	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NF Santiam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SF Santiam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Calapooia	N/A	N/A	N/A	N/A	N/A	N/A	N/A
McKenzie	90-05	2104	33%	70-05	1.017	70-05	0.927
MF Willamette	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in analyses of other ESUs of this Biological Opinion.

¹ Years of data for recent means.

² Geometric mean of total spawners.

³ Average recent proportion of hatchery origin spawners

⁴ Long-term trend of natural spawners (regression of log-transformed spawner abundances against time).

⁵ Long-term median population growth rate after accounting for hatchery spawners (equal spawning success assumption).

N/A = not available

Extinction Probability/Risk

The risk of extinction (Table 8.13.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (McElhany et al. 2007) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.13.2.1-4. Risk of extinction categories for populations of UWR Chinook (Source: McElhany et al. 2007).

Stratum	Population	Extinction Risk Category
Upper Willamette	Clackamas	L
	Molalla	VH
	NF Santiam	VH
	SF Santiam	VH
	Calapooia	VH
	McKenzie	M
	MF Willamette	VH

Spatial Structure

The UWR spring Chinook salmon ESU consists of seven populations. Spatial structure has been substantially reduced by the loss of access to the upper portions of the North Fork Santiam, South Fork Santiam, McKenzie, and Middle Fork Willamette River basins due to tributary hydropower and flood control development, including dams owned and operated by the Corps. The habitat conditions conducive to salmon survival in the Molalla and Calapooia subbasins have been reduced significantly by land use effects (McElhany et al. 2007).

Diversity

The diversity of some populations has been eroded by hatchery and harvest influences and degraded habitat conditions, which all contributed to low effective population sizes (McElhany et al. 2007).

8.13.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for UWR Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in the following subbasins: Middle Fork Willamette, Coast Fork Willamette, Upper Willamette, McKenzie, North Santiam, South Santiam, Middle Willamette, Molalla/ pudding, Clackamas, and Lower Willamette (NMFS 2005b). There are 60 watersheds within the range of this ESU. Nineteen watersheds received a low rating, 18 received a medium rating, and 23 received a high rating of conservation value to the ESU (for more information, see Chapter 4). The lower Willamette/Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 1,796 miles of habitat eligible for designation, 1,472 miles of stream are designated critical habitat.

In the lower Columbia and Willamette basins, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). A wide variety of actions with the potential to improve PCEs and habitat function have been implemented in the upper Willamette River and its tributaries since 2000, involving non-Federal and Federal parties. Actions have included beneficial land management practices, restoration projects such as culvert replacement

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to improve access, and improved passage at FERC-licensed and other small dams.² The latter include:

- **Willamette Falls Hydroproject:** FERC completed consultation with NOAA Fisheries (NMFS 2005p) on the relicensing of this project, which is located in the lower mainstem Willamette River. As a result, the project owner has recently completed two large fish passage projects (juvenile fish bypass and controlled flow structure). Six of the seven populations of UWR Chinook will experience a decrease in juvenile fish injury and mortality, in adult upstream passage delay, and in juvenile stranding as a result of these recent improvements (i.e., juvenile and adult migration corridors free of obstructions).
- **City of Albany Hydroproject:** The Corps completed consultation with NOAA Fisheries (NMFS 2004e) on the construction of a new fish ladder and intake screen and the reconstruction of an existing ladder at Lebanon Dam in the lower South Santiam River. Construction was completed in 2006. This recent action eliminated the only migration barrier and large unscreened intake in the mainstem South Santiam River in the reaches below the Corps' Foster Dam that are currently accessible to UWR Chinook (i.e., juvenile and adult migration corridors free of obstructions).
- **Brownsville Dam:** Originally built as a timber crib dam in the 1800s to power a mill, Brownsville Dam was rebuilt as a concrete structure with an inadequate fish ladder in the 1960s. The mill is long gone, but the 10-foot high dam continued to impound water for three months of the year, creating an area for swimming and sending water via canal to the City of Brownsville for aesthetic benefits and livestock watering. Brownsville Dam was breached on August 27, 2007 under NOAA's Open Rivers Initiative, allowing spring Chinook safe passage to more than 40 miles of historical spawning and rearing habitat. In 2008, the Brownsville Canal Company will install a small screened pump to facilitate its 2.5 cfs water withdrawal during the dry summer months (i.e., juvenile migration corridors free of obstructions).³
- **Thompson Mill:** This five-story factory, with its water-powered gristmills, was one of the oldest continuously operating businesses in Oregon. With the help of former owner, D. Babbitt, Oregon Parks and Recreation Department purchased the mill several years ago. The Oregon Water Trust paid the owner not to run his electrical generator in the summer months, to leave more water in the river channel. The Trust negotiated a deal with the state to buy 12 of the property's 180-cfs water right to permanently enhance water quantity in spring Chinook rearing areas and migration corridors.
- **Cougar Temperature Control:** During spring and summer, the sun warms the surface waters of Cougar Reservoir on the South Fork McKenzie River. The reservoir is emptied in the fall in preparation for the flood-control season, in the past this meant discharging warm surface into the

² The status of critical habitat within the action area is discussed in more detail in Section 8.13.5.2.

³ This project was considered implementation of NMFS' programmatic section 7 consultation on NOAA's Restoration Center Programs (NMFS 2004f).

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river. The unseasonable warmth hastened the maturation of any salmon eggs buried in the gravel so that the fry emerged in November and December, when there was little insect life on which to feed and survival rates were poor. Also, because the intakes for the powerhouse and regulating outlet were deep, the South Fork below the dam was unnaturally cold during summer, blocking salmon migration and reducing productivity. The Corps modified the intake tower by building a 302-foot tall wet well and a mechanism that allows the selective withdrawal of water from various levels of the reservoir (NMFS and USFWS 2000). The water temperature control tower has been in operation since 2005 and has substantially shifted the thermal conditions back toward the natural temperature regime on the South Fork McKenzie below the dam (i.e., improving water temperature in areas used for spawning, incubation, and rearing).

- Fish Trap at Cougar Dam: The trap-and-haul facility will restore access to over 37 miles of high quality historical spawning and rearing habitat in the South Fork McKenzie River (i.e., juvenile migration corridors free of obstructions) (NMFS 2007i).
- Leaburg-Waltermville Hydroelectric Project: Eugene Water and Electric Board has reduced smolt entrainment into the Waltermville Canal and Powerhouse, reduced fry mortality on the Leaburg fish screen, reduced the attraction and delay of adults in the tailrace of each project, maintained minimum flows downstream of the Leaburg Dam and the Waltermville intake, and met ramping rate criteria to prevent stranding and dessication (i.e., juvenile migration corridors free of obstructions) (NMFS and USFWS 2001).

In addition, the USFS has implemented restoration projects in areas of the North and South Santiam, McKenzie, and Middle Fork Willamette watersheds currently occupied by UWR Chinook. Watershed councils and private landowners also have implemented numerous projects in recent years such as removing fish passage barriers and enhancing stream channel conditions on the local scale.

Summary

Federal and state agencies, watershed councils, and private landowners are implementing numerous projects that are improving the PCEs of critical habitat for UWR Chinook. These include access to previously blocked habitat, increased channel complexity, and the creation of thermal refuges. Some projects, including restoration actions, will have short-term adverse effects and others will have neutral or even adverse long-term effects. Where needed,⁴ all of these projects have undergone Section 7 consultation and were found to meet the ESA standards for avoiding jeopardy and any adverse modification of critical habitat.

⁴ Projects by watershed councils or private landowners requiring Corps permits under Section 404 of the Clean Water Act were also subject to section 7(a)(2) consultation.

8.13.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions in the action area for this consultation that have improved the status of UWR Chinook salmon. Those implemented since the environmental baseline was described in the 2004 FCRPS Biological Opinion (NMFS 2004) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.13.2.1-3) will improve.

8.13.3.1 Recent FCRPS Hydro Improvements

It is highly unlikely that fish from this ESU encounter the FCRPS projects. Flow management at FCRPS and Upper Snake projects has affected the amount and quality of shallow, low velocity habitat in the lower Columbia River estuary, which is likely to be used by subyearling migrants from this ESU for rearing. Recent estuary habitat improvements to mitigate for this effect are described in Section 8.13.3.3, below.

8.13.3.2 Recent Tributary Habitat Improvements

Tributaries occupied by this species are outside the action area for the Prospective Actions. Information about the species' status in the tributary portion of its life cycle can be found in Section 8.13.2 (Current Rangewide Status).

8.13.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function to mitigate for the effects of water management on the seasonal hydrograph and thus the amount of rearing habitat available to subyearling Chinook salmon. These have resulted in an estimated 0.3% survival benefit for yearling Chinook, the predominant juvenile life history type for this species, and 0.7% for subyearling Chinook (Corps et al. 2007a).

8.13.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from a total of 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown since that time. Yearling Chinook are generally considered vulnerable to these predators based on PIT-tag data from upriver stocks (Ryan et al. 2006).

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for both yearling and subyearling salmonids (Friesen and Ward 1999; Corps et al. 2007a).

8.13.3.5 Recent Hatchery Management Issues

Hatcheries for and effects on Upper Willamette River Chinook are located in the upper Willamette Basin and thus are outside the action area for the Prospective Actions. Information about the species status in the upriver portion of its range can be found in Section 8.13.2 (Current Rangewide Status).

8.13.3.6 Recent Harvest Survival Improvements

Fishery impacts for spring Chinook salmon in combined ocean and freshwater fisheries have been reduced from greater than 50% before 2000 to less than 25% currently. Impacts of the freshwater fishery have been reduced more than 75% from previous levels since the regulation changed to allow only marked hatchery fish to be harvested. This reduction protects the weaker listed populations. It was largely achieved by implementing mark-selective sport and commercial fisheries. Harvest reductions immediately increase in-river escapement and reduce extinction risk, particularly during years when the run size is low.

The effects of the ocean fishery were considered in NMFS (2001d), which is still in effect. Effects of the freshwater fishery on this species were considered through an ESA evaluation, pursuant to Section 4(d), of a Fishery Management Evaluation Plan from the State of Oregon (Kruzic 2001a). These fisheries have been managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005 to 2007, which ensured that the incidental take of ESA-listed UWR Chinook did not exceed 15% for all Columbia River non-Indian fisheries (actual rates have been approximately 10%). Harvest rates are limited to 10% in freshwater and 11% in ocean fisheries, although the ocean limit may change as a consequence of ongoing negotiations regarding the Pacific Salmon Treaty. Any proposed changes would be subject to Section 7 consultation.

8.13.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between

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December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Projects Affecting Multiple Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.13.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (habitat restoration; tar remediation). Other projects, including dock and boat launch construction, maintenance dredging, road maintenance, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality habitat restoration; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.13.3.8 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. The principal factor affecting the conservation value of critical habitat within the action area is the alteration of seasonal and daily hydrographs.

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Spawning & Rearing Areas

Spawning and rearing areas (except the estuary, see Juvenile and Adult Migration Corridors, below) are not within the action area for the Prospective Actions.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Albany and Willamette Falls dams has improved with the construction of new screens and passage facilities. The safe passage of both yearling and subyearling UWR Chinook salmon through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island, although the cormorant colony grew during that period. For stream-type juveniles, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. For subyearling smolts, restoration projects in the estuary are improving the functioning of cover/shelter, food, and riparian vegetation required by this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth and Development to Adulthood

Although UWR Chinook salmon spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.13.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries has

determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a).⁵ Generally, all of these actions are either completed, ongoing, or reasonably certain to occur. They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve the environmental baseline for this ESU.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.13.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects will have continuing adverse effects that are described in this section. However, the Prospective Actions also include mainstem lower river habitat improvements and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will continue to provide benefits through 2034. Some estuary habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

⁵ The State of Oregon also identified habitat projects that are reasonably certain to occur within the Willamette Basin. Although outside the action area for the Prospective Actions, these will generally be beneficial to the ESU.

8.13.5.1 Effects of the Hydro Operations & Configuration Prospective Actions

Individuals from this ESU are unlikely to pass Bonneville Dam.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Table 8.13.1.2-2). The effects of Prospective Actions to mitigate for the remaining effects on estuarine habitat are discussed in Section 8.13.5.3, below.

Effects on Species Status & Critical Habitat

The prospective configuration and operation of the FCRPS and Upper Snake hydro projects will provide a small benefit to the status of the component populations of UWR Chinook salmon and the PCEs of its designated critical habitat.

8.13.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions do not include tributary habitat projects that will affect this ESU or its designated critical habitat.

8.13.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will implement approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The expected survival benefit for yearling Chinook associated with these specific actions will be 1.4%. The estimated benefit for subyearling Chinook will be less than 2.3%.

The RPA requires the implementation of additional estuary habitat projects to obtain specified survival benefits for Interior Columbia Basin Chinook populations, but will also provide benefits to those from the Willamette River. The estimated benefit for yearling Chinook is less than 4.3%; the benefit for subyearling Chinook is 6.7%. Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, reducing noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of UWR Chinook salmon.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for yearling Chinook migrants and in rearing

areas for subyearling Chinook from the Upper Willamette River ESU. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.13.5.4 Effects of Hatchery Prospective Actions

Hatchery actions in the Willamette are not addressed by the Prospective Actions. They are considered separately in the ongoing consultation on the Willamette Project.

There is considerable interest in the issue of density-dependent effects of releasing large numbers of hatchery-origin fish into areas used by natural-origin juveniles, but the nature and magnitude of these effects is largely unknown (Artificial Propagation for Pacific Salmon Appendix of the SCA).

8.13.5.5 Effects of Harvest Prospective Actions

As described in Section 8.13.3.6, the effects of all freshwater fisheries, including those being considered as part of the Prospective Actions, were reviewed and approved previously through an ESA evaluation pursuant to section 4(d). The 4(d) determination does not expire and so presumably will remain in effect through the duration of the *U.S. v. Oregon* Agreement. Fisheries proposed under the *U.S. v. Oregon* Agreement are entirely consistent with those considered through the 4(d) determination. For a description of the management strategy, see Oregon's Fishery Management and Evaluation Plan (ODFW 2001a).

8.13.5.6 Effects of Predation Prospective Actions

Avian predation

The survival of yearling UWR Chinook salmon will increase 2.1% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45).

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous Fish Predation

The prospective continued increase in incentives in the NPMP (RPA Action 43) will result in an additional 1% survival during the period 2008 to 2018.

Effects on Species Status

Prospective Actions that reduce avian and fish predation on juveniles will support the increased abundance and productivity of UWR Chinook populations.

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island will further reduce predation on yearling Chinook, improving the status of safe passage in the juvenile migration corridor. These fish migrate over the deep water channel adjacent to the East Sand Island colony, which has made them especially vulnerable to predation. The benefit of this action will be long term.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery should also improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.13.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.13.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Upper Willamette River Chinook Salmon

This section summarizes the basis for conclusions at the ESU level.

8.13.6.1 Recent Status of the Upper Willamette River Chinook Salmon ESU

Upper Willamette River Chinook is a threatened species. Of the seven historical populations in this ESU, two are extirpated or nearly so. The remaining five (Molalla, North Santiam, South Santiam, Calapooia, and Middle Fork Willamette) have very low abundances and most spawners are of hatchery origin. Female prespawning mortality is between 50 and 100%, depending on the population. The construction of the Corps dams on major tributaries in the 1950s through 1970s cut off access to highly productive spawning habitat in the upper North Santiam, Quartzville Creek (South Santiam watershed), South Fork McKenzie, and Middle Fork Willamette subbasins. These dams affect flows, water quality, sediment transport, and other attributes in downstream spawning and rearing habitat. Flood storage and release operations and to a lesser extent, irrigation withdrawals, have also altered temperatures and/or and bank hardening has cut the lower stream reaches off from side channels and the floodplain. Upper Willamette River Chinook also have experienced injury and passage delays at small hydroprojects, but many of these are now shut down or have recently installed improved fish screens, ladders, and in some cases tailrace barriers. It is highly unlikely that any fish from this ESU encounter FCRPS mainstem projects, but water management operations in the upper Columbia basin affect habitat and flow in the lower Columbia River, estuary, and plume. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to

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have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by barriers to many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development. Passage delay and injury at FERC-licensed hydroelectric projects in the lower reaches of the North and South Santiam and the McKenzie River have been addressed in recent years (migration corridors free of obstructions). The functioning of mainstem habitat in the Columbia River as a juvenile migration corridor has also improved in recent years with the reduction in predation by Caspian terns and northern pikeminnows.

8.13.6.2 Effects of the FCRPS, Upper Snake & U.S. v. Oregon Prospective Actions on the Upper Willamette River Chinook ESU

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River. In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The FCRPS Action Agencies' estuary habitat restoration projects are therefore expected to increase the survival of juvenile Upper Willamette River Chinook. Shifting the delivery of some of the flow augmentation water from summer to spring will address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.13.3.8). Relocating most of the Caspian terns to sites outside the Columbia basin, managing cormorant predation, and the continued increase in the northern pikeminnow reward fishery will further improve the viability of the ESU and the conservation value of the lower river as critical habitat.

8.13.6.3 Cumulative Effects Relevant to the Upper Willamette River Chinook Salmon ESU

Habitat-related actions and programs that the states of Oregon and Washington submitted and that NOAA Fisheries determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. The actions will improve the functioning of PCEs of critical habitat needed for the successful growth and development and emigration of juvenile Chinook.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for the Prospective Actions (the mainstem lower Columbia River below the confluence of the Willamette), these are likely to include urban development and other land use practices.

8.13.6.4 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Upper Willamette River Chinook Salmon ESU

Impacts of the FCRPS and Upper Snake projects on this ESU are limited relative to those from tributary hydropower, tributary habitat, harvest, hatcheries, and predation by birds and fish. None of the populations in this ESU are affected by upstream or downstream passage at FCRPS projects; only migration and habitat conditions in the mainstem lower Columbia and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington have identified habitat actions that will improve conditions along the mainstem lower Columbia River (including the estuary). The State of Oregon also identified tributary habitat actions that are reasonably certain to occur and that generally should be beneficial throughout the ESU. Some future Federal actions with completed Section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

The FCRPS Action Agencies' prospective estuary habitat and predator management improvements will contribute to the viability of this ESU by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The Prospective Actions will not further deteriorate the pre-action condition.

The effects of harvest in ocean and inriver fisheries were considered previously for ESA compliance and are thus part of the environmental baseline. Ocean fishery impacts are expected to average approximately 11%, although ocean harvest rates may be reduced in the future as a result of ongoing negotiations regarding the Pacific Salmon Treaty. A new agreement under the Pacific Salmon Treaty would be subject to subsequent section 7 consultation. Under Oregon's Fishery Management and Evaluation Plan all freshwater fisheries in the Columbia and Willamette rivers are subject to a harvest rate limit on natural origin Upper Willamette Chinook of 15%. Since implementing the management plan in 2001 harvest rates in freshwater fisheries have averaged approximately 10% with about half the harvest occurring in Columbia River fisheries that are subject to the *U.S. v. Oregon* Agreement.

Long term (100 year) extinction risk is high or very high for five of the seven populations in this ESU. Exceptions are the Clackamas and McKenzie populations. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above.

8.13.6.5 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Upper Willamette River Chinook Salmon ESU

NOAA Fisheries designated critical habitat for UWR Chinook salmon including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in the following subbasins: Middle Fork Willamette, Coast Fork

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Willamette, Upper Willamette, McKenzie, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Clackamas, and Lower Willamette. The environmental baseline within the action area, which includes the lower Columbia River and the estuary, has improved over the last decade but does not yet support the conservation value of designated critical habitat for UWR Chinook. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will improve the functioning of many of the PCEs in the action area; for example, reducing predation by Caspian terns and cormorants and northern pikeminnows will further improve safe passage for juveniles. Habitat work in the estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs in the action area used for juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action Agencies' projects on the Upper Willamette River Chinook ESU, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the species. The Proposed Action will not reduce the conservation value of this ESU's designated critical habitat. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Upper Willamette River Chinook ESU nor result in the destruction or adverse modification of designated critical habitat.

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Several of the analyses presented above are projections of ESU health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

- The noted changes in ESU health demonstrated above have been accompanied by regional efforts to protect and restore this ESU, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion include further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this ESU.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

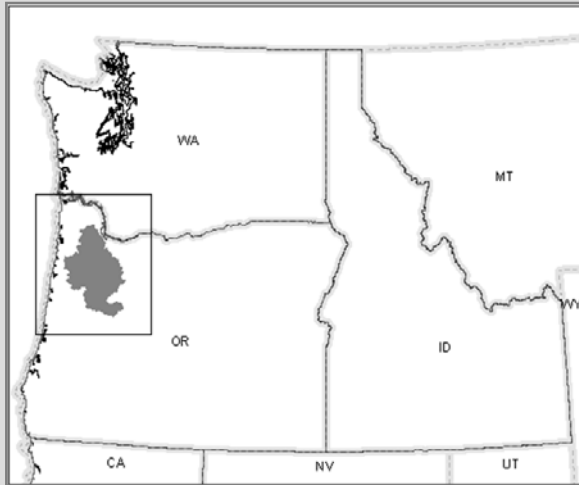
Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this ESU will continue to improve.⁶

⁶ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

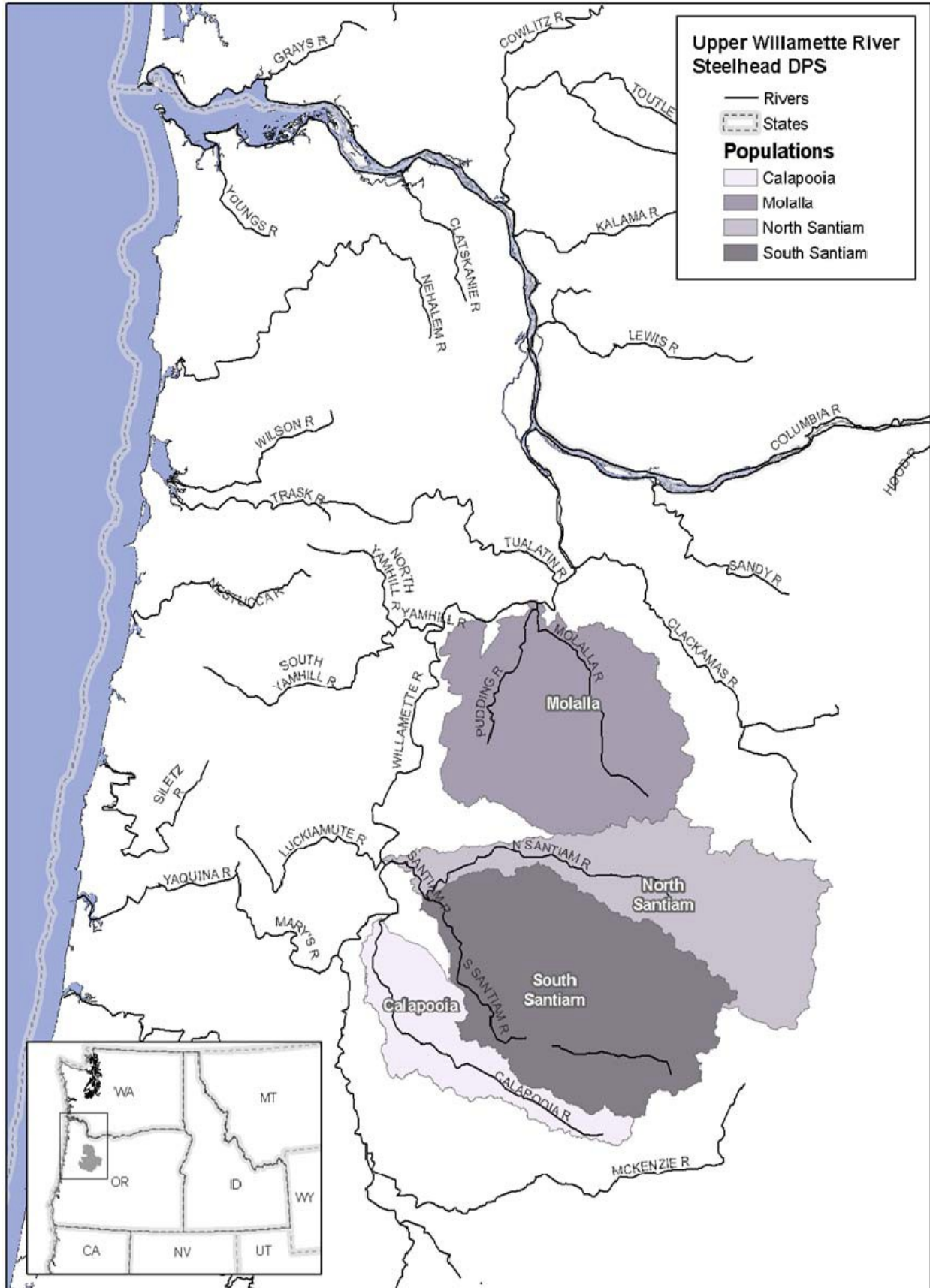
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Section 8.14 Upper Willamette River Steelhead



- 8.14.1 Species Overview
- 8.14.2 Current Rangewide Status
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- 8.14.5 Effects of the Prospective Actions
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Section 8.14

Upper Willamette River Steelhead

Species Overview

Background

The Upper Willamette River (UWR) steelhead DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). There is only one major population group in this DPS, comprised of four historical populations. All four remain extant and produce moderate numbers of natural-origin steelhead each year. The hatchery summer-run steelhead that occur in the Willamette Basin are an out-of-basin stock that is not part of the DPS. Upper Willamette River steelhead were listed as threatened under the ESA in 1999. This listing was reaffirmed in 2006.

Designated critical habitat for Upper Willamette River steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in a number of subbasins.

Current Status & Recent Trends

The abundance and productivity of Upper Willamette River steelhead populations are depressed from historical levels, but to a much lesser extent than for Upper Willamette River Chinook salmon. All of the historical populations remain extant and moderate numbers of steelhead are produced each year. DPS long-term abundance and productivity trends are stable to slightly decreasing and short-term trends are stable to slightly increasing. The long-term risk of extinction is considered moderate for all four populations.

Limiting Factors

Human impacts and limiting factors for Upper Willamette River steelhead include habitat loss and degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. FCRPS impacts are limited to habitat conditions in the mainstem below the confluence of the Willamette and in the estuary, which have been affected by hydrosystem flow operations. Mainstem Willamette and tributary habitat degradation have been pervasive, particularly in the lower reaches of tributaries to the Willamette, and both Corps and privately owned dams have blocked some important spawning areas. Habitat loss due to blockages has been especially severe in the North Santiam and Calapooia subbasins.

Recent Ocean and Mainstem Harvest

Ocean fishing mortality on Upper Willamette River steelhead is assumed to be zero. In recent years, non-Treaty mainstem winter and spring season fisheries have been managed subject to a 2% harvest rate limit on winter steelhead. The yearly incidental catch of winter-run steelhead populations in non-Treaty fisheries has averaged 1.9% and has ranged from 0.2 to 9.3% since 2001. The high harvest rate observed in 2002 (i.e. 9.3%) was due to a lack of proper in-season management guidelines. These guidelines were subsequently corrected in 2003 and have been in place since that time. Upper Willamette River steelhead are not caught in non-Treaty summer or fall season fisheries, or in treaty Indian fisheries above Bonneville Dam.

8.14.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.14.2.1 Current Rangewide Status of the Species

The Upper Willamette River (UWR) steelhead DPS includes four naturally-spawning anadromous populations in the Willamette River and its tributaries, from Willamette Falls upstream to the Calapooia River (inclusive) (Table 8.14.2.1-1). The West Side Tributaries represent an area of intermittent use, which could be important for the recovery of the species, but is not considered to have been a demographically independent population historically (Myers et al. 2006). This DPS does not include any artificially propagated winter steelhead stocks. The hatchery summer-run steelhead that occur in the Willamette Basin are an out-of-basin stock and are not included in the DPS (NMFS 2006a).

Winter steelhead enter the Willamette River beginning in January and February, but they do not ascend to their spawning areas until late March or April (Dimick and Merryfield 1945). Spawning takes place from April to June 1st and redd counts are conducted in May. The smolt migration past Willamette Falls also begins in early April and extends through early June (Howell et al. 1985), with migration peaking in early- to mid-May. Steelhead smolts generally migrate away from the shoreline and enter the Columbia via Multnomah Channel rather than the mouth of the Willamette. Most spend two years in the ocean before re-entering fresh water to spawn (Busby et al. 1996). Steelhead in the Upper Willamette River DPS generally spawn once or twice; a few fish may spawn three times based on patterns found in the LCR steelhead DPS. Repeat spawners are predominantly female and generally account for less than 10% of the total run size (Busby et al. 1996).

Table 8.14.2.1-1. Upper Willamette River steelhead DPS description. (Sources: Myers et al. 2006, NMFS 2006a) The designations “(C)” and “(G)” identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).¹

DPS Description	
Threatened	Listed under ESA in 1999, reaffirmed in 2006
Major Population Group	Population
UWR	Molalla, North Santiam (C,G), South Santiam (C,G) , Calapooia
Hatchery programs included in DPS	None

¹ Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the DPS (WLCTRT 2003).

Limiting Factors

Summarized below (Table 8.14.2.1-2 are key limiting factors for this DPS and recovery strategies to address factors in the mainstem Columbia River (including the estuary) as described in the Washington Lower Columbia River Recovery and Subbasin Plan (LCFRB 2004). Oregon is currently engaged in the recovery planning process for UWR steelhead, which will identify management actions to address these factors in the Willamette basin.

Table 8.14.2.1-2 Key limiting factors for Upper Willamette River steelhead.

<p>Hydropower</p>	<p>The Corps operates 13 dams in the largest five Willamette tributaries for flood control, irrigation, and hydropower. Major habitat blockages for UWR steelhead resulted circa 1952 from the construction of Big Cliff and Detroit dams on the North Santiam River, and circa 1967 from Green Peter Dam on the South Santiam River (Foster Dam on the South Santiam was built with trap and haul fish passage facilities). These dams were identified by NOAA Fisheries as the upper limit of winter steelhead distribution in its recent status review, although historically these fish spawned in habitat above the dams (NMFS 2006a). In addition to blocking winter steelhead access to historical upstream habitat in the South and North Santiam rivers these dams also affect flows, water quality, sediment transport, and downstream habitat in the North and South Santiam rivers and in the mainstem Willamette. Flow storage and release operations and, to a lesser extent, irrigation withdrawals have also altered temperatures and channel-forming processes. Adult and juvenile UWR steelhead also pass several smaller, FERC-licensed hydropower projects: Willamette Falls on the lower mainstem Willamette; the City of Albany/Lebanon Dam on the South Santiam; Stayton, Water Street, and Fery projects on the North Santiam; and the decommissioned Thompson Mills on the Calapooia. Except for the Stayton project, which is currently shut down, improved fish screens, ladders, and, in some cases, tailrace barriers have recently been installed at all of these FERC projects, thereby reducing adverse effects on UWR steelhead. It is highly unlikely that fish from this DPS encounter FCRPS projects. Impacts from those projects on Upper Willamette River populations are limited to effects on migration and habitat conditions in the lower Columbia River (below the confluence of the Willamette) including the estuary.</p>
<p>Hatcheries</p>	<p>There are no winter steelhead hatchery programs in the upper Willamette basin. However, the non-native summer steelhead hatchery program is a threat to listed winter steelhead. There is some separation in run and spawn timing between hatchery-origin summer and wild winter steelhead, but the potential exists for genetic introgression. Also, juvenile non-native hatchery-origin summer steelhead may compete with wild winter steelhead for rearing resources (space, food, etc.) and adults may compete for spawning sites.</p>

<p>Habitat</p>	<p>Habitat in all tributaries, particularly the lower reaches, and in the mainstem Willamette River is moderately to severely degraded, and some tributaries have numerous small passage barriers. Specific habitat concerns vary by subbasin but include impaired access on small streams, fine sediments in spawning gravel, reduced habitat complexity, reduced access to off-channel habitat, reduced floodplain function and connectivity, elevated water temperatures, toxic water pollutants, and insufficient stream flows. Causes of these conditions include the impacts of widespread development, as well as the habitat impacts of large hydropower and flood control dams, smaller passage barriers, and bank hardening. Recent improvements include removal of Brownsville Dam (in 2007), decommissioning of Thompson Mills Dam (2005) on the Calapooia River, resulting in increased stream flow and improved upstream and downstream fish passage, and other improvements described above (Hydropower). Conditions in the upper tributary basins, although not pristine, are relatively good. Riparian conditions in the lower portions of small tributaries can be severely degraded and contain numerous passage barriers.</p>
<p>Harvest</p>	<p>Ocean fishing mortality on UWR steelhead is assumed to be zero. Fisheries in the mainstem Columbia River that affect UWR steelhead are currently managed subject to the terms of the <i>US v. Oregon</i> Interim Management Agreement for 2005-2007. These fisheries are limited to assure that the incidental take of ESA-listed UWR steelhead does not exceed specified rates. In recent years, non-Indian mainstem winter and spring season fisheries have been managed subject to a 2% incidental harvest rate limit on winter steelhead. Upper Willamette River steelhead are not caught in non-Indian summer or fall season fisheries, or treaty Indian fisheries above Bonneville Dam. The incidental harvest mortality rate expected under current conditions is 2% or less.</p>
<p>Predation</p>	<p>Piscivorous birds including Caspian terns and cormorants and fishes including northern pikeminnow take significant numbers of juvenile or adult steelhead. Stream-type juveniles, especially larger smolts such as steelhead, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al 2005). In addition, steelhead are subject to pinniped predation when they return to the estuary as adults although the magnitude of pinniped predation for Upper Willamette fish is unknown. Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-type juveniles in the Columbia River basin (Corps et al. 2007a). Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas and a sport reward fishery to harvest pikeminnow.</p>

Estuary	The estuary is an important habitat for migrating salmonids from the UWR steelhead DPS. The survival of larger juveniles, such as steelhead, in the ocean can be affected by habitat factors in the estuary such as changes in food availability and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the Columbia basin have altered habitat-forming processes including the shape, behavior, size, and composition of the plume compared to historical conditions. Characteristics of the plume are thought to be significant to juvenile migrants during transition to the ocean phase of their lifecycle (Fresh et al 2005). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006b).
Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments (e.g., LCFRB 2004). Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this DPS to some extent, future trends, especially during the time period relevant to the Prospective Actions, are unclear.

Abundance, Productivity, & Trends

Steelhead in this DPS are depressed from historical levels, but to a much lesser extent than are spring Chinook in the Willamette basin (McElhany et al. 2007). All of the historical populations remain extant and moderate numbers of wild steelhead are produced each year. Long-term trends are less than one (Table 8.14.2.1-3), but short-term trends are 1.0 or higher (McElhany et al. 2007).

Table 8.14.2.1-3. Abundance, productivity, and trends of UWR Steelhead populations (source: McElhany et al. 2007). The designations “-C” and “-G” identify Core and Genetic legacy populations, respectively (Appendix B in WLCTRT 2003).

Population	Recent Natural Spawners			Long-Term Trend		Median Growth Rate	
	Years ¹	No. ²	pHOS ³	Years	Value ⁴	Years	λ^5
Molalla	90-05	914	0% ⁶	80-05	0.966	80-05	0.988
North Santiam	90-05	2109	0% ⁶	80-05	0.98	80-05	0.983
South Santiam	90-05	2149	0% ⁶	68-05	0.981	68-05	0.976
Calapooia	90-05	339	0% ⁶	80-05	0.987	80-05	1.023

Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in Biological Opinion analyses of other DPSs.

¹ Years of data for recent means.

² Geometric mean of total spawners.

³ Average recent proportion of hatchery origin spawners

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⁴ Long-term trend of natural spawners (regression of log-transformed spawner abundances against time).
⁵ Long-term median population growth rate after accounting for hatchery spawners (equal spawning success assumption).
⁶ Current hatchery fractions reflect termination of hatchery winter steelhead releases into natural production areas in the 1990s.
 N/A = not available

Extinction Probability/Risk

The risk of extinction (Table 8.14.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.14.2.1-4. Risk of extinction categories for populations of UWR Steelhead (source: McElhany et al. 2007).

Stratum	Population	Extinction Risk Category
Upper Willamette	Molalla	M
	North Santiam	M
	South Santiam	M
	Calapooia	M

The risk of extinction is moderate for all four populations.

Spatial Structure

Spatial structure for the North and South Santiam populations has been substantially reduced by the loss of access to the upper North Santiam basin and the Quartzville Creek watershed in the South Santiam subbasin due to construction of the dams owned and operated by the Corps without passage facilities (McElhany et al. 2007). Spatial structure in the Molalla subbasin has been reduced significantly by habitat degradation and in the Calapooia by habitat degradation and passage barriers (WLCTRT 2004).

Diversity

The diversity of some populations has been eroded by small population size, the loss of access to historical habitat, legacy effects of past winter-run hatchery releases, and the ongoing release of summer steelhead (McElhany et al. 2007).

8.14.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for UWR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in the following subbasins: Upper Willamette, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Yamhill, Tualatin, and Lower Willamette (NMFS 2005b). There are 38 watersheds within the range of this DPS. Seventeen watersheds received a low rating, 6 received a medium rating, and 15 received a high rating of conservation value to the DPS (for more information, see Chapter 4). The lower Willamette/Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 1,830 miles of habitat eligible for designation, 1,276 miles of stream are designated critical habitat.

In the lower Columbia and Willamette basins, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). A wide variety of actions with the potential to improve PCEs and habitat function have been implemented in the upper Willamette River and its tributaries since 2000, involving non-Federal and Federal parties.² Actions have included beneficial land management practices, restoration projects such as culvert replacement to improve access, and improved passage at FERC-licensed and other small dams.

Although outside the action area for this consultation, a variety of actions with the potential to improve the spatial structure of the DPS have been implemented in the upper Willamette River and its tributaries since 2000, involving non-Federal and Federal parties. Actions have included beneficial land management practices, restoration projects such as culvert replacement to improve access, and improved passage at FERC-licensed and other small dams.

- Willamette Falls Hydroproject: FERC completed consultation (NMFS 2005p) on the relicensing of this project, which is located in the lower mainstem Willamette River. As a result, the project owner has recently completed two large fish passage projects (juvenile fish bypass and controlled flow structure). All four populations of UWR steelhead will experience a decrease in juvenile fish injury and mortality, in adult upstream passage delay, and in juvenile stranding as a result of these recent improvements (i.e., improving safe passage in adult and juvenile steelhead migration corridors).
- City of Albany Hydroproject: The Corps completed consultation with NOAA Fisheries (NMFS 2004e) in December, 2004 on the construction of a new fish ladder and intake screen and the

² The status of critical habitat within the action area is discussed in more detail in Section 8.14.3.8.

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reconstruction of an existing ladder at Lebanon Dam in the lower South Santiam River. Construction was completed in 2006. This recent action eliminated the only migration barrier and large unscreened intake in the mainstem South Santiam below the Corps' Foster Dam (i.e., improving safe passage in adult and juvenile steelhead migration corridors).

- **Brownsville Dam:** Originally built as a timber crib dam in the 1800s to power a mill, Brownsville Dam was rebuilt as a concrete structure with an inadequate fish ladder in the 1960s. The mill is long gone, but the 10-foot high dam continued to impound water for three months of the year, creating an area for swimming and sending water via canal to the City of Brownsville for aesthetic benefits and livestock watering. Brownsville Dam was breached on August 27, 2007 under NOAA Fisheries' Open Rivers Initiative, allowing winter steelhead safe passage to more than 40 miles of historical spawning and rearing habitat. In 2008, the Brownsville Canal company will install a small screened pump to facilitate its 2.5 cfs water withdrawal during the dry summer months (i.e., juvenile migration corridors free of obstructions).³
- **Thompson Mill:** This five-story factory, with its water-powered gristmills, was one of the oldest continuously operating businesses in Oregon. With the help of former owner, D. Babbitt, Oregon Parks and Recreation Department purchased the mill several years ago. The Oregon Water Trust paid the owner not to run his electrical generator in the summer months, to leave more water in the river channel. The Trust negotiated a deal with the state to buy 12 of the property's 180-cfs water right to permanently enhance water quantity in winter steelhead rearing areas and migration corridors.

In addition, the USFS has implemented restoration projects in areas of the North and South Santiam watersheds currently occupied by UWR steelhead. Watershed councils and private landowners have also implemented numerous projects in recent years that affect UWR steelhead such as removing fish passage barriers and enhancing channel conditions on the local scale.

8.14.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions in the action area for this consultation that have improved the status of UWR steelhead. Those implemented since the

³ This project was considered implementation of NMFS' programmatic section 7 consultation on NOAA's Restoration Center Programs (NMFS 200f).

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environmental baseline was described in the 2004 FCRPS Biological Opinion (NMFS 2004) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.14.2.1-3) will improve.

8.14.3.1 Recent FCRPS Hydro Improvements

It is highly unlikely that fish from this DPS encounter the FCRPS projects. Flow management at FCRPS and Upper Snake projects has affected the amount and quality of river margin habitat below Bonneville Dam used by juvenile steelhead migrants. Recent habitat improvements to mitigate for this effect are described in Section 8.14.3.3, below.

8.14.3.2 Recent Tributary Habitat Improvements

Tributaries occupied by this species are outside the action area for the Prospective Actions. Information about the species status in the tributary portion of its range can be found in Section 8.14.2 (Current Rangewide Status).

8.14.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimated 0.3% survival benefit for juvenile UWR steelhead (Corps et al. 2007a).

8.14.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from a total of 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown since that time. Juvenile steelhead are considered vulnerable to these predators based on PIT-tag information from upriver stocks (Ryan et al. 2006).

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for larger juvenile salmonids (Friesen and Ward 1999; Corps et al. 2007a).

8.14.3.5 Recent Hatchery Management Issues

Effects of hatcheries on Upper Willamette River steelhead take place in the upper Willamette Basin and thus are outside the action area for the Prospective Actions. Information about the species' status in the upriver portion of its range can be found in Section 8.14.2 (Current Rangewide Status).

8.14.3.6 Recent Harvest Survival Improvements

Ocean fishing mortality on UWR steelhead is assumed to be zero. This species is also not caught in non-Indian summer or fall season fisheries or in treaty Indian fisheries above Bonneville Dam. The effects of freshwater fisheries on this species have been considered through an ESA evaluation, pursuant to Section 4(d), of a Fishery Management Evaluation Plan from the State of Oregon (Kruzic 2001b). The non-Indian mainstem winter and spring season fishery was limited in recent years to ensure that the incidental take of ESA-listed UWR steelhead did not exceed 2%. Harvest rates remain approximately 2%. Any proposed changes would be subject to Section 7 consultation.

8.14.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Projects Affecting Multiple Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.14.4).

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Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the DPS. The effects of some on population viability will be positive (habitat restoration; tar remediation). Other projects, including dock and boat launch construction, maintenance dredging, road maintenance, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these

projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality habitat restoration; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.14.3.8 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by UWR steelhead. Factors affecting the conservation value of critical habitat vary from inadequate access to spawning and rearing areas, altered seasonal and daily hydrographs, high summer water temperatures, lack of adequate pool/riffle channel structure, and poor overwintering conditions due to loss of connection to the floodplain.

Spawning & Rearing Areas

The following are the major factors that have limited the functioning of primary constituent elements and thus the conservation value of tributary habitat used for spawning and both tributary and estuarine habitat used for rearing (i.e., spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers [*culverts; dams; water withdrawals*]
- Reduced riparian function [*urban and rural development; forest practices; agricultural practices; channel manipulations*]
- Loss of wetland and side channel connectivity [*urban and rural development; past forest practices; agricultural practices; channel manipulations*]
- Elevated water temperatures [*water withdrawals; urban and rural development; forest practices; agricultural practices*]

The Corps operates four dams in two Willamette tributaries within this species' current range (North and South Santiam rivers) for flood control, irrigation, hydropower, and recreation, as well as to benefit fish and wildlife. Impacts of these dams include blocked passage, poor downstream water quality, entrapment and stranding due to flood control and power peaking operations, and degraded functioning of downstream habitat. The Corps, BPA (which markets power produced at these dams),

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and Reclamation (which markets water storage space in the project reservoirs) are currently consulting with NOAA Fisheries on the effects of these dams on UWR steelhead and its designated critical habitat. In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address these limiting factors. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions, addressing key limiting factors. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat [*agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Albany and Willamette Falls dams has improved with the construction of new screens and passage facilities. The safe passage of juvenile UWR steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. For stream-type juveniles, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although UWR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.14.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia and Willamette basins (see lists of projects in Chapter 17 in Corps et al. 2007a).⁴ Generally, all of these actions are either completed, ongoing, or reasonably certain to occur. They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve the environmental baseline for this DPS.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

⁴ The State of Oregon also identified habitat projects that are reasonably certain to occur within the Willamette Basin. Although outside the action area for the Prospective Actions, these will generally be beneficial to the DPS.

8.14.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects will have continuing adverse effects that are described in this section. However, the Prospective Actions also include mainstem lower river habitat improvements and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will continue to provide benefits through 2034. Some estuary habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

8.14.5.1 Effects of Hydro Operations & Prospective Actions on Species Status

Individuals from this DPS are unlikely to pass Bonneville Dam.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.14.2.1-2). The effects of Prospective Actions to mitigate for the remaining effects on estuarine habitat are discussed in Section 8.14.5.3, below.

8.14.5.2 Effects of Tributary Habitat Prospective Actions

The RPA does not include tributary habitat actions that will affect this DPS or its designated critical habitat.

8.14.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will implement approximately 44 estuary habitat projects over the first 3-year period of the RPA (2007-2009) (Section 12.3.2.3 in Corps et al. 2007b). The expected survival benefit for juvenile steelhead associated with these actions will be 1.4%.

The Action Agencies will implement projects that achieve an additional survival benefit for juvenile steelhead of less than 4.3% during the period 2010 to 2018. Prospective Actions, including protection and restoration of riparian areas, the protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds will address limiting factors.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of UWR steelhead.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for juvenile steelhead migrants. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). The positive effects on the functioning of PCEs and the conservation value of critical habitat will be long-term.

8.14.5.4 Effects of Hatchery Prospective Actions

Hatchery programs in the Willamette are not addressed by the hatchery Prospective Actions. They are considered separately in the ongoing consultation on the Willamette Project.

There is considerable interest in the issue of density-dependent effects of releasing large numbers of hatchery-origin fish into areas used by natural-origin juveniles, but the nature and magnitude of these effects is largely unknown (Artificial Propagation for Pacific Salmon Appendix of the SCA).

8.14.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

As described in Section 8.14.3.6, the effects of all freshwater fisheries, including those being considered as part of the Prospective Actions, were reviewed and approved previously through an ESA evaluation pursuant to section 4(d). The 4(d) determination does not expire and so presumably will remain in effect through the duration of the *U.S. v. Oregon* Agreement. Fisheries proposed under the *U.S. v. Oregon* Agreement are entirely consistent with those considered through the 4(d) determination. For a description of the management strategy, see Oregon's Fishery Management and Evaluation Plan (ODFW 2001a).

8.14.5.6 Effects of Predation Prospective Actions

Avian predation

The survival of juvenile UWR steelhead will increase 3.4% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45).

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The proposed continued increase in incentives in the NPMP (RPA Action 43) will result in an additional 1% survival during the period 2007 to 2018.

Effects on Species Status

Prospective actions that reduce avian and fish predation on juveniles will support the increased abundance and productivity of UWR steelhead populations.

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and managing cormorant predation on East Sand Island will further reduce predation on juvenile steelhead, improving the status of safe passage in the juvenile migration corridor. These fish migrate over the deep water channel adjacent to the East Sand Island colony, which has made them especially vulnerable to predation. The benefit of this action will be long term.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery will also improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.14.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.14.6 Aggregate Effect of the Environmental Baseline, Prospective Actions, and Cumulative Effects on Upper Willamette River Steelhead

This section summarizes the basis for conclusions at the DPS level.

8.14.6.1 Recent Status of the Upper Willamette River Steelhead DPS

Upper Willamette River steelhead is a threatened species. Of the four historical populations in this DPS, three (Molalla, North Santiam, and South Santiam) have relatively high abundances and all spawners are of natural origin. The construction of the Corps dams on major tributaries in the 1950s through 1970s cut off access to highly productive spawning habitat in the upper North Santiam and Quartzville Creek (South Santiam) subbasins. These dams affect flows, water quality, sediment transport, and other attributes in downstream spawning and rearing habitat. Flood storage and release operations and to a lesser extent, irrigation withdrawals, have also altered temperatures and/or and bank hardening has cut the lower stream reaches off from side channels and the floodplain. Upper Willamette River steelhead also have experienced injury and passage delays at small hydroprojects, but many of these are now shut down or have recently installed improved fish screens, ladders, and in some cases tailrace barriers. It is highly unlikely that any fish from this DPS encounter FCRPS mainstem projects, but water management operations in the upper Columbia basin affect habitat and flow in the lower Columbia River, estuary, and plume. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of

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the stocks in this DPS. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by barriers to many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development. Passage delay and injury at FERC-licensed hydroelectric projects in the lower reaches of the North and South Santiam rivers have been addressed in recent years (migration corridors free of obstructions). The functioning of mainstem habitat in the Columbia River as a juvenile migration corridor has also improved in recent years with the reduction in predation by Caspian terns and northern pikeminnows.

8.14.6.2 Effects of the FCRPS, Upper Snake & U.S. v. Oregon Prospective Actions on the Upper Willamette River Steelhead DPS

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River. In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The FCRPS Action Agencies' estuary habitat restoration projects are therefore expected to increase the survival of juvenile Upper Willamette River steelhead. Shifting the delivery of some of the flow augmentation water from summer to spring will address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.14.3.8). Relocating most of the Caspian terns to sites outside the Columbia basin, managing cormorant predation, and the continued increase in the northern pikeminnow reward fishery will further improve the viability of the DPS and the conservation value of the lower river as critical habitat.

8.14.6.3 Cumulative Effects Relevant to the Upper Willamette River Steelhead DPS

Habitat-related actions and programs that the states of Oregon and Washington submitted and that NOAA Fisheries has determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. The actions will improve the functioning of PCEs of critical habitat needed for successful emigration of juvenile steelhead.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for the Prospective Actions (the mainstem lower Columbia River below the confluence of the Willamette), these are likely to include urban development and other land use practices.

8.14.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Upper Willamette River Steelhead DPS

Impacts of the FCRPS and Reclamation projects on this DPS are limited relative to impacts from tributary hydropower, tributary habitat, harvest, hatcheries, and predation by birds and fish. None of the populations in this DPS are affected by upstream and downstream passage at FCRPS projects; only migration and habitat conditions in the mainstem lower Columbia and estuary have been affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington have identified habitat actions that will improve habitat conditions along the mainstem lower Columbia River (including the estuary). The State of Oregon also identified tributary habitat actions that are reasonably certain to occur and that generally should be beneficial throughout the DPS. Some future Federal actions with completed Section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat. Harvest rates will remain approximately 2%. Any proposed changes would be subject to Section 7 consultation.

The FCRPS Action Agencies' prospective estuary habitat and predator management improvements will contribute to the viability of this DPS by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The Prospective Actions will not further deteriorate the pre-action condition.

Ocean fishing mortality on UWR steelhead is assumed to be zero. This species is also not caught in non-Indian summer or fall season fisheries or in treaty Indian fisheries above Bonneville Dam. Under Oregon's Fishery Management and Evaluation Plan, the non-Indian winter and spring fisheries in the Columbia and Willamette rivers are subject to a harvest rate limit on natural origin Upper Willamette steelhead of 2%. Any proposed changes would be subject to Section 7 consultation.

Long term (100 year) extinction risk is moderate for all four populations in this DPS. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above.

8.14.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Upper Willamette River Steelhead DPS

NOAA Fisheries designated critical habitat for UWR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in the following subbasins: Upper Willamette, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Clackamas, and Lower Willamette. The environmental baseline within the action area, which includes the lower Columbia River and the estuary, has improved over the last decade but does not yet support the conservation value of designated critical habitat for UWR steelhead. The major factors currently limiting the conservation value of critical

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habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will improve the functioning of many of the PCEs; for example, reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles. Habitat work in the estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for migration and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Proposed Action, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the Proposed Action will address the influence of the Action Agencies' projects on the Upper Willamette River steelhead DPS, thereby contributing to its survival with an adequate potential for recovery, and will not cause deterioration in the pre-action condition for the species. The Proposed Action will not reduce the conservation value of this DPS' designated critical habitat. NOAA Fisheries therefore concludes that the Proposed Action is not likely to jeopardize the continued existence of the Upper Willamette River steelhead DPS nor result in the destruction or adverse modification of designated critical habitat.

Several of the analyses presented above are projections of DPS health characteristics for periods shorter than the duration of this Opinion (~ 27 years, through December 31, 2034). NOAA Fisheries considers those projections and the conclusions based on them to be valid throughout the duration of this Opinion for the following reasons.

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- The noted changes in DPS health demonstrated above have been accompanied by regional efforts to protect and restore this DPS, including substantial configuration and operations changes designed to improve dam and reservoir passage survival.
- These analyses have been informed by previous research, monitoring, and evaluation efforts and the SCA considered in this Opinion include further such efforts.
- Considerable effort is currently underway to develop and implement recovery plans for this DPS.
- Both the measures undertaken to date and the Proposed Action considered in reaching our conclusions involve substantial commitments of resources.

Given this high level of investment in the protection and recovery effort; and the broad regional commitment to achieve recovery, there is every reason to believe that those efforts and commitments will continue throughout the duration of this Opinion and the status of this DPS will continue to improve.⁵

⁵ This does not imply that recovery can be achieved without additional improvements in various life stages. Unless the potential production of available habitat is sufficient to meet recovery goals and sufficient actions are implemented to achieve that potential, recovery will require the implementation of additional measures.

Chapter 9

Southern Resident Killer Whales

- 9.1 Current Rangewide Status**
- 9.2 Environmental Baseline**
- 9.3 Effects of the Prospective Actions on Southern Resident Killer Whales**
- 9.4 Cumulative Effects**

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Chapter 9

Southern Resident Killer Whales

9.1 Current Rangewide Status

The Southern Resident killer whale DPS consists of three pods, identified as J, K, and L pods. In this section, the status of the Southern Resident killer whales throughout their range is summarized. Although the entire Southern Resident DPS has potential to occur in the coastal waters at any time during the year, occurrence is more likely during November to May when Southern Residents are only occasionally found in the inland waters of Washington State. The information on the rangewide status of the species is generally representative of the status of the species in coastal waters. The final recovery plan for Southern Residents was issued in January 2008 (NMFS 2008j). This section summarizes information taken largely from the recovery plan, as well as new data that became available more recently. For more detailed information about this population, please refer to the Final Recovery Plan for Southern Resident Killer Whales, which can be found on the internet at www.nwr.noaa.gov.

9.1.1 Status and Trends

Although there is little information available regarding the historical abundance of Southern Resident killer whales, two methods have been used to estimate a historical population size of 140 to 200. The minimum estimate (~140) is the number of whales killed or removed for public display in the 1960s and 1970s added to the remaining population at the time of the captures. The maximum estimate (~200) is based on a recent genetic analysis of microsatellite DNA (NMFS 2003e).

At present, the Southern Resident population has declined to essentially the same size that was estimated during the early 1960s, when it was considered as likely depleted (Olesiuk et al. 1990) (Figure 9.1-1). Since censuses began in 1974, J and K pods have steadily increased their sizes. However, the population suffered approximately a 20% decline from 1996-2001, largely driven by declines in L pod. There have been recent increases in the population from 2002-2006 indicating that L pod's decline may have ended, however such a conclusion is premature. The 2007 census counted 87 Southern Resident killer whales, 25 in J pod, 19 in K pod and 43 in L pod.

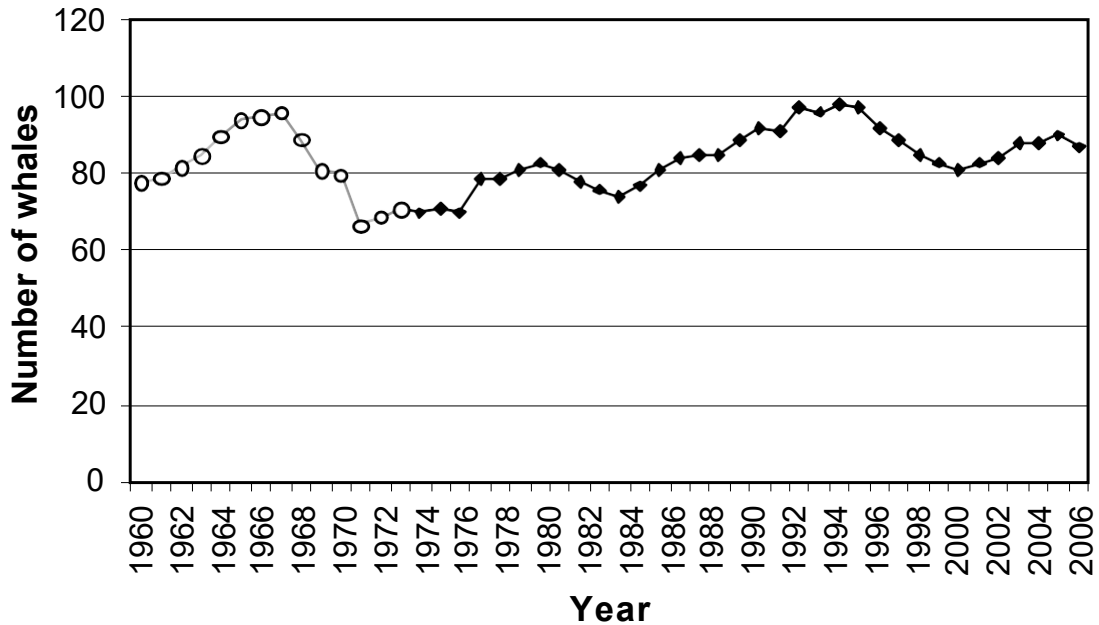


Figure 9.1-1. Population size and trend of Southern Resident killer whales, 1960-2007. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990). Data from 1974-2007 (diamonds, black line) were obtained through photo-identification surveys of the three pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpubl. data) and NMFS (2008j). Data for these years represent the number of whales present at the end of each calendar year except for 2007, when data extend only through October.

9.1.2 Listing status

The Southern Resident killer whale Distinct Population Segment (DPS) was listed as endangered under the ESA on November 18, 2005 (NMFS 2005d). The final rule included information on the population decline in the 1990s and identified several potential factors that may have caused the decline or may be limiting recovery. These are: quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. Southern Residents are designated as “depleted” and “strategic” under the Marine Mammal Protection Act (MMPA) (NMFS 2003e). Critical habitat for the Southern Resident killer whale DPS was proposed on June 15, 2006 (NMFS 2006l) and the final designation of critical habitat was published November 29, 2006 (NMFS 2006c). Critical habitat includes approximately 2,560 square miles of inland waters in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Southern Resident critical habitat does not occur in the coastal waters, and is therefore not considered further in this consultation.

9.1.3 Range and Distribution

Southern Residents are found throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia (Figure 9.1-2).

Figure 9.1-2. Geographic Range (light shading) of the Southern Resident Killer Whale Population. Reprinted from Wiles (2004).



Southern Residents are highly mobile and can travel up to 86 miles (160 km) in a single day (Erickson 1978, Baird 2000). To date, there is no evidence that Southern Residents travel further than 50 km offshore (Ford et al. 2005). Although the entire Southern Resident DPS has potential to occur in coastal waters at any time during the year, occurrence is more likely during November to May.

Southern Residents spend the majority of their time from late spring to early autumn in inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound) (Bigg 1982, Ford et al. 2000, Krahn et al. 2002) (Figure 9.1-3). Typically, J, K and L pods arrive in May or June and spend most of their time in the core area of Georgia Basin and Puget Sound until departing in October. K and L pods also make frequent trips to the outer coasts of Washington and southern Vancouver Island during this time, which generally last a few days (Ford et al. 2000).

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Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976				J,K								
1977												
1978			J,K									
1979											J,K	
1980												
1981				J,K								
1982						J,K				J,K		
1983										J,K	J,K	
1984						J,K						
1985						J,K						
1986					J,K							
1987										J,K	J,K	J,K
1988					J,K							
1989			J,K							J,K	J,K	J,K
1990												
1991					J,K					J,K		
1992												
1993					J,K							
1994										J,L		
1995												
1996										J,K	J,K	
1997										J,L	J,L	J,K
1998											J,K	
1999												
2000												
2001												
2002			J,K,L?									
2003												J,K
2004					J,L	J,L						J,K
2005		J?			J,L							
2006	J?											
2007	none					J,L						
	Only J Pod present	Two pods present, as indicated			J, K, and L pods present			Data not available				

Figure 9.1-3. Monthly occurrence of the three Southern Resident killer whale pods (J, K, and L) in the inland waters of Washington and British Columbia, 1976-2005. This geographic area is defined as the region east of Race Rocks at the southern end of Vancouver Island and Port Angeles on the Olympic Peninsula. Pods were recorded as present during a month if they were sighted on at least one day (Hanson 2008).

Late summer and early fall movements of Southern Residents in the Georgia Basin have remained fairly consistent since the early 1970s, with strong site fidelity shown to the region as a whole. However, presence in inland waters in the fall has increased in recent years (NMFS 2008j). It is uncertain whether potential variability in sighting effort over time has contributed to this trend. During early autumn, Southern Residents, and J pod in particular, expand their routine movements into Puget Sound, likely to take advantage of chum and Chinook salmon runs (Osborne 1999). During late fall, winter, and early spring, the ranges and movements of the Southern Residents are less well known.

Sightings through the Strait of Juan de Fuca in late fall suggest that activity shifts to the outer coasts of Vancouver Island and Washington (Krahn et al. 2002).

The Southern Residents were formerly thought to range southward along the coast to about Grays Harbor (Bigg et al. 1990) or the mouth of the Columbia River (Ford et al. 2000). However, recent sightings of members of K and L pods in Oregon (in 1999 and 2000) and California (in 2000, 2003, 2005, 2006 and 2008) have considerably extended the southern limit of their known range (NMFS 2008j). There have been 40 verified sightings or strandings of J, K or L pods along the outer coast from 1975 to present with most made from January to May. These include 16 records off Vancouver Island and the Queen Charlottes, 11 off Washington, four off Oregon, and nine off central California. Most records have occurred since 1996, but this is more likely because of increased viewing effort along the coast for this time of year. Sightings in Monterey Bay, California coincided with large runs of salmon, with feeding witnessed in 2000 (Black et al. 2001). L pod was also seen feeding on unidentified salmon off Westport, Washington, in March 2004 during the spring Chinook run in the Columbia River (M. B. Hanson, personal observation, as cited in Krahn et al. 2004).

9.1.4 Life history

Southern Resident killer whales are a long lived species, with late onset of sexual maturity (review in NMFS 2008j). Females produce a low number of surviving calves over the course of their reproductive life span (5.4 surviving calves over 25 years) (Olesiuk et al. 1990, Bain 1990). Mothers and offspring maintain highly stable social bonds throughout their lives, which is the basis for the matrilineal social structure in the Southern Resident population (Bigg et al. 1990, Baird 2000, Ford et al. 2000). Groups of related matrilineal form pods. Three pods – J, K, and L, make up the Southern Resident community. Clans are composed of pods with similar vocal dialects and all three pods of the Southern Residents are part of J clan.

Southern Resident killer whales are known to consume 22 species of fish and one species of squid (Scheffer and Slipp 1948, Ford et al. 1998, 2000, Ford and Ellis 2006, Saulitis et al. 2000). A long-term study of resident killer whale diet identified salmon as their preferred prey (97 percent of prey consumed during spring, summer and fall) (Ford and Ellis 2006). Feeding records for Southern Residents suggest that diet resembles that of the Northern Residents, with a strong preference for Chinook salmon (78 percent of identified prey) during late spring to fall (Hanson et al. 2005, Ford and Ellis 2006). Chum salmon (11 percent) are also taken in significant amounts, especially in autumn. Other species eaten include coho (5 percent), steelhead (*O. mykiss*, 2 percent), sockeye (*O. nerka*, 1 percent), and non salmonids (e.g., Pacific herring and quillback rockfish [*Sebastes maliger*] 3 percent combined). Chinook were preferred despite the much lower abundance of Chinook in the study area in comparison to other salmonids (such as sockeye), presumably because of the species' large size, high fat and energy content, and

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year-round occurrence in the area. Killer whales also captured older (i.e., larger) than average Chinook (Ford and Ellis 2006).

Researchers are expanding the sample size for Southern Residents and collecting additional fecal samples for analysis to address the potential biases of scale sampling. In inland waters from May to September, Southern Residents' diet consists of approximately 88% Chinook (Hanson et al. 2007a). These studies also confirmed a shift to chum salmon in fall. Little is known about the winter and early spring diet of Southern Residents. Early results from genetic analysis of fecal and prey samples indicate that Southern Residents consume Fraser River-origin Chinook, as well as salmon from Puget Sound, Washington and Oregon coasts, the Columbia River, and Central Valley California (Hanson et al. 2007b). As further data are analyzed, they will provide information on which specific runs of salmon the whales are consuming in certain locations and seasons.

There are no fecal or prey samples or direct observations of predation events (where the prey was identified to the species) when the whales are in coastal waters. Although less is known about diet preferences of Southern Residents off the Pacific coast, it is likely that salmon are also important during late fall and winter when Southern Residents more predictably occur in coastal waters. Chemical analyses support the importance of salmon in the year round diet of Southern Residents (Krahn et al. 2002, 2007). Krahn et al. (2002), examined the ratios of DDT (and its metabolites) to various PCB compounds in the whales, and concluded that the whales feed primarily on salmon throughout the year rather than other fish species. Krahn et al. (2007) analyzed stable isotopes from tissue samples collected in 1996 and 2004/2006. Carbon and nitrogen stable isotopes indicated that J and L pods consumed prey from similar trophic levels in 2004/2006 and showed no evidence of a large shift in the trophic level of prey consumed by L pod between 1996 and 2004/2006.

Researchers have estimated the energy requirements of killer whales and caloric values for salmon to calculate the number of fish needed per day. Salmon differ significantly in size across species and runs, and prey preference among salmon would affect annual consumption rates. Fewer salmon per day would be required from a larger preferred prey species such as Chinook salmon. NOAA Fisheries provides an estimate of the biological requirements of Southern Residents using the best available information on metabolic needs of the Southern Resident population and the caloric content of salmon (NMFS 2008k).

9.2 Environmental Baseline

Because the entire listed entity is found in the coastal waters during some portion of the year, the status of the species in this area is the same as the range-wide status of the species, described above. The following discussion summarizes the conditions in coastal waters that are known to affect the likelihood that Southern Resident killer whales will survive and recover in the wild. The small size of the population increases the level of concern about any risks to Southern Resident killer whales (NMFS 2008j).

Natural Mortality

Seasonal mortality rates among Southern and Northern Resident whales are believed to be highest during the winter and early spring, based on the numbers of animals missing from pods returning to inland waters each spring. Olesiuk et al. (2005) identified high neonate mortality that occurred outside of the summer field research seasons. At least 12 newborn calves (9 in southern community and 3 in northern community) were seen outside the summer field season and disappeared by the next field season. Additionally, stranding rates are higher in winter and spring for all killer whale eco-types in Washington and Oregon (Norman et al. 2004). Southern Resident strandings in coastal waters include three separate events (1995 and 1996 off of Northern Vancouver Island and the Queen Charlotte Islands, and 2002 offshore of Long Beach, Washington State), and the causes of death are unknown (NMFS 2008j).

In recent years, sighting reports indicate anecdotal evidence of thin killer whales returning to inland waters in the spring. For example, in March 2006 a thin female from the Southern Resident population (L54) with a nursing calf was sighted off Westport, WA. The sighting report indicated she had lost so much blubber that her ribs were showing under the skin (Cascadia Research 2008).

Prey Availability

Salmon, particularly Chinook salmon, are the preferred prey of Southern Resident killer whales in inland waters of Washington State during spring, summer and early fall. Chemical analyses support the importance of salmon in the year round diet of Southern Residents. Based on the best available information, Southern Residents may equally prefer Chinook salmon in inland and coastal waters. This analysis therefore focuses on effects of the Prospective Actions on Chinook abundance in coastal waters. Focusing on Chinook provides a conservative estimate of potential effects of the Prospective Action on Southern Residents within coastal waters. The total abundance of all salmon and other potential prey species is difficult to quantify, but is orders of magnitude larger than the total abundance of Chinook in coastal waters.

When prey abundance is low, killer whales may spend more time and energy foraging than when prey abundance is high, with the potential for fitness consequences including reduced reproductive rates and higher mortality rates. Ford and Ellis (2006) correlated

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coastwide reduction in Chinook abundance (Alaska, British Columbia, and Washington) with decreased survival of resident whales (Northern and Southern Residents), but changes in killer whale abundance have not been linked to changes in salmon stock groups.

The availability of prey to Southern Resident killer whales is affected by a number of natural and human actions. Details regarding baseline conditions of those Chinook salmon in the Columbia River basin that are listed under the Endangered Species Act are described in Chapters 8.2 (Snake River fall Chinook), 8.3 (Snake River spring/summer Chinook), 8.6 (Upper Columbia River spring Chinook), 8.10 (Lower Columbia River Chinook), and 8.13 (Upper Willamette River Chinook) sections of the SCA. The baseline also includes Chinook ESUs that are not ESA-listed, notably the typically abundant Hanford Reach fall Chinook ESU and the Mid-Columbia spring Chinook ESU. Adult salmon are also affected by fisheries harvest in fresh and marine waters. In addition, climate effects from Pacific decadal oscillation and El Niño/Southern oscillation conditions and events cause changes in ocean productivity which can affect natural mortality of salmon, as described in more detail in Chapter 5 (5.7 Large-scale Environmental Variation). Predation in the ocean also contributes to natural mortality of salmon. Salmonids are prey for pelagic fishes, birds, and marine mammals.

Based on the best available information regarding diet composition for Southern Residents killer whales (which suggests that Chinook salmon are their preferred prey), their metabolic needs, and the caloric content of salmon, NOAA Fisheries estimates that the Southern Resident population (based on 2007 population size and structure) could need approximately 221,000 Chinook on an annual basis in coastal waters of their range (NMFS 2008k). Based on estimates derived from fisheries catch and escapement data over the past decade, there may be approximately 3.5 million adult Chinook salmon available in the coastal range of Southern Residents (NMFS 2008k). This estimate includes estimated annual reductions in prey availability from fisheries harvest in coastal waters. However, this estimate is likely to vary on an annual basis due to a combination of factors including ocean conditions and harvest management decisions (implementing the regulations for ocean salmon fisheries include ESA section 7 consultation).

Another factor that could affect the number of salmon required is the size of individual Chinook. NOAA Fisheries is not able to assess the potential differences in biomass of individual Chinook available to Southern Residents, and thus relies on abundance estimates as a proxy measure (as in past consultation, i.e., NMFS 2006m). Southern Resident killer whales consume both natural and hatchery salmon (DFO unpubl. data). There is no information available suggesting that Southern Residents would be affected differently by consuming natural or hatchery salmon (i.e., no known differences in size, energy content, contaminant level, or behavior or location in the ocean).

Prey Quality

Contaminants enter fresh and marine waters and sediments from numerous sources, but are typically concentrated near populated areas of high human activity and industrialization. As discussed in the Status of the Species section above, recent studies have documented high concentrations of PCBs, DDTs, and PBDEs in killer whales (Ross et al. 2000, Ylitalo et al. 2001, Reijnders and Aguilar 2002, Krahn et al. 2004). Harmful contaminants are stored in blubber; however, organochlorines can be released from the blubber and become redistributed to other tissues increasing risk of immune or reproductive effects during weight loss from reductions in prey (Krahn et al. 2002).

As top predators, when killer whales consume contaminated prey they accumulate the contaminants in their blubber. When prey is scarce, killer whales metabolize their blubber and the contaminants are mobilized. In addition, nursing females transmit large quantities of contaminants to their offspring. Chinook salmon contain higher levels of some contaminants (i.e., PCBs) than other salmon species (O'Neill et al. 2005). Only limited information is available for contaminant levels of Chinook along the west coast (i.e., higher PCB and PBDE levels may distinguish Puget Sound-origin stocks, whereas higher DDT-signature may distinguish California origin stocks; Krahn et al. 2007). Adult Chinook that originate from the Columbia River may accumulate contaminants through development and growth in the freshwater and marine environment, and become a source of contaminant loading if consumed by Southern Residents.

Vessel Activities and Sound

Commercial shipping, ferry operations, military vessels and recreational vessels occur in the coastal range of Southern Residents; however, the density of traffic is lower in the coastal compared to inland waters of Washington State and British Columbia. Several studies in the inland waters of Washington State and British Columbia have linked interactions of vessels and Northern and Southern Resident killer whales with short-term behavioral changes (Kruse 1991; Williams et al. 2002a, b; Foote et al. 2004, Bain et al. 2006). Although the potential impacts from vessels and the sounds they generate are poorly understood, these activities may affect foraging efficiency, communication, and/or energy expenditure through their physical presence, increased underwater sound level, or both. Collisions of killer whales with vessels are rare, but remain a potential source of serious injury and mortality. There are no known incidents of Southern Resident collisions with vessels in coastal waters, however, very few stranded killer whales are recovered and there are stretches of unpopulated coastline where stranded whales would not be reported.

Vessel sounds in coastal waters are most likely from large ships, tankers and tugs. Most sound generated by large vessels is a source of low frequency (5 to 500 Hz) human-generated sound in the world's oceans (NRC 2003). While ships generate some broadband noise in the hearing range of whales, the majority of energy is below their peak hearing sensitivity. Such vessels do not target whales, move at relatively slow

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speed and are likely detected and avoided by Southern Residents. It is difficult to precisely quantify or estimate the magnitude of the risks posed by commercial whale watching and recreational vessels in coastal waters; however, weather conditions in the Pacific Ocean in winter limit these activities. The risk to Southern Residents is less in coastal waters than within the inland waters of Washington State and British Columbia, where traffic levels are higher and a greater proportion of traffic may target whales (whale watching and recreational vessels).

Non-Vessel Sound

Anthropogenic (human-generated) sound in coastal waters within the range of Southern Residents is generated by other sources besides vessels, including oil and gas exploration, construction activities, and military operations. Natural sounds in the marine environment include wind, waves, surf noise, precipitation, thunder, and biological noise from other marine species. The intensity and persistence of certain sounds (both natural and anthropogenic) in the vicinity of marine mammals vary by time and location and have the potential to interfere with important biological functions (e.g., hearing, echolocation, communication).

Sound from in-water construction activities could potentially occur through permits issued by the Army Corps of Engineers under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899 and by the State of Washington under its Hydraulic Project Approval (HPA) program. Several consultations on federal projects in the coastal range of Southern Residents have been conducted and conservation measures have been included to minimize or eliminate potential effects to marine mammals. Sound, such as sonar generated by military vessels also has the potential to disturb killer whales in coastal waters.

Oil spills

Oil spills have occurred in the coastal range of Southern Residents in the past, and there is potential for spills in the future. Oil can be discharged into the marine environment in any number of ways, including shipping accidents, refineries and associated production facilities, and pipelines. Despite many improvements in spill prevention since the late 1980s, much of the region inhabited by Southern Residents remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers in inland waters. Numerous oil tankers transit through the coastal range of Southern Residents throughout the year. The magnitude of the risks posed by oil discharges in this area is difficult to precisely quantify or estimate.

The long-term effects of repeated ingestion of sub-lethal quantities of petroleum hydrocarbons on killer whales are not well understood. In marine mammals, acute exposure to petroleum products can cause changes in behavior and reduced activity, inflammation of the mucous membranes, lung congestion, pneumonia, liver disorders, and neurological damage (Wursig 1990 and Geraci 1990). In addition, oil spills have the

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potential to adversely impact habitat and prey populations, and, therefore, may adversely affect Southern Residents by reducing food availability.

Scientific Research

Most of the scientific research conducted on Southern Resident killer whales occurs in inland waters of Washington State and British Columbia. In general, the primary objective of this research is population monitoring or data gathering for behavioral and ecological studies. In 2006, NOAA Fisheries issued scientific research permits to seven investigators who intend to study Southern Resident killer whales. Research activities are typically conducted between May and October in inland waters. However, some permits include authorization to conduct research in coastal waters.

In the biological opinion NOAA Fisheries prepared to assess the impact of issuing the permits, we determined that the effects of these disturbances on Southern Residents were likely to adversely affect, but not jeopardize the continued existence of, the Southern Resident killer whales (NMFS 2006n). The annual authorized takes by harassment of Southern Residents under these permits totaled 1,935 non-invasive takes (e.g., surveys and photo-identification); 70 takes from biopsy, tagging, or breath sampling; and 820 takes due to unintentional harassment, although actual anticipated takes are substantially lower. While most of the authorized takes would occur in inland waters, a small portion of this disturbance is part of the baseline in the coastal range of Southern Residents.

Activities Outside U.S. Jurisdiction

The Southern Resident killer whales are highly migratory and may transit in and out of the waters of the United States and the high seas. NOAA Fisheries does not presently have information to assess the impact on Southern Residents of scientific research or boating activities within Canadian jurisdictional waters. NOAA Fisheries included information on Canadian fisheries within the coastal range of Southern Residents using the same methods to quantify U.S. fisheries in this area (NMFS 2008k).

Summary of the Environmental Baseline

Southern Resident killer whales are exposed to a wide variety of past and present state, federal or private actions and other human activities in their coastal range as well as federal projects in this area that have already undergone formal section 7 consultation, and state or private actions that are contemporaneous with this consultation. All of the following activities discussed in the above section are likely to have some level of impact on Southern Residents when they are in coastal waters of their range.

Reductions in food availability, increased exposure to pollutants, and human disturbance have all been identified as potential threats to killer whales in Washington and British Columbia (Ford and Ellis 1999, 2005; Ford et al. 2000; Baird 2001; Krahn et al. 2002, 2004; Taylor 2004, Wiles 2004). Researchers are unsure about which threats are most significant to the Southern Resident population. Although the three primary factors are identified as prey availability, environmental contaminants, and vessel effects and sound,

none have been directly linked to or identified as the cause of the recent decline of the Southern Resident killer whales (Krahn et al. 2002). There is limited information on how these factors or additional unknown factors may be affecting Southern Resident killer whales when in coastal waters in winter. For reasons discussed earlier, it is possible that two or more of these factors may act together to harm the whales. The small size of the population increases the level of concern about all of these risks (NMFS 2008j).

9.3 Effects of the Prospective Actions on Southern Resident Killer Whales

The potential effects of the Prospective Actions on Southern Resident killer whales relate to prey availability. Contamination (prey quality) is not an issue because the effects of the Prospective Actions do not include the introduction of contaminants into freshwater. Chapter 2 of the SCA defines the federal actions aggregated in the SCA, or Prospective Actions, which include:

- Operation and configuration of the Federal Columbia River Power System (FCRPS) as described in the 2007 FCRPS Biological Assessment (Corps et al. 2007b) and the mainstem effects of 11 Reclamation irrigation projects (Corps et al. 2007b, Appendix B-1-7), as modified by NOAA Fisheries' RPA for the FCRPS (described in Chapter 4 of the FCRPS Biological Opinion (NMFS 2008a).
- Operation and Maintenance of 12 Irrigation Projects in the Upper Snake (described in Reclamation's 2007 Upper Snake Biological Assessment (USBR 2007).
- NOAA Fisheries' § 10(a)(1)(A) Transportation Permit issued as part of NOAA Fisheries' FCRPS Opinion.
- NOAA Fisheries' participation in the 2008-2017 *U.S. v. Oregon* Management Agreement (hereafter, "2008 *U.S. v. Oregon* Agreement") concerning particular Columbia River fisheries related activities as described in Chapter 2 of NOAA Fisheries' Biological Opinion for that Agreement.
- Federal Action Agencies' funding of all FCRPS mitigation hatchery programs.

Most of the direct effects of the Prospective Actions occur within the freshwater system and plume of the Columbia River; effects experienced by Southern Residents in the coastal area are indirect. The Prospective Actions may affect the abundance of killer whale prey in the ocean. Changes in prey abundance would affect the entire population of Southern Resident killer whales. The best available information indicates that salmon are the preferred prey of killer whales year round, including in coastal waters (Status of the Species), and that Chinook are the preferred salmon species. Prey abundance is a

concern for killer whales both in the near and long term. To survive in the near term, killer whales require regular supplies of adult Chinook prey in the ocean, and to recover over the longer term, killer whales require abundant Chinook stocks coast-wide, likely including stocks from the Columbia River (Status of the Species). This analysis considers the short-term (less than ten years) and long-term (ten years and longer) effects of the Prospective Actions described above.

9.3.1 Effects of Hydro and Associated Actions on Southern Resident Killer Whales

Short-Term Effects

The hydro and associated actions combined include operation and configuration of the FCRPS, federal water management in the Upper Snake, and federal actions to improve habitat, reduce predation and fund hatcheries. Included in the hatchery funding is a commitment to review and reform (as needed) future hatchery operations. No details are proposed regarding hatchery reform, and NOAA Fisheries expects that future hatchery production, including reforms, will be subject to additional future consultation when detailed actions are proposed. In the interim, the Prospective Action is to continue funding hatchery operations at current levels.

Effects of Artificial Production

The Prospective Actions include continued funding for artificial propagation of Chinook salmon, which produces killer whale prey. Action agency (BPA, Corps and Reclamation) funding accounts for approximately 50 percent of the Chinook smolts released above Bonneville Dam (Jones 2008). This analysis also assumes that current levels of funding and production will continue over the short term.

For returns prior to 2007, the proportion of hatchery-origin Chinook passing Bonneville Dam ranged between 50 and 80 percent for individual stocks of Chinook from the Columbia River (PCSRF 2007). Since 2000, Chinook hatchery returns to Bonneville Dam represented approximately 70 percent of the total Chinook run, on average (Turner 2008). If the Prospective Actions produce approximately 50% of all returning hatchery Chinook above Bonneville Dam, and all hatchery Chinook combined represent approximately 70% of the Chinook returns at Bonneville, approximately 35% of the total annual return of Chinook above Bonneville Dam can be attributed to the Prospective Actions.

Effects of Hydrosystem Operations

The operation and configuration of the FCRPS causes mortality of migrating juvenile Chinook, which in turn results in fewer adult Chinook in the ocean and reduced prey availability, compared to an absence of dam-related juvenile mortality. For purposes of determining whether the Chinook prey base for killer whales is adversely affected by the proposed action, it is not necessary to precisely quantify the mortality resulting from the hydrosystem operations (as distinguished from other causes), so long as it can be

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reasonably concluded that the decrease in the prey base for killer whales resulting from hydrosystem operations is less than the increase in the prey base resulting from the hatchery programs funded by the action agencies.

The effect of the hatchery programs is to increase by 35% the number of Columbia and Snake River Chinook originating above Bonneville Dam and available to the killer whales. In order for any decrease caused by the hydrosystem to exceed this increase, the hydrosystem would have to cause a 35% or greater reduction in the total number of Columbia and Snake River Chinook available to killer whales. For the reasons discussed below, it is unlikely that the hydrosystem results in a 35% or greater reduction in the killer whale prey base.

Many factors cause mortality to juvenile salmon as they migrate to the ocean. Natural mortality occurs from predators, competition for food, and disease. Human actions unrelated to the hydrosystem, such as the diking and filling of wetlands, road construction and maintenance, and introduction of pollutants can increase mortality in that part of the migration corridor that is within the hydrosystem. And the “bare existence” of the dams, as well as the operation of the dams, also causes juvenile mortality.

Although we have relatively good estimates of the overall level of mortality experienced by juvenile Chinook as they move through the hydrosystem, available information does not enable us to partition the overall level of mortality among the various potential causes. Attempts to allocate mortality have not been notably successful. Most recently, in *National Wildlife Federation v. NMFS*, CV 01-640-RE (D. OR. May 26, 2005) the Court rejected NOAA Fisheries’ attempt to partition the sources of mortality. The Court directed the federal agencies to focus instead on the actions needed to bring ESA-listed salmon to recovery. Thus, the analysis in other parts of this opinion does not attempt to estimate how many fewer ESA-listed salmon are present as a result of the operating the hydrosystem.

To assure that the effects of the hydro operations in the Prospective Action on the killer whale prey base will not outweigh the benefits to that prey base resulting from the hatchery programs funded as part of that action, NOAA Fisheries compared the percent increase in adult Chinook from the hatchery actions to the total mortality rate for juvenile Chinook passing through the hydrosystem, regardless of cause. This comparison is a very conservative approach since only a portion of these mortalities are, in fact, the result of the hydro operations being consulted upon.

As further described in other portions of this biological opinion dealing with ESA-listed salmon (SCA, Hydro Modeling Appendix), the estimated average survival for spring/summer Chinook passing through the area of the hydrosystem under the proposed action varies from about 67% (for both in-river migrating and transported juveniles from

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Lower Granite to Bonneville Dams, assuming a “D” value of 0.709) to more than 95% (passing 1 dam). More than 85% of adult spring/summer Chinook returning to the Columbia and Snake Rivers come from fish that pass 4 dams or fewer dams, which have a survival rate of 73 to over 95%. Thus, for spring/summer Chinook, the total mortality, regardless of cause, is less than 35% (That is, the total survival through the hydrosystem is greater than 65%).

Spring/summer Chinook primarily spawn and rear in tributaries and enter the Snake and Columbia Rivers as yearling smolts that use the area of the hydrosystem primarily as a migratory corridor. Thus, the high level of natural mortality that occurs to all salmon in the egg-to-smolt stage has already taken place before the spring Chinook enter the hydrosystem. For fall Chinook, the reverse is true.

Fall Chinook spawn and rear principally in the mainstem of the Snake and Columbia Rivers. Regardless of whether they originate in the wild or from a hatchery, fall Chinook move through the system primarily as smaller, sub-yearling fish. Due to their size, such fish are more vulnerable to predation and other natural mortalities. This loss is exacerbated by the increased time that sub-yearlings spend rearing in shallow-water habitat as they move through the migratory corridor. Many of these losses would occur regardless of whether the fall Chinook were migrating through a hydrosystem or in a natural river.

Since fall Chinook losses from natural causes are considerably greater than the spring/summer Chinook losses during the downstream migration, it is no surprise that the estimated survival rates for fall Chinook passing through the hydrosystem are considerably lower than those for spring/summer Chinook, but combined these rates exceed 65%. The survival rate¹ for those passing through 8 dams is approximately 33%; for 4 dams survival is about 54%; and for 1 dam survival is approximately 85%.² Less than 3% of the fall Chinook adults originate from locations that are above more than 8 dams. About 29% (primarily the Hanford Reach run) pass through 4 dams, and about 68% of the fall Chinook adults (primarily hatchery production) originate above only 1 dam. When the survival rate is weighted based on the percentage of the fall Chinook found in each group, the overall weighted average survival of fall Chinook passing through the hydrosystem is approximately 74% [(3%*33%)+(29%*54%)+(68%*85%)].

¹ The implementation of the Prospective Actions should substantially improve the survival of migrating fall Chinook salmon. However, NOAA Fisheries does not attempt to estimate quantitative improvements for fall Chinook salmon from these actions due to complications arising from the expression of multiple life-history strategies.

² Juvenile fall Chinook survival estimates are calculated based on per km survival estimates from McNary tailrace to John Day tailrace (1999 – 2002 migrations, June 19 to July 23 releases) using information presented in Williams et al. 2005 (Table 39). The average of these data is 76.7% over a 123 km reach, or a survival rate of nearly 0.998 / km. The entire FCRPS reach is about 512 km, the Bonneville to McNary reach is about 287 km, and Bonneville dam and reservoir is about 73 km in length.

Because the overall losses occurring within the area of the hydrosystem to both spring/summer and fall Chinook are less than 35%, the hatchery production contained in the Prospective Actions more than mitigates for losses to the killer whale prey base, regardless of the source of loss.

The above assessment does not take into account the increased productivity and survival due to habitat and predator programs, which, if included, would show a further increase in the prey base for killer whales. Additionally, there are more hatchery and natural Chinook salmon available to Southern Resident killer whales from Columbia River stocks than is apparent from returns to Bonneville Dam. Recent estimates of ocean abundance (estimated by extrapolation from fisheries catch data) indicate approximately 1,000,000 adult Chinook originate from Columbia River stocks (NMFS 2008k, CTC 2007, ODFW and WDFW 2007). Although there is large annual variability in adult Chinook returns to the mouth of the Columbia River, returns from 1980 to 2007 indicate a slight positive trend, with average abundance of approximately 800,000 Chinook (Corps et al. 2008a).

Long-Term Effects

Salmon analyses presented in the SCA indicate that Prospective Actions including actions that affect the operation of the hydrosystem, tributary and estuary habitat, harvest, predation (tern, pike minnow and marine mammal), hatcheries, and RM&E overall have positively affected and will continue to positively affect the survival and recovery of the listed entities of salmon and steelhead. These analyses consider whether a sufficient number of populations within specific Major Population Groups (MPGs) will survive (i.e., low 24-year extinction risk) and trend toward recovery (i.e., improved average returns-per-spawner, median population growth rate, and abundance trend) to indicate that a specific MPG trends toward recovery (more details available in SCA, Chapter 7).

As discussed in SCA Section 8.1.5 (Effects of Hatchery Programs), while hatchery Prospective Actions (the Action Agencies' obligation to fund hatcheries) are important steps to reducing risk and assuring the long-term viability of these ESUs, at present the hatchery reform process is underway and it is not possible to quantify results or expect that benefits of these reforms are "reasonably certain to occur," and therefore was not part of the basis for conclusions. The Prospective Actions include implementation of hatchery reform (described in RPA 39) pending completion of separate ESA consultations (target completion dates: November 2009 to June 2010; SCA Section 5.5.1). Thus, hatchery effects from the Prospective Actions were assumed as constant from present until future adoption of hatchery reforms as the result of these separate consultations.

Over the long term, the abundance of Columbia River Chinook, and thus of Southern Resident killer whale prey, may be affected by climate change. The Prospective Actions

include monitoring of climate effects on salmonids and mechanisms to synthesize, update, and modify implementation to respond to new information regarding the effects of climate change on listed salmonids (SCA Section 7.1.2.1).

The analysis in the SCA concludes that listed Chinook ESUs, and all other listed salmonid ESUs/DPSs in the Columbia River Basin, are expected to survive with an adequate potential for recovery, and the Prospective Actions are not likely to jeopardize the continued existence of these ESUs. Additionally, the Prospective Actions will not adversely modify the designated critical habitat of these and all other listed ESUs/DPSs addressed, and critical habitat is expected to remain functional (or retain the ability to become functional) to serve the intended conservation role in the near and long term. These conclusions were derived after reviewing the effects of the Prospective Actions, the effects of the environmental baseline, and any cumulative effects presented in the salmon analyses. The long-term recovery of listed Columbia River salmon is a benefit for Southern Resident killer whales in the long term.

The potential harmful effects of artificial production on long-term fitness of salmon populations are discussed in the SCA Appendix, Hatchery Effects Report. Specifically, hatcheries can negatively affect population viability by reducing abundance, productivity, spatial distribution and/or diversity of natural-origin fish (described in McElhany et al. 2000). Table 3 of the SCA Appendix, Hatchery Effects Report, identified risks or threats to population viability for Chinook ESUs, including isolated hatchery practices or non-indigenous hatchery broodstock and/or the influence of strays, in combination with a high proportion of hatchery fish in the population can increase the risks to productivity and diversity. The Prospective Actions contemplate future hatchery reforms intended to address harmful effects of hatchery production on the long-term fitness of the naturally spawning fish. Detailed information is not presently available to evaluate long-term effects of a continuation of current hatchery production on Chinook availability, or of reforms to hatchery operations. Thus, an analysis of long-term effects of the hatchery funding contemplated in the Prospective Actions is not possible at this time and will be considered in separate future consultations when detailed information is available.

9.3.2 Effects of Harvest Actions on Southern Resident Killer Whales

Prospective Actions include the 2008 *U.S. v. Oregon* Agreement, which includes some take of hatchery- and natural-origin Chinook salmon. The terminal fisheries do not directly affect Southern Residents, as the fisheries occur after the fish have returned to the river and are no longer available to the whales in the ocean.

Short-Term Effects

Since the majority of fish available for in-river harvest are hatchery fish, the majority of salmon caught will be hatchery salmon. Although the harvest action is constrained by take limitations on natural-origin salmon, some are incidentally caught. Even with the

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proposed harvest levels on Chinook, most hatchery programs are expected to meet or exceed escapement goals (SCA Chapter 8), and thus will continue to operate at full production with no effect on the future availability of hatchery Chinook in the ocean. In-river harvest of natural-origin fish reduces the number of adults returning to the spawning grounds, and consequently could reduce the number of offspring in the following generation. Such a reduction could in turn reduce the number of adult Chinook available as prey to killer whales in the ocean.

Spring and fall run Chinook are likely to be affected differently by the prospective harvest actions because of differences in their life histories. Spawning habitat for natural-origin Snake River fall Chinook is fully seeded, and Upper River Brights are above escapement goals. Spawning habitat for fall stocks below Bonneville dam, with few exceptions, is also fully seeded, because of stray hatchery fish. Thus harvest of fall run Chinook is not expected to result in a decrease in the number of offspring in the subsequent generation. In contrast, spring returns of natural-origin Chinook, particularly for upriver stocks, tend to be under-seeded. The prospective harvest action manages take of natural-origin upriver Chinook using a sliding scale, and can result in take levels from 5.5 to 17 percent of natural-origin Chinook. Generally, the level of take can be characterized as 10 percent natural-origin from these ESUs. This analysis makes the conservative assumption that in some cases available spawning habitat will be under-seeded, and that a further reduction may occur as a result of the harvest of natural-origin Chinook. That reduction would be proportional to the allowable harvest rate.

Overall, Chinook returns are approximately 30 percent natural-origin fish (70 percent hatchery), whereas upriver spring Chinook are approximately 12 and 32 percent natural-origin for runs returning to spawn above Priest Rapids Dam on the Columbia River and to the Snake River, respectively (average return, 2003 to 2007). On average, the return of natural-origin Chinook to the mouth of the Columbia River from these stocks combined is approximately 30,000 (average return, 2003 to 2007). The 10 percent take that can be expected from the harvest action is therefore approximately 3,000 natural-origin Chinook.

A conservative assumption is that spawner-to-spawner rates are on the order of one-to-one. Given this assumption, the annual return to the river mouth would be 3,000 additional Chinook had there been no fishing. Approximately 3,000 Chinook represents less than 1 percent of the Chinook stocks available to Southern Residents in the ocean that originate from the Columbia River (~1,000,000 Chinook; NMFS 2008k, CTC 2007, ODFW and WDFW 2007) or that return to the mouth of the Columbia River annually (~800,000 Chinook; Corps et al. 2008a).

Long-Term Effects

Over the long term, reductions in naturally spawning spring Chinook could compound. This could reduce Chinook available for killer whale prey in the year in which the

reduction was realized and over the long term if it increased the extinction risk of the listed Chinook stocks. As discussed above, the SCA concludes that the combination of Prospective Actions in all areas is likely to ensure the survival, and maintain the long-term potential for recovery, of the listed Chinook ESUs.

9.4 Cumulative Effects

Cumulative effects are those effects of future tribal, state, local or private activities, not involving Federal activities, reasonably certain to occur within the action area (50 CFR 402.02). For the purpose of the Southern Resident killer whale analysis, this area is the coastal range of the species. Future Federal actions will be reviewed through separate section 7 consultation processes.

Future tribal, state and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities are primarily those conducted under state, tribal or federal government management. These actions may include changes in ocean policy and increases and decreases in the types of activities that currently occur, including changes in the types of fishing activities, resource extraction, or designation of marine protected areas, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to the geographic scope, which encompasses several government entities exercising various authorities, and the changing economies of the region, make analysis of cumulative effects speculative. A Final Recovery Plan for Southern Resident Killer Whales was published January 24, 2008 (NMFS 2008I). Although state, tribal and local governments have developed plans and initiatives to benefit marine fish species, ESA listed salmon, and the listed Southern Residents, they must be applied and sustained in a comprehensive way before NOAA Fisheries can consider them “reasonably certain to occur” in its analysis of cumulative effects. Details regarding cumulative effects of Chinook salmon in the Columbia River are described in Chapter 8 sections of the SCA for each ESU affected.

Private activities are primarily associated with commercial and sport fisheries, construction, and marine pollution. These potential factors are ongoing and expected to continue in the future, and the level of their impact is uncertain. For these reasons, it is not possible to predict beyond what is included in SCA Chapter 8 whether future non-Federal actions will lead to an increase or decrease in prey available to Southern Resident killer whales, or have other effects on their survival and recovery.

Conclusion

The Supplemental Comprehensive Analysis (SCA), Chapter 9, thoroughly details the biological information and likely effects of the Prospective Actions, including the USBR’s Proposed Action for its projects in the Upper Snake River Basin, on listed Southern Resident

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Killer Whales (SRKW). That analysis is incorporated by this reference as if set forth here in full.

The operation and configuration of the Reclamation's Upper Snake projects affect the quantity and quality of water flowing in the lower Snake and Columbia Rivers which indirectly causes a small mortality of migrating juvenile Chinook, relative to the FCRPS passage losses in the environmental baseline, which in turn result in fewer adult Chinook in the ocean and reduced prey availability for SRKW. However, based on the analysis in the SCA, NOAA finds that any possible reduction in SRKW prey base caused by the USBR Upper Snake Projects' Proposed Actions, is insignificant and discountable and therefore does not adversely affect SRKW, for purposes of an informal ESA consultation, 50 C.F.R. § 402.14(a). Longer term, the USBR Proposed Actions will continue to positively affect the survival and recovery of listed salmon and steelhead and should benefit killer whales. Therefore, NOAA Fisheries concurs with the Reclamation's determination that the Prospective Actions may affect, but are not likely to adversely affect killer whales. If additional information on killer whales becomes available, then this determination may be reconsidered pursuant to 50 C.F.R. § 402.16.

Chapter 10

Green Sturgeon of the Southern DPS

- 10.1 Status of the Species**
- 10.2 Effects of the Proposed Action**

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Chapter 10

Green Sturgeon of the Southern DPS

Purpose

By letter of April 18, 2008 the Action Agencies requested NOAA Fisheries' concurrence with their determination that the Prospective Actions may affect but are not likely to adversely affect green sturgeon (*Acipenser medirostris*). This Chapter provides a discussion of the status of the species, estimates the effects of the proposed action on them, and provides NOAA Fisheries statement of concurrence. Much of this information was provided by the Action Agencies in the form of a biological assessment on April 18, 2008 (Corps, et al. 2008).

10.1 Status of the Species

10.1.1 Listing

Upon completion of a status review, NOAA Fisheries determined that green sturgeon comprise two DPSs that qualify as species under ESA: 1) a northern DPS, consisting of populations in coastal systems from the Eel River, California northward, that was determined to not warrant listing; and 2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River (Adams et al. 2002). The southern distinct population segment (DPS) of green sturgeon was listed as threatened under the ESA by NOAA Fisheries on April 7, 2006 (NMFS 2006d). Take prohibitions via section 4(d) of the ESA have not yet been promulgated, nor has critical habitat yet been designated for the southern DPS, although both actions are expected to occur in 2008.

10.1.2 Life history

Green sturgeon are the most marine-oriented of the North American sturgeon species. Juveniles of this species are able to enter estuarine waters after only one year in freshwater. During this time, they are believed to feed on benthic invertebrates, although little is known about rearing habitats and feeding requirements. Green sturgeon are known to range in nearshore marine waters from Mexico to the Bering Sea, and are commonly observed in bays and estuaries along the west coast of North America, including the Columbia River (NMFS 2008m). McLain (2006) noted that Southern DPS green sturgeon were first determined to occur in Oregon and Washington waters in the late 1950s when tagged San Pablo Bay green sturgeon were recovered in the Columbia River estuary. The proportion of the Southern relative to Northern DPS is high (~ 67-82%, or 121 fish, of 155 fish sampled) (Israel and May 2007). Aggregations of adults occupy the lower Columbia River and estuary, up to the Bonneville Dam, primarily

during summer months (WDFW and ODFW 2002, Moser and Lindley 2007). Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of non-natal rivers to feed. Information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall in the northwestern United States. Green sturgeon are known to enter Washington estuaries during summer (Moser and Lindley 2007). There is no evidence of spawning in the Lower Columbia. Green sturgeon in the Lower Columbia River are most likely feeding, but, to date, all stomachs examined (n>50) have been empty (Rien as cited in Grimaldo and Zeug 2001).

10.1.3 Status/Population Trend

Quality data on current population sizes and trends for green sturgeon is non-existent. Lacking any empirical abundance information, Beamesderfer et al. (2007) recently attempted to characterize the relative size of the Sacramento-San Joaquin green sturgeon population (Southern DPS) by comparison with the Klamath River population (Northern DPS). Using Klamath River tribal fishery harvest rate data and assuming adults represent 10% of the population at equilibrium, they roughly estimate the Klamath population at 19,000 fish with an annual recruitment of 1,800 age-1 fish. Given the relative abundance of the two stocks in the Columbia River estuary based on genetic samples, they speculate abundance of the Sacramento population may equal, or exceed the Klamath population estimate. Collectively, Beamesderfer et al. (2007) estimate abundances of the various green sturgeon populations may be larger than previously thought due to seasonal high abundances in the Columbia River, Willapa Bay, and Grays River estuaries and other coastal tributaries, historical high harvest in different areas at different times, and a significant portion of each population likely remains in the ocean at any given time.

10.1.4 Key Limiting Factors for Green Sturgeon

The principal factor in the decline of the Southern DPS is the reduction of the spawning habitat to a limited section of the Sacramento River (NMFS 2006d). The potential for catastrophic events to affect such a limited spawning area increases the risk of the green sturgeon's extirpation. Insufficient freshwater flow rates in spawning areas, contaminants (e.g., pesticides), bycatch of green sturgeon in fisheries, potential poaching (e.g., for caviar), entrainment of juveniles by water projects, influence of exotic species, small population size, impassable migration barriers, and elevated water temperatures in the spawning and rearing habitat likely also pose threats to this species (NMFS 2006d).

10.1.5 Harvest Effects

In the past, take of green sturgeon may have occurred from direct harvest in sport and commercial fisheries and from catch and release mortality in commercial fisheries. In the more recent years, the take of green sturgeon in the Columbia River was incidental to fisheries directed at white sturgeon. The numerous management actions implemented by

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the states of Oregon and Washington since 1994 to control white sturgeon harvest also reduced harvest of green sturgeon, including a reduction of impacts to the listed Southern DPS. The reduced catch of green sturgeon in recent years is believed to be the result of these collective management actions by the states resulting in lower catch, and is not considered indicative of lower abundance of the stock (TAC 2008).

Incidental take of green sturgeon primarily occurs during the early-fall (August) and late-fall (September-November) seasons, concurrent with peak abundance of green sturgeon in the lower Columbia River. Sturgeon angler effort and catch in the estuary increased steadily during the 1990s and peaked in 1998 when anglers made 86,400 trips and caught 30,300 white sturgeon, or 73% of the total catch below Bonneville Dam (TAC 2008). Since 1989, all fisheries affecting lower Columbia River white sturgeon have been managed for Optimum Sustainable Yield (OSY) to provide sustainable broodstock recruitment and ensure the overall health of the white sturgeon population. Beginning in 1996, the states formally adopted a three-year Joint State management agreement based on OSY to guide Columbia River sturgeon fisheries and management decisions. Although the majority of the tenets within the current Joint State sturgeon management agreement focus on white sturgeon, a few objectives specific to benefit green sturgeon management were also included. Beginning July 7, 2006, and in response to the ESA listing of the Southern DPS, retention of green sturgeon in the commercial fisheries was disallowed (TAC 2008). Beginning in January 2007, the states changed the regulations in the recreational fishery to also disallow retention of green sturgeon (TAC 2008). The delay in the implementation of non-retention requirements in the recreational fishery were related to the prescribed process for changing sport regulations and the need for a concurrent public education process.

Harvest of green sturgeon has declined from an average of 1,388 fish annually during 1991-2000 to 154 fish per year since 2001 due to changes in regulations and season structure (Table 10.1-1). During 1996-2006, an average of 61 green sturgeon were harvested in the recreational fishery (Table 10.1-1). During 1996-2006, anglers released an average of 7 green sturgeon annually (2.7 sub-legal, 3.1 legal, and 1.3 over legal-sized) (TAC 2008). With the listing of the Southern green sturgeon DPS, the states took additional emergency action to disallow retention of green sturgeon during commercial fisheries beginning in July 2006, when the ESA listing became effective. During the remainder of 2006, the states started a public awareness and education process so that the sport fishing community would be better able to recognize the differences between white and green sturgeon. The states also disallowed retention of green sturgeon in the recreational fishery starting in 2007 (TAC 2008).

Table 10.1-1. Lower Columbia River Green Sturgeon Catch, 1991-2007

Green Sturgeon						
Year	Sport	Commercial				Total
		Winter	Summer	Early Fall	Late Fall	
1991	22	4	--	2	3,180	3,208
1992	73	10	--	1,750	400	2,233
1993	15	1	--	--	2,220	2,236
1994	132	1	--	--	240	373
1995	21	--	--	--	390	411
1996	63	1	--	--	610	674
1997	41	2	--	1,474	138	1,655
1998	73	0	--	743	151	967
1999	93	2	--	508	279	882
2000	32	0	--	568	636	1,236
2001	50	4	--	338	--	392
2002	51	7	--	--	156	214
2003	52	1	--	11	27	91
2004	29	1	--	6	51	87
2005	119	0	38	32	21	210
2006	70	16	0	--	--	86
2007						0

10.2 Effects of the Proposed Action

- Green sturgeon only encounter the effects of the Reclamation's upper Snake projects between Bonneville Dam and the Columbia River plume, including the Columbia River estuary.
- Adults are known to be found in this portion of the action area only during late summer and fall. At this time, operation of Reclamation's upper Snake projects has a very small, positive effect on streamflow (e.g. flows are increased about 11 kcfs (7.5%) in August and

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are increased 12 kcfs or about 9.5% in September). Such minor flow effects would have unmeasurable effects on benthic fish species such as green sturgeon.

- Green sturgeon are bottom (benthic) feeders and are not known to rely on salmonids as a prey base.

Conclusion

By changing flow, sediment transport (turbidity), and the characteristics of the Columbia River estuary, Reclamation's upper Snake projects may affect green sturgeon. Because these effects are slight to negligible and because adult green sturgeon, the only life stage known to use lower Columbia River habitats, prefer deep water habitats that are generally unaffected by the upper Snake projects, NOAA Fisheries concurs with the Action Agency determination that the Proposed Actions may affect, but are not likely to adversely affect green sturgeon. If additional information on green sturgeon becomes available, then this determination may be reconsidered.

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Chapter 11

Reinitiation of Consultation

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Chapter 11

Reinitiation of Consultation

Consultation must be reinitiated if the amount or extent of taking specified in the incidental take statement is exceeded or is expected to be exceeded; if new information reveals effects of the proposed action that may affect listed species in a way not previously considered; if the proposed action is modified in a manner that causes an effect on listed species that was not previously considered; or if a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. § 402.16).

11.1 Framework for Reinitiation Determinations

The following framework will apply when NOAA Fisheries evaluates a deviation from Reclamation's implementation of its proposed action, or when new information becomes available that is materially relevant to the effects of the proposed action or the status of the species.

1. NOAA Fisheries will request, by letter, information from Reclamation concerning any deviations from the proposed action or any new information about proposed action effects or species status.
2. Reclamation will provide in writing any and all information and analysis available to the agency regarding the proposed action deviation or new information.
3. NOAA Fisheries will issue a written determination whether reinitiation of consultation for Reclamation's upper Snake projects is warranted pursuant to 50 C.F.R. § 402.16, and, if so, provide its recommendation to Reclamation. In reaching this determination NOAA Fisheries will consider all relevant factors, including:
 - a. whether a deviation from the proposed action is material, meaning that the shortfall in the implementation is likely to appreciably reduce short-term survival benefits or appreciably reduce a contribution to the long term recovery of the species, which is needed to maintain the species' improving status, or
 - b. whether the new information about proposed action effects or species status indicate an appreciable increase in proposed action adverse effects or appreciable decline in species status; and,
 - c. whether there are alternative measures to which Reclamation can commit that additionally will offset the adverse effects of the proposed action deviation or new information about effects or species status.

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Chapter 12

Conservation Recommendations

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Chapter 12

Conservation Recommendations

This section discusses NOAA Fisheries' obligation to develop conservation recommendations under Section 7(a)(1) of the ESA, which states in part that:

All other Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act. (ESA § 7(a)(1))

The following conservation recommendations were developed for this Opinion.

12.1 Water Quality

NOAA Fisheries recommends that Reclamation, in coordination with IDEQ and ODEQ, as part of the TMDL implementation planning process complete the following:

- As appropriate, work with State agencies and Tribes, as well as irrigation districts, canal companies, drainage districts, designated management agencies, and other interested entities, within the framework of Watershed Advisory Groups, Watershed Councils, and other appropriate public forums in Idaho and Oregon to develop plans for implementing the Snake River-Hells Canyon TMDLs and tributary basin load allocations. NOAA Fisheries recommends that Reclamation keep NOAA Fisheries and the Tribes informed about Reclamation's assistance efforts by providing annual reports.
- Provide technical assistance to irrigation system operators and other appropriate entities in implementing nutrient, sediment, and/or temperature improvement measures to help meet the States' TMDL load allocations, as identified in TMDL implementation plans, and as authorities and funding permit. NOAA Fisheries recommends that Reclamation keep NOAA Fisheries informed about Reclamation's assistance efforts by providing annual reports.
- Develop and implement a basin-wide temperature monitoring plan for the upper Snake River to describe temperature regimes and dynamics relative to Reclamation's water management activities, including storage, diversions and return flows, and hydropower operations. NOAA Fisheries recommends that Reclamation keep NOAA Fisheries and Tribes informed about Reclamation's temperature monitoring efforts and results by providing annual reports.

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Chapter 13

Incidental Take Statement

- 13.1 Amount or Extent of Anticipated Take**
- 13.2 Effect of the Take**
- 13.3 Reasonable & Prudent Measures**
- 13.4 Terms & Conditions**

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Chapter 13 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct.” Incidental take is defined as “take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.” Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

NOAA Fisheries has identified reasonable and prudent measures to further minimize the impact of the incidental take authorized by this Opinion.

13.1 Amount or Extent of Anticipated Take

As indicated in Section 8 above, NOAA Fisheries has determined that incidental take is reasonably certain to occur for the 13 ESA-listed salmonid species considered in this Opinion as a result of Reclamation’s proposed action.¹ This take is primarily a result of Reclamation’s effect on Snake and Columbia River flows during the juvenile migration season. Although likely to occur, NOAA Fisheries finds that it is not feasible to quantitatively monitor the amount of take expected solely as a result of this action, but expects that take will be inversely proportional to the amount (and proportional to quality) of flows resulting from upriver water management, including that of Reclamation. Therefore, NOAA Fisheries will consider Reclamation is not exceeding its authorized take so long as flows are provided at levels (and of a quality) expected by the analysis in this Opinion (Table 13-1).

13.2 Effect of the Take

In Section 8, NOAA Fisheries determined that the projected levels of juvenile and adult survival through the FCRPS are not likely to jeopardize the continued existence of any of the 13 listed ESUs considered in this Opinion.

13.3 Reasonable & Prudent Measure

The actions proposed by Reclamation minimize incidental take of 13 listed salmonid species to the extent necessary and appropriate. The following monitoring and reporting requirements are necessary to ensure that Reclamation is implementing these actions as described in its BA and considered in this Opinion.

¹ No incidental take is expected for UWR Chinook salmon or UWR steelhead.

Table 13-1. Estimated mean monthly inflow to Brownlee Reservoir and the flow augmentation component for Reclamation’s Proposed Actions under wet, average, and dry years. Source: USBR (2007).

Month	Average of Wet Years (at or below 10% exceedance)			Average of Average Years (between 10% and 90% exceedance)			Average of Dry Years (at or above 90% exceedance)		
	Total Inflows (cfs)	Flow Augmentation Component		Total Inflows (cfs)	Flow Augmentation Component		Total Inflows (cfs)	Flow Augmentation Component	
		cfs	percent		cfs	percent		cfs	percent
April	58,139	261	0.45	28,667	261	0.91	11,652	261	2.24
May	57,995	1,505	2.59	32,663	2,016	6.17	12,526	1,498	11.96
June	42,746	1,555	3.64	27,203	2,005	7.37	9,358	1,098	11.73
July	20,704	2,977	14.38	11,873	1,826	15.38	7,213	350	4.85
August	12,935	1,682	13.00	10,171	1,171	11.52	6,961	350	5.03

13.3.1 New Contracts for Water Stored in Reclamation Projects

Reclamation’s salmon flow augmentation program is heavily dependent on annual water rentals from Idaho’s water rental pools, which are variable and insecure sources. Due to this variability, Reclamation must consult with NOAA Fisheries prior to issuing a new contract that would reduce streamflows or reduce Reclamation’s ability to meet salmon flow augmentation commitments, as described in its PA; or whenever Reclamation otherwise determines that listed salmon or steelhead species or critical habitat may be affected.

13.3.2 Annual Coordination of the Salmon Flow Augmentation Program

Reclamation must continue to coordinate annually with the Technical Management Team (TMT) and Regional Forum when planning and implementing its annual salmon flow augmentation program.

13.3.3 Annual Progress Report

For the purposes of ensuring that Reclamation is taking all appropriate measures to minimize incidental take attributable to its proposed action, NOAA Fisheries directs Reclamation to annually report its water deliveries under the flow augmentation program and monthly average April through August inflows to Brownlee Reservoir. Because the incidental take attributable to the proposed action is the indirect result of streamflow reductions caused by the project on flow-related survival of juvenile salmonids passing through the FCRPS and because that incidental take is minimized by Reclamation’s flow augmentation program, if April through August inflows to Brownlee Reservoir approximate those estimated to occur by Reclamation in its MODSIM modeling used to inform this

Opinion (Table 13-1), then Reclamation will have minimized the incidental take attributable to the proposed action.

13.4 Terms & Conditions

The measures described in this section are nondiscretionary and must be undertaken by Reclamation, which has a continuing duty to regulate the activities covered by this Incidental Take Statement. If Reclamation fails to assume and implement the terms and conditions of this Incidental Take Statement, the protective coverage of Section 7(o)(2) may lapse. Thus, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above.

13.4.1 New Contracts for Water Stored in Reclamation Projects

Prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by this Opinion to any use other than salmon flow augmentation, Reclamation shall consult with NOAA Fisheries under Section 7(a)(2) of the ESA. In addition, Reclamation shall consult with NOAA Fisheries under Section 7(a)(2) of the ESA prior to entering into a new contract that would reduce streamflows or reduce Reclamation's ability to meet its salmon flow augmentation commitments, as described in its PA, or whenever Reclamation otherwise determines that listed salmon or steelhead species or critical habitat may be affected. Such consultations shall identify the amount of discretionary storage being sought or the amount of streamflow reduction, the current probability of such storage or streamflow being available for salmon flow augmentation, and any plan to replace the storage volume or streamflows currently available to salmon flow augmentation that would be lost as a result of the proposed commitment. NOAA Fisheries criterion in conducting such a review is to ensure that there either be an improvement or "zero net impact" on Snake River flows and on Reclamation's ability to provide up to 487 kaf for salmon flow augmentation. Replacement supplies should have at least an equal probability of being available for salmon flow augmentation as the storage space or streamflows that are being committed.

13.4.2 Annual Coordination of the Salmon Flow Augmentation Program

Reclamation must continue to coordinate annually with the TMT and Regional Forum when planning and implementing its annual salmon flow augmentation program. Reclamation must provide and update estimates of flow augmentation volume acquisitions and delivery as part of the annual FCRPS Water Management Plan and for discussion at TMT meetings. In emergency situations, Reclamation must work with NOAA Fisheries and the TMT within established Regional Forum procedures to assess whether actions can be taken to improve migration conditions.

Developing an annual salmon flow augmentation program and sharing it with the TMT as a component of the FCRPS Water Management Plan will ensure that regional coordination occurs. NOAA Fisheries will review the Reclamation's salmon flow augmentation program each year and inform Reclamation if its plan appears inconsistent with the action that was evaluated in this Opinion.

13.4.3 Annual Progress Report

Reclamation must prepare a Progress Report by December 31 of each year to document actions that it has taken to implement its salmon flow augmentation program. In particular, Reclamation shall document and report to NOAA Fisheries the mean monthly inflows to Brownlee Reservoir from April through August and the specific amounts and sources of water provided as part of each year's flow augmentation program.

These annual Progress Reports will be useful for confirming assumptions applied in the analyses included in this Biological Opinion (Section 8). This information will also help NOAA Fisheries evaluate whether new information reveals effects of the action that may affect listed or proposed species in a way that was not previously considered (Section 10).

Reclamation shall then use this information to inform, and if necessary, adjust accordingly the next year's salmon flow augmentation program.

Chapter 14

Magnuson-Stevens Fishery Conservation & Management Act

- 14.1 Background**
- 14.2 Identification of EFH**
- 14.3 Proposed Action**
- 14.4 Effects of the Proposed Action**
- 14.5 Conclusion**
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Chapter 14

Magnuson-Stevens Fishery Conservation & Management Act

14.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).
- EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). "Adverse effect" means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).
- EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the PA as described in the U. S. Bureau of Reclamation's (Reclamation) BA (USBR 2007) would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

14.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council has designated EFH for three species of federally managed Pacific salmon: Chinook salmon (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (as identified by the PFMC 1999) and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California north of Point Conception to the Canadian border. Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the PA is based, in part, on this information. For purposes of this analysis, this Opinion addresses potential effects to Chinook and coho salmon.

Designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, and seaward to the boundary of the U.S. exclusive economic zone (PFMC 1998a, 1998b). Detailed descriptions and identifications of non-salmonid EFH are contained in the fishery management plans for groundfish (PFMC 1998a) and coastal pelagic species (PFMC 1998c). Casillas et al. (1998b) provide additional detail on the groundfish EFH habitat complexes. NOAA Fisheries has identified seven groundfish habitat complexes (estuarine, rocky shelf, non-rocky shelf, neritic zone, oceanic zone, continental slope/break and canyon) and identified species that may occur in each of those areas. The estuarine complex, which (with the neritic zone) is pertinent to this consultation, includes those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary, as defined in 33 CFR 80.1 (Coast Guard lines of demarcation). The neritic zone is the relatively shallow ocean that extends from the outer edge of the intertidal zone to the edge of the continental shelf. It therefore contains the Columbia River plume. Two groundfish and two coastal pelagic species occur within the action area for the PA (Table 14-1).

Table 14-1. Non-salmonid fish species with EFH in the action area for operations and maintenance of Reclamation’s projects in the Snake River basin above Brownlee Reservoir. Sources: Casillas 1998b and Emmett et al 1991.

Species	Habitat Preferences
Starry Flounder <i>Platichthys stellatus</i>	Mud, sand; often found in estuaries and upstream in freshwater
English sole <i>Pleuronectes vetulus</i>	sand, mud
Northern Anchovy <i>Engraulis mordax</i>	pelagic
Pacific Sardine <i>Sardinops sagax</i>	pelagic

14.3 Proposed Action

For this EFH consultation, the PA and action area are described in Chapter 2 and Chapter 4 of this Opinion, respectively. The action area is in portions of the states of Oregon, Washington, and Idaho that are also within the range of EFH designated under the MSA. The action area relative to both juvenile and anadromous salmonids is that part of their in-water and riparian habitat that would be affected by the proposed operations and maintenance of Reclamation’s projects above Brownlee Reservoir that are described in the PA (Chapter 2). Parts of the action area below Hells Canyon Dam serve as a migratory corridor for juveniles and adults of five ESA-listed species of Chinook salmon (SR spring/summer and fall Chinook salmon, UCR spring Chinook salmon, UWR Chinook salmon, and LCR Chinook salmon) and one species of coho salmon (LCR coho salmon). The effects of the PA on all six of these species are considered in this Opinion. The area serves to a varying extent as habitat for spawning, rearing, and growth and development to adulthood for these salmonids. EFH is also designated in the action area for three unlisted species of Chinook salmon: Deschutes River summer/fall-run, MCR spring-run, and UCR summer/fall-run Chinook salmon ESUs. The PA affects flow in areas of the Columbia River estuary and plume used by the two species of groundfish (starry flounder and English sole) and two coastal pelagic species (northern anchovy and Pacific sardine) for which EFH is also designated.

14.4 Effects of Proposed Action

As described in Chapter 8 of this Opinion, the proposed operations and maintenance of Reclamation’s projects above Brownlee Reservoir may result in short- and long-term impacts, both positive and negative, to a variety of habitat parameters. The adverse impacts to EFH for the unlisted Chinook salmon species are the same as those described for the ESA-listed salmonids. Therefore, the ESA effects analysis in this Opinion addresses impacts of the PA to salmon EFH. As described in the following sections, the proposed operations and maintenance of Reclamation’s projects above Brownlee Reservoir are likely to negatively affect some properties of designated EFH.

14.4.1 Effects on Mainstem Habitat Conditions, Including the Estuary & Plume

14.4.1.1 Effects of Flow Management on EFH

Coho & Chinook Salmon

The PA would cause a substantial net reduction (21%) in seasonal average spring flows (April-May) in the Snake River upstream from Lower Granite Dam during the peak of the juvenile SR spring/summer Chinook salmon migrate through that part of the action area (Section 8.1). In the lower Columbia River, the PA would reduce spring flows by about 3%. These spring flow reductions will reduce the survival of yearling migrant SR spring/summer Chinook salmon, UCR spring Chinook salmon, UWR Chinook salmon, some populations of LCR Chinook salmon, and (unlisted) MCR spring Chinook salmon migrating through the FCRPS.

Two sets of authors recently evaluated the sensitivity of the amount and distribution of shallow-water rearing habitat in the lower Columbia River (i.e., Hyde et al. 2004, for conditions in RMs 0-35; Jay et al. 2004 for RMs 35-55) to changes in discharge at Bonneville Dam during summer (i.e., July through September; Section 6.2.1.1). Snake River fall Chinook, UCR summer/fall Chinook, and Deschutes River summer/fall Chinook salmon produce subyearling smolts that migrate through and rear within the mainstem during summer, as do migrants from fall-run populations of LCR Chinook salmon. Hyde et al. (2004) focused on the sensitivity to changes in discharge in the 150 to 190 kcfs range, which brackets the flow operation in Reclamation's PA. In the lower 35 miles of the Columbia River, changes in operations that would result in discharges in the range of 150 to 190 kcfs would appear to have only slight impacts on the total area of shallow-water habitat available and the hours during which it would fit specific depth criteria. Hyde et al. (2004) suggested that this was because the length of time an area was inundated increased with flow and as a function of its interaction with the tide. The direction and strength of these impacts would vary within the lower estuary.

Due to extensive diking and the effects of tides, Jay et al. (2004) found that the amount of shallow-water habitat in the lower Columbia River varies very little over a much wider range of flow changes than those identified in Reclamation's PA. Thus, effects on juvenile rearing habitats are likely to be small to negligible.

The reduction of the spring freshet associated with the PA may have a somewhat larger influence on habitat conditions in the Columbia River plume. Assuming that effects on the habitat value of the plume roughly equal the relative change in spring discharge, the PA would reduce the plume's habitat value by about 3%. The plume's role as salmon and steelhead habitat is poorly understood. However, a 3% reduction in the size of the plume would appear to be a relatively small effect.

Groundfish

Two groundfish species, the starry flounder and the English sole, are likely to have designated EFH in areas affected by the PA. Starry flounder spawn in the ocean, and juveniles enter the estuary at a young age where they are associated with the bottom, feeding on amphipods and copepods (Fox et al. 1984). They are distributed throughout the estuary, but younger fish (less than 2 years) are more concentrated in the freshwater or low salinity areas. Fish older than 2 years are more concentrated in areas of higher salinity. During spring, abundance is generally low and flounder are restricted to part of Youngs Bay and an area between Tongue Point and Woody Island (approximately RM 29). During summer and fall, they are more widely distributed but are most abundant in areas of low velocity currents such as Grays Bay, Youngs Bay, Baker Bay, Cathlamet Bay, and intertidal habitats, where their principal prey, amphipods, concentrate.

The English sole is a marine species that is associated with the bottom for most of its life cycle. It prefers high salinities and therefore is found only in the downriver portions of the estuary where the population, primarily juveniles, feed and rear (Fox et al. 1984). English sole eat mainly copepods, amphipods, and mysids, but also incorporate the clam *Macoma balthica*, polychaetes, and oligochaetes into their diet. Sole less than 1 year old are localized in low-velocity, shallow areas such as the Ilwaco and Chinook Channels during spring, but are distributed further upriver in relatively saline water during summer and fall. Both their relative abundance and distribution in the estuary decrease in winter. Relatively few of the individuals in the estuary are 1 year old or older, and these are found downriver from the Astoria-Megler Bridge year round.

Both species are associated with low-velocity, shallow-water habitat in the estuary, where their prey species are abundant. Thus, effects on estuarine EFH are likely to be similar to those described above for subyearling salmon. That is, the PA only slightly affects the total area of shallow-water rearing habitat available in the lower Columbia River and the hours during which it fits specific depth criteria, with the difference greatest during summer and in the upstream tidally-influenced reach closest to Bonneville Dam.

Coastal Pelagic Species

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California, and anchovy have recently colonized the Gulf of California (PFMC 1998c). The population is divided into northern, central, and southern subpopulations, or stocks. The southern subpopulation is entirely within Mexican waters. The central subpopulation, which supports significant commercial fisheries in the U.S. and Mexico, ranges from approximately San Francisco, California, to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico (about 40 miles south of the U.S.-Mexico border) in the south. The geographic distribution of northern anchovy has been more consistent over time and is more nearshore than the geographic distribution of Pacific sardine.

The northern anchovy is commonly found both within the Columbia River estuary and offshore in large schools during all seasons. Adults spawn in the ocean, but all life stages can be found in the

estuary where they feed mostly on copepods (and some phytoplankton) in the water column (Fox et al. 1984). Fish older than one year prefer higher salinity areas and are found further upriver when outflow is lower.

It is generally accepted that sardines off the west coast of North America form three subpopulations or stocks: a northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation. A fourth, far northern subpopulation has also been postulated (PFMC 1998c). Although the ranges of the northern and southern subpopulations overlap, the stocks may move north and south at similar times and not overlap significantly.

Pacific sardines are pelagic at all life history stages. They occur in estuaries, but are most common in the nearshore and offshore domains along the coast. They have been captured in both purse and beach seines in the Columbia River estuary, often with anchovies. Like the northern anchovy, sardines are planktivorous, consuming both phytoplankton and zooplankton.

The PA has a small effect on flows in the Columbia River plume, primarily during the spring. For pelagic species, the increase in summer flows means that the aerial extent of the low salinity environment in the plume will also be slightly larger. There is no information available on how habitat use by coastal pelagic species is affected by changes in flow on the order of the PA.

14.5 Conclusion

NOAA Fisheries concludes that Reclamation's PA would adversely affect EFH for Columbia Basin Chinook and coho salmon.

14.6 EFH Conservation Recommendations

Pursuant to §305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies, including itself, regarding actions that would adversely affect EFH. NOAA Fisheries contends that the following three conservation measures, which are identical to the terms and conditions stated in the Incidental Take Statement (Chapter 11), are needed to avoid, mitigate, or offset the effect that the PA would have on designated EFH for Chinook and coho salmon. Consequently, NOAA Fisheries recommends that Reclamation adopt the terms and conditions in Chapter 11 of this Opinion as EFH conservation measures.

14.6.1 New Contracts for Water Stored in Reclamation Projects

Prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by this Opinion to any use other than salmon flow augmentation, or enter into a new contract that would reduce streamflows or reduce Reclamation's ability to meet its salmon flow augmentation commitments, as described in its PA, or whenever Reclamation otherwise determines that listed salmon or steelhead species or critical habitat may be affected, Reclamation shall consult with NOAA

Fisheries under Section 7(a)(2) of the ESA. Such consultations shall identify the amount of discretionary storage being sought or the amount of streamflow reduction, the current probability of such storage or streamflow being available for salmon flow augmentation, and any plan to replace the storage volume or streamflows currently available to salmon flow augmentation that would be lost as a result of the proposed commitment. NOAA Fisheries' criterion in conducting such a review is to ensure that there either be an improvement or "zero net impact" on Snake River flows and on Reclamation's ability to provide up to 487 Kcf for salmon flow augmentation. Replacement supplies should have at least an equal probability of being available for salmon flow augmentation as the storage space or streamflows that are being committed.

14.6.2 Annual Coordination of the Salmon Flow Augmentation Program

The Bureau of Reclamation should continue to coordinate annually with the TMT and Regional Forum when planning and implementing its annual salmon flow augmentation program. Reclamation must provide and update estimates of flow augmentation volume acquisitions and delivery as part of the annual FCRPS Water Management Plan for discussion at TMT meetings. In emergency situations, Reclamation should work with NOAA Fisheries and the TMT within established Regional Forum procedures to assess whether actions can be taken to improve migration conditions.

Developing an annual salmon flow augmentation program and sharing it with the TMT as a component of the FCRPS Water Management Plan will ensure that regional coordination occurs. NOAA Fisheries will review Reclamation's salmon flow augmentation program each year and inform Reclamation if its plan appears inconsistent with the action that was evaluated in this Opinion.

14.6.3 Annual Progress Report

The Bureau of Reclamation must prepare a Progress Report by December 31 of each year to document actions that it has taken to implement its salmon flow augmentation program. In particular, Reclamation shall document and report to NOAA Fisheries the mean monthly inflows to Brownlee Reservoir from April through August and the specific amounts and sources of water provided as part of each year's flow augmentation program

These annual Progress Reports will be useful for confirming assumptions applied in the analyses included in this Biological Opinion (Chapter 8). This information will also help NOAA Fisheries evaluate whether new information reveals effects of the action that may affect listed species in a way that was not previously considered (Chapter 10).

The Bureau of Reclamation shall then use this information to inform, and if necessary, adjust accordingly the next year's salmon flow augmentation program.

14.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within

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30 days of receipt of these recommendations. In case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the PA and the measures needed to avoid, minimize, mitigate, or offset such effects.

14.8 Supplemental Consultation

The Bureau of Reclamation must reinitiate EFH consultation with NOAA Fisheries if the PA is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920(k)).