FINAL ENVIRONMENTAL ASSESSMENT

Section 10 Permit Applications by the Washington State Department of Fish and Wildlife for Incidental Take of ESA-listed Rockfish and Other Listed Fish within the Puget Sound/Georgia Basin and Take Due to Scientific Research

National Marine Fisheries Service
Northwest Region

October 2012

COVER SHEET

Title of Environmental Review:

Section 10 Permit Applications by the Washington State Department of Fish and Wildlife for Incidental Take of ESA-listed Rockfish and Other Listed Fish within the Puget Sound/Georgia Basin and Take Due to Scientific Research

Listed Species and Evolutionarily Significant Units:

yelloweye rockfish (*Sebastes ruberrimus*)
canary rockfish (*Sebastes pinniger*)
bocaccio (*Sebastes paucispinis*)
southern eulachon *(Thaleichthys pacificus)*
Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*)
Puget Sound summer chum salmon (*Oncorhynchus omykiss)*
Puget Sound steelhead (*Oncorhynchus keta)*
bull trout (*Salvelinus confluentus*)
southern green sturgeon (*Acipenser medirostris*)

Responsible Agency Official and Contact:

William W. Stelle, Jr., Regional Administrator
National Marine Fisheries Service, Northwest Region
7600 Sand Point Way N.E.
Seattle, WA 98115

Dan Tonnes
National Marine Fisheries Service
7600 Sandpoint Way
Seattle, WA 98115-6349
Phone: (206) 526-4643

Legal Mandates:

Endangered Species Act of 1973 (ESA, 16 U.S.C. 1531 *et seq.*)
National Environmental Policy Act (NEPA, 42 U.S.C. 4321 *et seq.*)

Location of Proposed Activities:

Waters of the Puget Sound and the Strait of Georgia

Actions Considered:

NMFS' approval or disapproval of the State of Washington Department of Fish and Wildlife applications for ~~two~~ ESA section 10 permits: ~~a~~ section 10(a)(1)(A) permit~~s~~ for take of ESA-listed rockfish and other listed fish as part of routine research activities, and a section 10(a)(1)(B) permit for incidental take from one commercial and one recreational fishery.

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LIST OF ACRONYMS

CEQ	Council on Environmental Quality
DPS	Distinct Population Segment
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCP	Fishery Conservation Plan
ITP	Incidental Take Permit
MCA	Marine Catch Area
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Northwest Indian Fisheries Commission
PAHs	Polycyclic Aromatic Hydrocarbons
PFMC	Pacific Fisheries Management Council
SEPA	State Environmental Policy Act
TRT	Technical Recovery Team
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife

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EXECUTIVE SUMMARY

THE FOLLOWING IS NEW TEXT FROM THE DRAFT ENVIRONMENTAL ASSESSMENT AND IS PROVIDED AS AN EXECUTIVE SUMMARY OF THE REVIEW PROCESS AND PREFERRED ALTERNATIVE

On April 23, 2009, National Marine Fisheries Service (NMFS) proposed to list the Puget Sound/Georgia Basin Distinct Population Segments (DPSs) of yelloweye rockfish (*Sebastes ruberrimus*) and canary rockfish (*Seb. pinniger*) as threatened, and bocaccio (*Seb. paucispinis*) as listed species under the Endangered Species Act (ESA) (74 Fed. Reg. 18516). The proposal went final on April 27, 2010 and the species listings were effective on July 27, 2010. The Washington State Department of Fish and Wildlife (WDFW) manage fisheries in Puget Sound. In November of 2009, WDFW initiated discussions with NMFS on pursuing ESA take coverage for state-authorized fisheries and research activities that are likely to encounter yelloweye rockfish, canary rockfish, and bocaccio (ESA-listed rockfish) in state waters. Because of those discussions, and over the ensuing months and years, NMFS advised WDFW on development of a Fishery Conservation Plan (FCP)[1] and an application for an Incidental Take Permit (ITP) for ESA-listed rockfish and other listed species taken by the several state-authorized fisheries and state-conducted research efforts.

This final Environmental Assessment (EA) is for NMFS's issuance of section 10 of the Endangered Species Act (ESA) permits to WDFW for take due to scientific research and fisheries management of ESA-listed rockfish and other listed fish within the Puget Sound/Georgia Basin. NMFS has conducted this environmental review under the National Environmental Policy Act in support of evaluating WDFW's permit applications under section 10 of the ESA. The EA evaluates the environmental consequences of alternative actions for issuing incidental take permits to WDFW for scientific research and fisheries management in the Puget Sound/Georgia Basin. The analysis of alternatives and consequences will inform NMFS' decision regarding issuance of these section 10 permits. The covered species for these permits would include the Puget Sound/Georgia Basin DPSs of threatened yelloweye rockfish, canary rockfish, and endangered bocaccio. Additional covered species would include the threatened Evolutionarily Significant Units of Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound summer chum salmon (*O. keta*) and, the threatened DPS of Puget Sound steelhead (*O. omykiss*), and the threatened DPSs of southern green sturgeon (*Acipenser medirostris*) and southern eulachon (*Thaleichthys pacificus*).

Introduction

The final EA reflects changes from the draft EA based on new information collected since the draft was published. All new text is indicated in redline/strikeout format to show changes from the draft EA, or is indicated with a new subsection title and explanation of the new text, as illustrated under this Executive Summary.

Preferred Alternative

After close of the public comment period, NMFS developed a Preferred Alternative. The Preferred Alternative is the same as the Proposed Action and is described in detail in Subsection 1.2, Description of the Proposed Action.

Public Comment Period

NMFS published a document in the Federal Register on March 30, 2012 (77 Fed. Reg. 19225) concerning the availability of a draft document for public comment related to a Fishery Conservation Plan and Research Permits for the WDFW. The comment period for review of the EA on this action expired on April 23, 2012. The comment period was re-opened to provide additional opportunity for public comment (77 Fed. Reg. 26514, May 4, 2012). The comment period extension expired May 11, 2012. No comments were received during either of the public comment periods.

Changes to the Draft Environmental Assessment

This final EA includes only the following revisions based on public comment and new information since the draft EA was published for comment. Revisions are illustrated in redline/strikeout format.

- Updated data in the table included as Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives.
- Additional citations have been added to Section 7, References.

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1. Introduction and Background

The ~~National Marine Fisheries Service (~~NMFS~~)~~ has prepared this EA in accordance with the National Environmental Policy Act (NEPA). NEPA provides an interdisciplinary framework for Federal agencies to evaluate environmental consequences of programs and projects over which they have discretionary authority. NMFS, of the National Oceanic and Atmospheric Administration (NOAA), has the authority to issue permits for the take of species listed under the ~~Endangered Species Act (~~ESA~~)~~. This EA considers the environmental consequences of NMFS issuing ~~two~~ such permits, and environmental consequences of alternatives to NMFS issuing such permits. One permit considered here would cover incidental take of ESA-listed rockfish, Chinook salmon, green sturgeon, and eulachon from one commercial and one recreational fishery in Puget Sound authorized by the State of Washington. The other permits would cover take of ESA-listed rockfish, Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, eulachon, and green sturgeon resulting from state-conducted scientific research activities.

On April 28, 2010, NMFS listed the Puget Sound/Georgia Basin ~~Distinct Population Segments (~~DPSs~~)~~[2] of yelloweye rockfish (*Sebastes ruberrimus*) and canary rockfish (*Sebastes pinniger*) as threatened, and listed the Puget Sound/Georgia Basin DPS of bocaccio (*Sebastes paucispinis*) as endangered under the ESA (75 Fed. Reg. 22276). On May 17, 2010, NMFS listed the Southern DPS of eulachon *(Thaleichthys pacificus)* as a threatened species under the ESA (75 Fed. Reg. 13012, March 18, 2010). NMFS listed Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), as threatened under the ESA on March 24, 1999 (64 Fed. Reg. 14308). Figure 1 shows the geographic extent of the action area and ESA-listed rockfish DPSs. Figure 2 shows the Evolutionary Significant Units for Puget Sound Chinook salmon and Hood Canal summer-run chum salmon, a portion of which also occur within the action

[2] Under the ESA, NMFS lists Pacific salmon as threatened or endangered according to the status of the "Evolutionarily Significant Unit" (ESU). An ESU is a population or a group of populations that 1) is substantially reproductively isolated from conspecific (another organism of the same species) populations and 2) represents an important component of the evolutionary legacy of the species. See http://www.nwfsc.noaa.gov/trt/glossary.cfm#E for formal definitions of ESA-related terms used by NMFS.

In contrast to salmon, NMFS lists steelhead runs under the joint NMFS-U.S. Fish and Wildlife Service policy for recognizing *Distinct Population Segments* (DPSs) under the ESA (61 Fed. Reg. 4722, February 7, 1996). This policy applies to all species except Pacific salmon. It adopts criteria similar to those in the ESU policy for determining when a group of vertebrates constitutes a DPS – the group must be discrete from other populations and it must be significant to its animal group, or taxon. A group is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (61 Fed. Reg. 4722, February 7, 1996). NMFS lists steelhead according to the status of the DPS.

area. The action area is larger than the rockfish DPSs area because some WDFW research actions occur westward of the Puget Sound/Georgia basin DPSs boundary indicated in Figure 1.

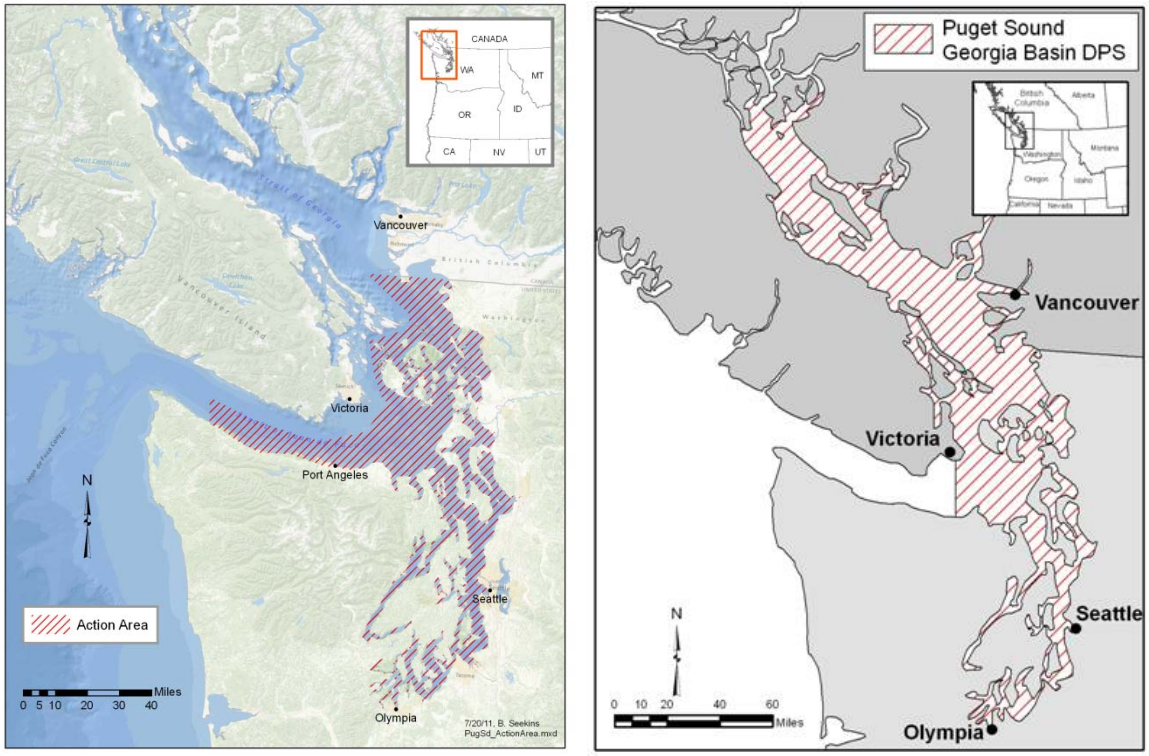

Figure 1. Action area for this Environmental Assessment (left) and ESA-listed rockfish DPSs (right).

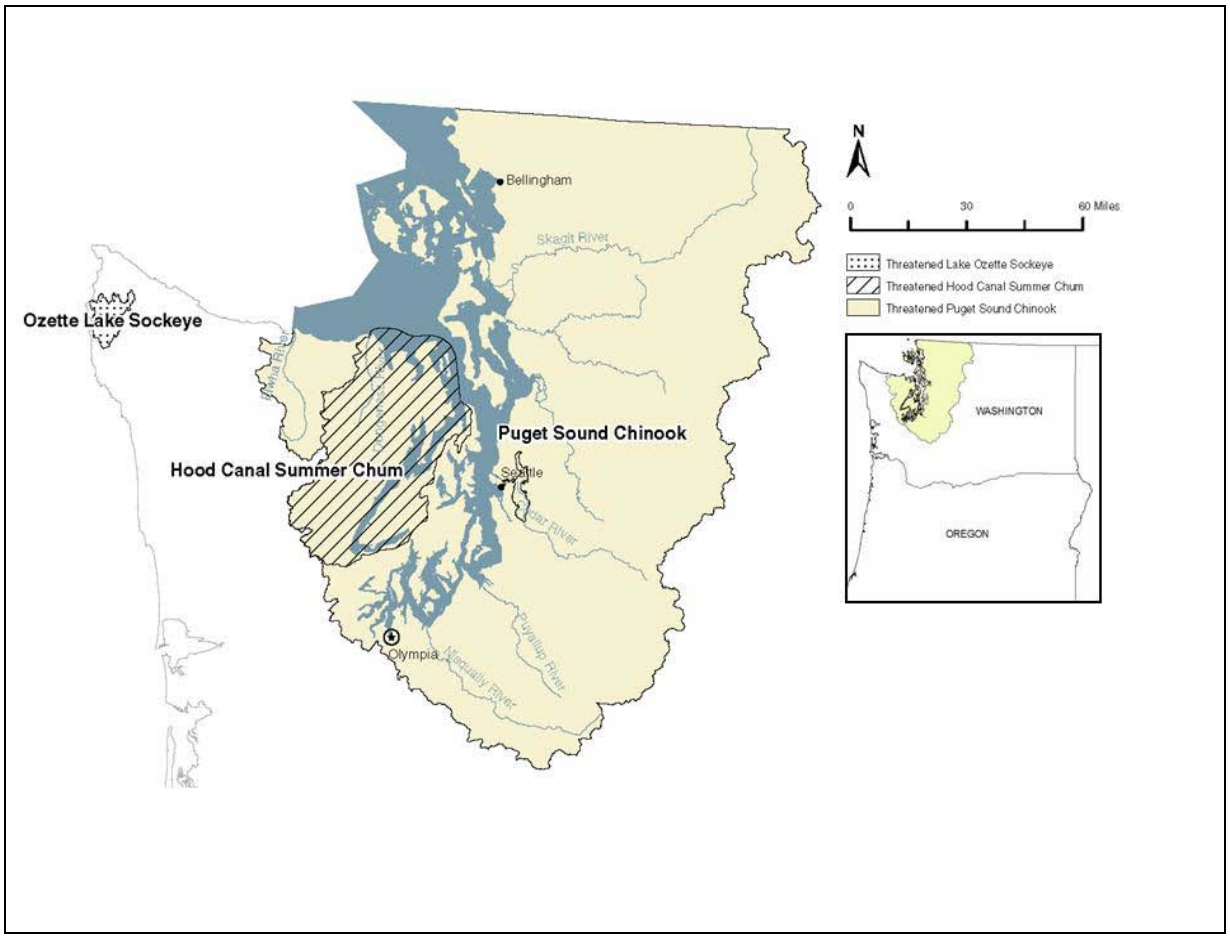

Figure 2. Evolutionarily Significant Units (ESUs) of Puget Sound Chinook salmon and Hood Canal summer chum in the action area.

Fisheries within Puget Sound are managed by WDFW. ESA-listed rockfish and Puget Sound Chinook salmon are incidentally caught in the commercial shrimp trawl fishery and the recreational bottom fish and other fish fishery (herein referred to as the recreational bottom fish fishery) authorized by the state. Eulachon are caught in one state-managed commercial fishery. ESA-listed rockfish and Puget Sound Chinook salmon are also caught in Puget Sound commercial, recreational, and tribal salmon fisheries. Those takes are authorized by NMFS under other authorities[3] and are addressed in this EA as cumulative effects (Section 5.0, Cumulative Impacts).

In 2010, the Washington State Fish and Wildlife Commission formally adopted regulations that ended the retention of rockfish by recreational anglers in Puget Sound and closed fishing for bottom fish (often referred to as demersal fish, or groundfish; the terms bottom fish and groundfish are used interchangeably throughout this document) in waters deeper than 120 feet. On July 28, 2010, WDFW enacted the following package of regulations by emergency rule for the following commercial fisheries in Puget Sound (WDFW 2010a).

1) Closure of the set net fishery
2) Closure of the set line fishery
3) Closure of the bottom trawl fishery
4) Closure of the inactive scallop trawl fishery
5) Closure of the inactive pelagic trawl fishery
6) Closure of the inactive bottom fish pot fishery

As a precautionary measure, WDFW closed the above commercial fisheries westward of the ESA-listed rockfish DPSs boundary to Cape Flattery (Figure 1). WDFW extended the closure west of the rockfish DPSs boundary to prevent commercial fishermen from concentrating gear in that area. The WDFW made these fisheries adjustments as proactive implementation measures to minimize the possibility of take of yelloweye rockfish, canary rockfish, and bocaccio, as well as other depressed rockfish species.

The commercial fisheries closures listed above were enacted on a temporary basis (up to 240 days), and WDFW permanently closed them in February 2011. The pelagic trawl fishery was closed permanently by rule on the same date. WDFW conducts Puget Sound fish research activities that include a bottom

[3] NMFS has authorized take of ESA-listed rockfish, Puget Sound steelhead, and Puget Sound Chinook salmon in the Chinook salmon fisheries in the action area through consultations under ESA section 7 because of proposed approvals under ESA section 4(d) rules (see, for example, NMFS Biological Opinion F/NWR/2010/06051).

fish trawl census that has occurred on an annual basis since the late 1980s, a midwater trawl survey, an acoustic trawl survey of Pacific herring (*Clupea harengus pallasi*), and hook and line and tagging studies of non-listed rockfish.

WDFW has developed a Fishery Conservation Plan (FCP) for ESA-listed rockfish and seeks an ~~incidental take permit (~~ITP~~)~~ under ESA section 10(a)(1)(B) for incidental take of ESA-listed yelloweye rockfish, canary rockfish, and bocaccio from recreational bottom fishing, and incidental take of ESA-listed rockfish and eulachon (*Thaleichthys pacificus*) from commercial shrimp trawling in Puget Sound. WDFW also seeks to include in the ITP Puget Sound Chinook salmon incidentally caught within each fishery. Each fishery is authorized and managed by the State of Washington. Further, WDFW seeks ~~a~~ scientific research permits under ESA section 10(a)(1)(A) for take of ESA-listed rockfish, Puget Sound Chinook salmon, Puget Sound steelhead (*Oncorhynchus omykiss*), Puget Sound summer chum salmon (*O. keta*), green sturgeon (*Acipenser medirostris*), and eulachon resulting from scientific research activities.

1.2. Description of the Proposed Action (Preferred Alternative)

The Preferred Alternative is the same as the Proposed Action, which is for NMFS to issue the requested permits and for WDFW to implement the proposed Fishery Conservation Plan and Puget Sound fish research program. Specifically:

1) NMFS would issue an incidental take permit under section 10(a)(1)(B) of the ESA that would cover the incidental take of ESA-listed rockfish, Chinook salmon, and eulachon in two state-authorized fisheries in Puget Sound—the recreational bottom fish fishery and the commercial shrimp trawl fishery. Pursuant to the Fishery Conservation Plan, WDFW would implement the following measures:

    a. Continue the permanent closure by regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries;

    b. Continue to prohibit fishing for rockfish in Marine Areas 5 through 13;

    c. Continue to prohibit retention of rockfish caught as bycatch in any fishery in Marine Areas 5 through 13;

d. Continue to prohibit bottom fishing in waters deeper than 120 feet throughout the geographic range of the U.S. waters of the Puget Sound/Georgia Basin rockfish DPSs (halibut and salmon fisheries would still be allowed in waters deeper than 120 feet);

e. Require permit holders in the shrimp trawl fishery to have on-board observers on 10 percent of all trips, who would identify and track bycatch; and

f. Continue to allow only beam trawls in the shrimp trawl fishery (no rockhopper gear).

2) NMFS would issue ~~a~~ scientific research permits under section 10(a)(1)(A) of the ESA that would cover the direct take of ESA-listed rockfish, Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer chum, green sturgeon, and eulachon resulting from WDFW scientific research activities on fish, including Puget Sound bottom fish. Activities for the Puget Sound fish research program would include continuation of a bottom fish trawl census that has occurred on an annual basis since the late 1980s, a midwater trawl survey, an acoustic trawl survey of Pacific herring , and hook-and-line and tagging studies of non-listed rockfish.

3) WDFW would report to NMFS annually on the above activities and adapt future fisheries and research efforts as necessary to avoid exceeding take requests.

The proposed permits, Fishery Conservation Plan, and research activities would continue for a period of 5 years. The WDFW has proposed to manage these activities to result in the number of takes shown in Table 1-1.

Table 1-1. Requested maximum annual and 5-year incidental takes for ESA-listed rockfish, Chinook salmon, and eulachon by the commercial shrimp trawl and recreational fisheries for bottom fish and other fish within Puget Sound DPSs.

Species	Recreational		Shrimp Trawl		Annual Takes		5-Year Takes	
	Nonlethal	Lethal	Nonlethal	Lethal	Nonlethal	Lethal	Nonlethal	Lethal
Bocaccio	26	12	0	5	26	17	130	85
Canary Rockfish	81	47	0	10	81	57	405	285
Yelloweye Rockfish	87	55	0	10	87	65	435	325
Eulachon, adult	0	0	0	3,240	0	3,240	0	16,200
PS Chinook salmon*	30	12	0	50	30	62	150	310

*Number of Puget Sound Chinook salmon in the Recreational columns are estimated based on 2008-2010 creel data. These numbers assume a 20 percent sample rate and a 20 percent mortality rate for released Chinook salmon. Take requests for all species from research activities can be found in Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives.

1.3. Purpose of and Need for the Proposed Action

The purpose of and need for the Proposed Action is to allow two state-regulated fisheries to continue by implementing a Fishery Conservation Plan (part of the basis for NMFS' issuance of an Incidental Take Permit) that provides a proactive fisheries management and research/data collection program for the conservation of yelloweye rockfish, canary rockfish, bocaccio, and other ESA-listed fish in the Puget Sound/Georgia Basin DPSs, while at the same time providing commercial and recreational fishing opportunities to the people in the State of Washington. Additionally, ~~a~~ scientific research permits is needed to allow the WDFW Puget Sound fish research program to assess the overall abundance, species assemblages, distribution, and health of a variety of fish including rockfish, salmonids, groundfish, and non-groundfish (pelagic fish).

1.4. Action Area

The action area is all of Puget Sound and the Straits of Georgia and Juan de Fuca westward to the town of Sekiu. The ESA-listed rockfish DPSs include all yelloweye rockfish, canary rockfish, and bocaccio found in waters of the Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill (Figure 1). Research activities conducted by WDFW extend beyond the range of the ESA-listed rockfish DPSs, westward to the town of Sekiu, located on the Strait of Juan de Fuca. Fishing activities that would be covered by the ITP take place in the geographical area of the rockfish DPSs.

Puget Sound is the second-largest estuary in the United States, located in northwest Washington State, covering an area of about 900 square miles (2,330 square kilometers), including 2,500 miles (4,000 kilometers) of shoreline and 14 major river systems, and is home to a rapidly-expanding human population. Puget Sound is part of a larger inland waterway, the Georgia Basin, situated between southern Vancouver Island, British Columbia, Canada, and the mainland coasts of Washington State. Puget Sound can be subdivided into five interconnected basins separated by relatively shallow sills (areas of relatively shallow bathymetry that separate two basins): (1) The San Juan/Strait of Juan de Fuca Basin (also referred to as "North Sound"), (2) Main Basin, (3) Whidbey Basin, (4) South Puget Sound, and (5) Hood Canal. The term ''Puget Sound proper'' within this EA refers to all of these basins except the San Juan/Strait of Juan de Fuca Basin. All five basins have unique temperature regimes, water residence times and circulation patterns, biological condition, depth profiles and contours, species compositions, and nearshore and benthic habitats (Ebbesmeyer et al. 1984; Burns 1985; Rice 2007).

1.5. Relationship to Other Plans and Policies

The Proposed Action and alternatives analyzed in this environmental assessment relate to other Federal, state, tribal, and local organizations' plans and policies addressing rockfish conservation in the Puget Sound/Georgia Basin.

Puget Sound Chinook Harvest Agreement

NMFS reviews harvest of Puget Sound Chinook salmon within section 4(d) of the ESA. Resource Management Plans (RMPs) are developed by the State of Washington and Puget Sound Treaty Tribes. Since 2001, NMFS has received, evaluated, and approved a series of jointly developed RMPs from the Puget Sound Treaty Indian Tribes and WDFW under Limit 6 of the 4(d) Rule. These RMPs provide the framework within which the tribal and state jurisdictions jointly manage all salmon and steelhead gillnet fisheries affecting listed Chinook salmon within the greater Puget Sound area. NMFS issued the current 4(d) determination in 2011, and it extends to April 30, 2014.

Halibut Management Plan

Regulations governing the fisheries for Pacific halibut in the waters of the United States (including state waters) and Canada are developed by the International Pacific Halibut Commission (IPHC) and are accepted by the Secretary of State with the concurrence of the Secretary of Commerce. The IPHC develops its regulations governing the Pacific halibut fishery under the authority of the Convention

between the United States and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and the Bering Sea. WDFW incorporates halibut fishing regulations within state waters in accordance with the annual allocations developed by the IPHC and approved by the Pacific Fishery Management Council and the Secretary of Commerce.

Puget Sound Groundfish Management Plan

Meaningful efforts to protect rockfish in Puget Sound from overharvest began in 1982 when the Washington Department of Fisheries (now WDFW) published their Puget Sound Groundfish Management Plan. This plan identified rockfish as an important commercial and recreational resource in Puget Sound, established catch levels to control harvest, and emphasized recreational fisheries for rockfish while limiting the degree of commercial fishing (Palsson et al. 2009). During the 1980s, WDFW continued to collect information on rockfish harvest with an emphasis on increasing the amount of information available on rockfish bycatch in nontargeted fisheries (e.g., salmon fishery).

WDFW updated the 1982 Groundfish Management Plan in 1986 and, during this same time, WDFW received a Federal grant to monitor recreational catches of rockfish and to collect biological data on rockfish populations in Puget Sound. The state collected information, and WDFW developed new management scenarios but never implemented them (Palsson et al. 2009).

In 1991, WDFW adopted a major change in strategy for rockfish management in Puget Sound. The strategy, called "passive management," ended all monitoring of commercial fisheries for groundfish and collection of biological data (Palsson et al. 2009). In 1996, the Washington State Fish and Wildlife Commission established a new policy for Puget Sound groundfish management. The policy stated that the Commission would manage Puget Sound groundfish, especially Pacific cod, in a conservative manner to minimize the risk of overharvest and to ensure the long-term health of the resource. During the next 2 years, WDFW developed a Groundfish Management Plan (Palsson et al. 1998) that identified specific management objectives to achieve the Commission's preference for a precautionary approach (Palsson et al. 2009). The plan also called for the development of species-specific (including many rockfishes) conservation and use plans. The next step in the sequence of groundfish management by the state was the development of the Puget Sound Rockfish Conservation Plan (WDFW 2010c; WDFW 2011a).

WDFW Puget Sound Rockfish Conservation Plan

WDFW conducted a State Environmental Policy Act (SEPA) review of its Rockfish Conservation Plan (WDFW 2010c). The plan (WDFW 2011a) encompasses more management actions than are addressed in the Fishery Conservation Plan (Subsection 1.2, Description of the Proposed Action) because WDFW is not seeking take coverage for all of the activities in the Rockfish Conservation Plan. The Fishery Conservation Plan is consistent with the Rockfish Conservation Plan's goal of fishery management that will enable the health and productivity of rockfish populations. For instance, the Rockfish Conservation Plan discusses the future use of hatchery supplementation and artificial habitats as a proposed means to augment populations of rockfish and to improve their habitat, but these actions are not a component of this Proposed Action. Consequently, the SEPA review is more comprehensive than the scope of this EA regarding the full suite of possible environmental impacts from implementation of the Rockfish Conservation Plan.

Washington Department of Fish and Wildlife 2010/2011 and 2011/2012 Sportfishing Rules Pamphlet

The current sportfishing regulations for Washington State, which are administered and enforced by WDFW, include regulations specific to rockfish and bottom fish fishing, salmon fishing, halibut fishing, and other fish. The regulations state that "fishing for, or retention of, any species of rockfish is now prohibited in most of Puget Sound (Marine Areas 6 through 13)." Additionally, fishing for bottom fish "in waters deeper than 120 feet is now prohibited because of the need to reduce the catch of rockfish from deep water. Studies have shown that rockfish caught and released from waters deeper than 120 feet suffer high rates of mortality" (WDFW 2010b). This depth restriction does not apply to salmon or halibut fishing; however, any bottom fish caught must be returned to the water (WDFW 2010b). The 2011/2012 pamphlet includes information on rockfish conservation that includes general information about rockfish biology and behavior, and instructions for releasing a rockfish to improve its chances of survival (WDFW 2011b).

Northwest Straits Conservation Initiative, Derelict Gear Program

The Northwest Straits Initiative oversees seven county-based Marine Resource Committees and administers the removal of derelict fishing gear within Puget Sound. The Marine Resource Committees conduct nearshore, intertidal, and estuarine restoration projects; support salmon and bottom fish recovery; and identify and carry out protection strategies for marine species and habitats. The derelict fishing gear program has removed nearly 3,850 derelict fishing nets and over 2,000 crab pots since 2002. The Northwest Straits Initiative reports that more than 211,000 animals representing more than

223 species—including canary rockfish and several other rockfish species—were found entangled in derelict gear (Northwest Straits Initiative 2011).

Puget Sound Chinook Recovery Plan

The Puget Sound Chinook Recovery Plan encompasses 14 local watershed planning areas and the nearshore of Puget Sound with a tailored approach for restoration actions to enable recovery based on local characteristics and conditions. Although this plan focuses on Chinook salmon recovery, it encompasses the broader ecosystem, including the biological processes that create a healthy environment for salmon. NMFS prepared a Federal supplement to the plan and approved it in January 2007 (72 Fed. Reg. 2493, January 19, 2007).

Southern Resident Killer Whale Vessel Regulations

New vessel regulations were recently issued for killer whales (76 Fed. Reg. 20870, April 14, 2011). These regulations prohibit vessels from approaching killer whales within 200 yards (182.9 m) and from parking in the path of whales when in inland waters of Washington State. Certain vessels are exempt from the prohibitions. The purpose of these regulations is to protect killer whales from interference and noise associated with vessels.

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. Introduction

NMFS selected alternatives for this analysis by developing selection criteria from key issues surrounding the incidental take of ESA-listed rockfish in Puget Sound. Selection criteria were developed to meet the purpose and need of the Proposed Action (i.e., the alternative must occur within the action area; restrictions could be imposed, but would need to meet the purpose and need). NMFS then used these criteria to assess the range of reasonable alternatives. The three alternatives selected for analysis met all or most of the criteria established; those that did not meet these criteria and did not meet the purpose of and need for the action were considered but not analyzed in detail, as described below (Subsection 2.2.3, Alternatives Considered but Not Analyzed in Detail). Table 2-1 at the end of this section summarizes key components among the three alternatives.

2.2. Alternatives

2.2.1. No-action Alternative

Under the No-action Alternative, NMFS would not issue an ITP under section 10(a)(1)(B) of the ESA, and WDFW would not implement a Fishery Conservation Plan. Additionally, NMFS would not issue a permit under section 10(a)(1)(A) of the ESA for research activities, and WDFW would not conduct research that may take ESA-listed rockfish. WDFW would continue to manage the commercial and recreational fisheries in Puget Sound that have ESA-coverage, and other fisheries that have no risk of catching ESA-listed rockfish, and would:

1) Continue the closure by permanent regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries (Subsection 1.1, Introduction and Background).

2) Close the recreational bottom fish fishery and commercial shrimp trawl fishery to eliminate the unpermitted bycatch of listed fish[4].

3) Not conduct research on bottom fish and other fish if that research has a risk of taking ESA-listed rockfish.[5]

[4] As mentioned previously, listed fish are also incidentally caught in salmon fisheries in Puget Sound, but those incidental catches are permitted by NMFS under other authorities.

[5] There is considerable research on ESA-listed Puget Sound Chinook salmon, which NMFS authorizes through separate section 4(d) authorizations.

2.2.2. Alternative 2: Proposed Action

Under the Proposed Action, NMFS would issue an ITP under section 10(a)(1)(B) of the ESA and WDFW would implement the Fishery Conservation Plan. Additionally, NMFS would issue a permit under section 10(a)(1)(A) of the ESA for scientific research activities and WDFW would implement the Puget Sound fish research program. Each permit would be effective for a period of 5 years. The plan incorporates fisheries management and research activities and would include the activities described above in Subsection 1.2, Description of the Proposed Action.

2.2.2.1. Fishing Activities under the Proposed Action

The type of fishing that would occur under the Proposed Action includes recreational bottom fishing with hook-and line-gear, and commercial shrimp trawling using bottom trawls. Fishing activities would be representative of those that currently occur in the action area.

Recreational bottom fishing is open for various periods of time within portions of Puget Sound. A few species, such as flatfish (other than halibut) and surfperch, can be legally harvested year-round in most areas of Puget Sound, but other fisheries have defined seasons. During May and the first half of June, anglers are permitted to fish for lingcod (*Ophiodon elongates*) throughout most of Puget Sound. The lingcod fishery is the most popular of the bottom fish fisheries in Puget Sound (Pacunski and Palsson 2001). Anglers use large jigs, artificial worms, and live bait such as herring, flatfish, and kelp greenling while targeting lingcod and other bottom fish (Olander 1991; Martinis 2008). Fishing for cabezon (*Scorpaenichthys marmoratus*) in Marine Catch Areas (MCAs) 6 to 13 is only permitted from May 1 to November 30, and fishing for codfishes is allowed year-round in MCAs 6 and 7, but prohibited in MCAs 8 to 13. Hood Canal (MCA 12) has been closed to bottom fishing since 2002 because of the adverse impacts of hypoxia. From 2004 through 2009 the number of angler trips targeting bottom fish ranged between 68,000 and 105,000 annually (compared to approximately 350,000 angler trips targeting salmon) and caught an average of 113,000 fish annually (WDFW 2011a), and NMFS expects similar fishing efforts to occur under the Proposed Action. Recreational salmon and halibut fisheries also result in bycatch of listed rockfish, though these fisheries are not addressed in WDFW's fishery conservation plan because each are permitted by NMFS under other authorities.

The shrimp trawl fishery occurs in the San Juan/Strait of Juan de Fuca Basin of Puget Sound. The fishery uses a beam trawl, consisting of a bag-shaped trawl net utilizing a beam to spread the mouth of the net horizontally as it is towed and does not have weighted otter frames or otter doors.

Only beam trawls are legal trawl gear in the Puget Sound commercial shrimp fishery. The minimum mesh size for Puget Sound beam trawl nets is 1.5 inches (3.8 centimeters) stretch measure. The maximum beam width is 60 feet (18.29 meters) in the eastern Strait of Juan de Fuca, and 25 feet (7.62 meters) in the San Juan Islands.

From 2005 to 2010 the shrimp trawl fishery averaged 193 individual trips, with an average of 5 tows per trip (WDFW 2011d). Observers have not been regularly deployed in this fishery, though WDFW has observed several trips over the past 10 years that allow estimates and composition of bycatch. From this data, bycatch is estimated to be approximately 15,759 pounds of fish annually. Beam trawls are towed for several minutes in waters restricted to deeper than 120 feet. Beam trawls can only be operated effectively over level bottoms such as mud, sand, and gravel (Roberts 2008). Rockhopper trawl gear is not allowed by WDFW (WDFW 2011d).

2.2.2.2. Research Activities under the Proposed Action

WDFW conducts research of Puget Sound fishes on an annual basis to assess their overall abundance, species assemblages, distribution, and health (WDFW 2011d). The type of research that would occur under the Proposed Action would be representative of the existing research program that occurs in the action area. The Puget Sound fish research program would include bottom and midwater trawl surveys, hook-and-line capture, and tagging of rockfish. Acoustic-midwater trawl studies for Pacific herring and Pacific hake (whiting, *Merluccius productus*) are designed to estimate the abundance of these pelagic species in key areas in Puget Sound. Midwater trawling operations are conducted from a 58-foot (17.7-meter) steel vessel that is used to tow a midwater rope trawl. The rope trawl has meshes ranging in size from 2.6 feet (0.8 meters) at the throat, to mesh sizes that decrease to 1.5 inches (3.8 centimeters) at the cod end of the net. There is a liner in the cod end that consists of 0.39-inch (1 cm) knotless mesh. The net is towed for a duration of 10 minutes to 2 hours, depending upon the needed sample amount.

WDFW conducts a systematic bottom trawl index survey of Puget Sound. The index survey deploys a bottom trawl twice at 51 pre-selected, permanent stations (between 102 to 200 trawls annually). The stations are stratified by depth and were initially selected at random within one of four depth zones. The depth zones are 30 to 120 feet (9 to 36.7 meters), 120 to 240 feet (36.7 to 73 meters), 240 to 358 feet (73 to 109 meters), and greater than 358 feet (109 meters). The bottom trawl is a 400 mesh Eastern Trawl fitted with a 1.8-inch (3-centimeter) mesh liner. The net is attached to heavy steel doors on each side and the entire assembly is towed along the seafloor for a distance of approximately 0.46 miles (0.74 kilometers) at a speed of 2.3 miles per hour (2 knots). The trawl is towed for 5 to 20 minutes at

each station. Puget Sound assessment and monitoring program bottom trawl surveys occur during odd years. This index survey samples at fixed locations and places of interest to collect English sole (*Parophrys vetulus)* and other species of interest at selected sites throughout Puget Sound.

The final research category is biological sampling using hook-and-line. Fish are sampled for tissue, held for broodstock, or sacrificed for more in-depth analysis. The primary species of interest are lingcod, greenlings, flatfishes, wolf-eels, rockfishes, and codfishes. Hook-and-line gear are used to sample the adult and juvenile phases of non-listed rockfishes, lingcod, Pacific cod, flatfishes, and other groundfish species. No yelloweye rockfish, canary rockfish, or bocaccio are targeted, and sampling would occur in water depths less than 120 feet (39 meters), which is shallower than these fish are typically found and thus it is unlikely that they would be caught.

2.2.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

Alternative 3 would be similar to Alternative 2; NMFS would issue an ITP under section 10(a)(1)(B) of the ESA, and WDFW would implement the Fishery Conservation Plan. As under the Proposed Action Alternative, NMFS would also issue a section 10(a)(1)(A) permit for scientific research activities and WDFW would conduct rockfish research. Each permit would be effective for a period of 5 years. Under this alternative, WDFW would take some of the same actions as under the Proposed Action Alternative (Subsection 1.2, Description of the Proposed Action), except:

1) WDFW would manage the recreational bottom fish fishery without a 120-foot depth restriction throughout Puget Sound, and

2) WDFW would not require on-board observers for the commercial shrimp trawl fishery. The absence of on-board observers would require commercial shrimp trawl fishermen to document their own bycatch.

These two measures are part of the Fishery Conservation Plan and the Proposed Action, but it is reasonable to consider an alternative that does not include them as they represent the recent characteristics of these fisheries prior to the rockfish ESA listing.

2.2.4. Alternatives Considered but Not Analyzed in Detail

2.2.4.1. Additional Conservation Measures—Inclusion of Marine Protected Areas in the Fishery Conservation Plan

The establishment of Marine Protected Areas within the DPSs would assist with ESA-listed rockfish conservation because it would prevent activities that could result in the catch of protected species in these specified areas. Establishment of Marine Protected Areas may be a valuable recovery action for ESA-listed rockfish; however, while this possible alternative would likely meet the purpose of and need for this action, NMFS does not have enough information to determine the actual value to the covered species of designating Marine Protected Areas. NMFS is currently collecting information to make an informed assessment of this management strategy. Consequently, inclusion of this alternative in this EA would be premature because the analysis would be speculative until more information is collected and analyzed.

2.2.4.2. Continued Fisheries Management Without a Section 10(a)(1)(B) ITP and Do Not Issue ~~a~~ Research Permits

Under this alternative, WDFW would continue to authorize the commercial and recreational fisheries that incidentally take ESA-listed rockfish, but without ESA coverage for the direct take of federally-listed species from research activities. This alternative would not further the purpose and need for conserving ESA-listed species because it would preclude fishery conservation efforts through valuable research, and thus would not provide conservation measures that address potential incidental take of ESA-listed rockfish in the two fisheries.

WDFW is mandated to maintain the economic well-being and stability of the fishing industry in the state while also conserving fisheries resources (RCW 77.04.012). As such, it seeks take coverage of some ESA-listed fish species to both provide a fishing opportunity for non-listed fish and to conduct research designed to gain further understanding of listed fish and their habitats. In addition, lack of Federal involvement in the fishery or research activities via an ITP and section 10(a)(1)(A) permit could limit or preclude collaborative work between NMFS and WDFW to conserve and protect ESA-listed rockfish.

For the EA analysis, a distinction was made between this potential alternative and the No-action Alternative. Under this potential alternative, WDFW would continue to approve fisheries that incidentally catch ESA-listed rockfish, but would not manage those fisheries to further reduce bycatch of ESA-listed rockfish and would not conduct research activities. Under the No-action Alternative,

WDFW would close the recreational bottom fish fishery and commercial shrimp trawl fishery to eliminate future bycatch from these two fisheries.

2.2.4.3. Section 10(a)(1)(B) ITP Issuance for Fisheries Management, but No Section 10(a)(1)(A) Permit Issuance for Research Activities

Providing ITP coverage for fisheries but eliminating section 10(a)(1)(A) permit issuance for WDFW research activities would not be consistent with the purpose and need because it would result in less future data regarding ESA-listed rockfish status and other listed fish, and thus less information for future species conservation efforts. This would be contrary to the need for more information regarding these species to inform management decisions intended to promote the survival and recovery of ESA-listed rockfish and other listed species. For instance, WDFW's research would be a valuable information source for recovery planning for ESA-listed rockfish. Because the No-action Alternative does not include research activities, a separate analysis to address impacts or benefits from eliminating research coverage would not likely garner a measurable distinction from the analysis under the No-action Alternative or the Proposed Action.

2.2.4.4. No Section 10(a)(1)(B) ITP Issuance for Fisheries Management, Section 10(a)(1)(A) Permit Issuance for Research Activities

WDFW is mandated to maintain the economic well-being and stability of the fishing industry in the state while also conserving fisheries resources (RCW 77.04.012). Further, the state must maximize public recreational fishing opportunities (RCW 77.04.012). Not issuing an ITP for each fishery would not preclude all saltwater fishing opportunities; however, because of the risk of incidentally taking ESA-listed rockfish, Puget Sound Chinook salmon, and eulachon, the recreational bottom fish and commercial shrimp trawl fisheries could be curtailed by the state to meet its mandate to conserve and protect fish in state waters (RCW 77.04.012). Lack of ESA coverage could, therefore, reduce opportunities for many residents of the Puget Sound/Georgia Basin area to fish for and/or purchase locally-caught non-ESA-listed fish and shrimp.

2.2.4.5. Issuance of a Section10(a)(1)(A) Permit for Research Activities and Section 10(a)(1)(B) ITP Issuance for Fisheries Management in an Expanded Geographic Area or in a Smaller Geographic Area

Under this potential alternative, the ITP for recreational bottom fishing and commercial shrimp trawls would cover fisheries occurring in areas outside the action area, or in smaller areas within it. It would not be practical or necessary to analyze rockfish bycatch effects outside of the action area (i.e., an expanded geographic area from the area under the Proposed Action) because the scope of WDFW

research efforts on Puget Sound fish has established these boundaries. Additionally, ESA coverage of a smaller subset of the action area would not address take of listed species that may occur across the Puget Sound, and would thus preclude a more comprehensive fisheries and research management approach.

The section 10(a)(1)(A) permit would cover research efforts that occur in the Strait of Juan de Fuca, westward of, but near, the ESA-listed rockfish DPS. By including all DPSs and the Strait of Juan de Fuca in the research area, NMFS is able to work comprehensively with WDFW to collect research data on these protected species, learn more about the ecosystem, and limit and monitor bycatch across the entire range of the DPSs. Consequently, changing the geography of the fisheries and research activities covered by the ITP and 10(a)(1)(A) permit for EA analysis is not warranted because expanding or reducing the full covered area would not fully address impacts to each species from these activities.

2.2.4.6. ITP Issuance for an Expanded or Reduced Number of Listed Species

Eliminating or adding species from the requested ITP coverage to form a new alternative was not warranted because the purpose and need is to specifically address ESA-listed rockfish and other listed fish. The purpose and need is intended to comprehensively address activities that have the potential to take ESA-listed rockfish directly or incidentally in a specific geographic area.

2.3. Comparison of Alternatives

Table 2-1. Comparison of Alternatives.

	No-action Alternative	**Alternative 2: Proposed Action (Preferred Alternative)**	**Alternative 3: Similar to Proposed Action, but with Fewer Restrictions**
ESA Section 10(a)(1)(B) Incidental Take Permit	No	Yes	Yes
ESA Section 10(a)(1)(A) Permit Issuance for Research Activities	No	Yes	Yes
Fishery Conservation Plan	No Fishery Conservation Plan would be implemented.	WDFW would implement a Fishery Conservation Plan to manage recreational bottom fishing and commercial shrimp trawl fisheries to track and reduce bycatch through adaptive management; 5-year term.	Same as Alternative 2.
WDFW Fishery Closures and Rockfish Regulations	• Continue the closure by regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries. • Close recreational bottom fish fishery. • Close shrimp trawl fishery. • No guarantee fisheries would remain closed.	• Continue the closure by regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries. • Allow bottom fishing in waters less than 120 feet deep. • Allow shrimp trawl fishery with observers on 10% of trips. • 5-year term.	• Continue the closure by regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries. • Allow bottom fishing in all waters. • Allow shrimp trawl fishery without requiring observers (self-reporting). • 5-year term.
WDFW Research on Puget Sound Fish	No research that has a chance of taking ESA-listed species.	WDFW would conduct research on bottom fish (including rockfish) and other fish.	Same as Alternative 2.
WDFW Reports to NMFS Annually on Above Activities	No report.	Annual report to NMFS on the above activities.	Same as Alternative 2.

3. AFFECTED ENVIRONMENT

This section describes those resources that may be affected by the Proposed Action and its alternatives, to the extent necessary to understand potential impacts. Resources that would not be potentially affected by the Proposed Action are not included in this review. For species addressed in this section, the term "life-history expression" is used. This term refers to the ability of a species to express its natural behavior and reproductive potential.

3.1. Marine Ecosystem and Habitat

The Puget Sound and Georgia Basin is the southern arm of an inland sea located on the Pacific Coast of North America and directly connected to the Pacific Ocean. Puget Sound is the second largest estuary in the United States, as described in Subsection 1.4, Action Area. Most of the water exchange in Puget Sound proper is through Admiralty Inlet (Figure 1), and the configuration of sills and deep basins results in the partial recirculation of water masses and the retention of contaminants, sediment, and biota (Rice 2007). Tidal action, freshwater inflow, and ocean currents interact to circulate and exchange salty marine water at depth from the Strait of Juan de Fuca, and less dense fresh water from the surrounding watersheds at the surface producing a net seaward flow of water at the surface (Rice 2007).

Most of the benthic habitats of Puget Sound proper consist of unconsolidated sediments such as sand, mud, and cobbles. The vast majority of the rocky-bottom areas of Puget Sound occur within the San Juan Basin, with the remaining portions spread among the rest of Puget Sound proper (Palsson et al. 2009). Depths in the Puget Sound extend to over 920 feet (280 meters). Mean depths in each of the major basins of the DPSs include 113 feet (34.7 meters) in the San Juan/Strait of Georgia Basin, 206 feet (63 meters) in the Whidbey Basin, 323 feet (98.5 meters) in the Main Basin, 147 feet (45.1 meters) in the South Sound, and 176.5 feet (53.8 meters) in Hood Canal (Burns 1985). The nearshore of Puget Sound includes intertidal waters extending outward to the termination of the photic zone (upper layer of a water body delineated by the depth at which enough sunlight can penetrate to allow photosynthesis), which is approximately 90 feet (27 meters) deep. Habitats of the nearshore are naturally dynamic; wave energy and sediment inputs from local streams, rivers, and beach bluff erosion cause fluctuating habitat conditions and sediment levels (Downing 1983).

Habitats within the Puget Sound/Georgia Basin have been influenced by a number of factors. Nearly one-third of the nearshore habitat has been developed, which has degraded juvenile rockfish and salmonid rearing habitat (Subsection 3.2.1.1, Rockfish Life History). Benthic habitats have been altered

by derelict fishing gear and water quality problems such as reduced levels of dissolved oxygen and inputs of toxins such as metals, bioaccumulative chemicals, and petroleum products from sources such as surface runoff, wastewater discharges, spills, migration of contaminated biota, and groundwater discharge (Palsson et al. 2009; Washington State Department of Ecology 2011). The vast majority of derelict fishing gear is from gill nets used in salmon fisheries and crab pots; as of 2010, only two of 902 recovered nets were trawl nets (Good et al. 2010). The most likely pollutants attributable to the operation of fishing and research vessels are in the class of compounds known as polycyclic aromatic hydrocarbons (PAHs). These include diesel fuel, gasoline, and lubricants that might be spilled directly into the water; unburned fuels and oils associated with the operation of two-cycle engines such as outboard motors; and deposition of the products of combustion from larger vessel engines. PAHs have limited solubility in water (Varanasi 1989) and are typically not found free in the water column. Lighter fractions tend to come to the surface where they evaporate. PAHs are not known to bioaccumulate within vertebrates such as fish.

These changes to habitat have occurred in each of the individual basins of Puget Sound, but the various levels-of-impact to ESA-listed rockfish from these stressors is dependent upon the particular basin. For instance, low levels of dissolved oxygen is a chronic issue within Hood Canal, while impacts from derelict fishing gear appear to be most acute within North Sound (Palsson et al. 2009; Good et al. 2010). The removal of some derelict fishing gear has improved habitat conditions for rockfish and other biota (Palsson et al. 2009). As mentioned in Subsection 3.2.2, Salmonids, Subsection 3.2.4, Green Sturgeon, and Subsection 3.4, Marine Mammals and Turtles, critical habitat has been designated for Puget Sound Chinook salmon, Hood Canal chum salmon, bull trout, green sturgeon, and southern resident killer whales in portions of Puget Sound. Essential Fish Habitat (EFH) in Puget Sound has been listed for 44 species of groundfish, in addition to several species of salmonids and some coastal pelagic species (Appendix B: Species of Fishes with Designated EFH in the Action Area).

3.2. ESA-listed Fish

3.2.1. Rockfish Species

The Puget Sound/Georgia Basin DPSs of yelloweye rockfish and canary rockfish are listed as threatened, and bocaccio are listed as endangered under the ESA (75 Fed. Reg. 22276, April 28, 2010).

3.2.1.1. Rockfish Life History

The life histories of yelloweye rockfish, canary rockfish, and bocaccio include larval and pelagic juvenile stages followed by a juvenile stage in shallower waters, and a sub-adult/adult stage. Much of the life history of these three species is similar, with differences noted below.

Rockfish are iteroparous (i.e., have multiple reproductive cycles during their lifetime) and are typically long-lived (Love et al. 2002). As such, they are examples of populations that may persist through what has been termed "the storage effect" where long-lived species are able take advantage of sporadically good conditions for survival of offspring (Warner and Chesson 1985; Tolimieri and Levin 2005). Recruitment is generally poor because larval survival and settlement are dependent upon the vagaries of climate, abundance of predators, oceanic currents, and chance events. Being long-lived allows each species to persist through many years of poor reproduction until a good recruitment year occurs. The relative importance of these factors are not readily understood in the Puget Sound/Georgia Basin.

Larval and Pelagic Juvenile Stage

Rockfish fertilize their eggs internally, and the young are extruded as larvae. Larvae can make small local movements to pursue food immediately after birth (Tagal et al. 2002), but are nonetheless distributed by prevailing currents (Drake et al. 2010). Larvae and pelagic juveniles occur throughout the water column (Love et al. 2002; Weis 2004). Oceanographic conditions within Puget Sound proper likely result in the larvae staying within the basin where they are born rather than being broadly dispersed by tidal action or currents (Subsection 1.4, Action Area) (Drake et al. 2010).

Juvenile Stage

When bocaccio and canary rockfish reach sizes of 1 to 3.5 inches (3 to 9 centimeters) or 3 to 6 months old, they settle into shallow, nearshore waters in rocky or cobble substrates with or without kelp (Love et al. 1991; Love et al. 2002). This habitat feature offers a beneficial mix of warmer temperatures, food, and refuge from predators (Love et al. 1991). Areas with floating and submerged kelp species support the highest densities of juvenile bocaccio and canary rockfish, as well as many other rockfish species (Carr 1983; Halderson and Richards 1987; Matthews 1989; Love et al. 2002; Hayden-Spear 2006). Unlike bocaccio and canary rockfish, juvenile yelloweye rockfish do not typically occupy intertidal waters (Love et al. 1991; Studebaker et al. 2009), but are most frequently observed in waters deeper than 98 feet (30 meters) near the upper depth range of adults (Yamanaka et al. 2006).

Sub-adult/Adult Stage

Sub-adult and adult yelloweye rockfish, canary rockfish, and bocaccio typically use habitats with moderate to extreme steepness, complex bathymetry, and rock and boulder-cobble complexes (Love et al. 2002). Within Puget Sound proper, each species has been documented in areas of high relief rocky and non-rocky substrates such as sand, mud, and other unconsolidated sediments (Washington 1977; Miller and Borton 1980). Yelloweye rockfish remain near the bottom and have small home ranges, while some canary rockfish and bocaccio have larger home ranges, move long distances, and spend time suspended in the water column (Love et al. 2002). Adults of each species are most commonly found between 131 to 820 feet (40 to 250 meters) (Love et al. 2002; Orr et al. 2000). In British Columbia, Canada 5.5 percent of yelloweye rockfish were caught with recreational fishing methods in waters shallower than 131 feet (40 meters), and the rest of the caught fish were in depths from 131 to 328 feet (40 to 100 meters) (Richards and Cass 1985). In the San Juan Basin, WDFW documented that the vast majority of yelloweye rockfish were observed in waters deeper than 120 feet (37 meters) (Pacunski et al. 2009).

Yelloweye rockfish are one of the longest lived of the rockfishes, reaching more than 100 years of age. Yelloweye rockfish reach 50 percent maturity at sizes of 16 to 20 inches (40 to 50 centimeters) and ages of 15 to 20 years (Rosenthal et al. 1982; Yamanaka and Kronlund 1997). The maximum age of canary rockfish is at least 84 years (Love et al. 2002), although 60 to 75 years is more common (Caillet et al. 2000). Canary rockfish reach 50 percent maturity at sizes around 16 inches (40 centimeters) and ages of 7 to 9 years. The maximum age of bocaccio is unknown, but may exceed 50 years. Bocaccio are reproductively mature near age 6 (FishBase 2010). The timing of larval release for each species varies throughout their geographic range of the west coast. In Puget Sound, there is some evidence that larvae are extruded in early spring to late summer for yelloweye rockfish (Washington et al. 1978). In British Columbia, parturition (the process of giving birth) peaks in February for canary rockfish (Hart 1973; Westrheim and Harling 1975). Along the coast of Washington State, female bocaccio release larvae between January and April (Love et al. 2002). Mature females of each species produce from several thousand to over a million eggs annually (Love et al. 2002).

3.2.1.2. Current Status

In the following section, the status of yelloweye rockfish, canary rockfish, and bocaccio is summarized at the DPS level according to the following demographic viability criteria: abundance and productivity, spatial structure/connectivity, and diversity. These viability criteria are outlined in McElhaney et al.

(2000), and reflect concepts that are well-founded in conservation biology and are generally applicable to a wide variety of species. These criteria describe habitat limiting factors and demographic risks that individually and collectively provide strong indicators of extinction risk (Drake et al. 2010).

A number of factors affect the current status of rockfish and their prey in the Puget Sound/Georgia Basin (75 Fed. Reg. 22276, April 28, 2010). Derelict fishing gear, such as lost fishing nets and shrimp pots, kill rockfish and their various prey. Excess nutrients entering Puget Sound impact habitat suitability in some areas (e.g., Hood Canal) by creating low dissolved oxygen levels. Some contaminants within Puget Sound bioaccumulate, possibly resulting in reproductive impairment of rockfish. Nearly one-third of the nearshore of Puget Sound has been degraded by development. This development impairs the productivity of food sources of rockfish, as well as altering the quality of rearing habitats for juvenile canary rockfish and bocaccio. As with nearly all marine species of the Puget Sound, oil spills represent a significant risk to rockfish and their prey sources. Finally, bycatch in fisheries affects listed rockfish viability parameters.

Abundance and Productivity

The abundance of individuals in a population is important to assessing two aspects of extinction risk. First, population size can be an indicator of whether the population can sustain itself in the face of environmental fluctuations, random behaviors, and unpredictability of reproductive success of a small-population. Second, abundance in a declining population is an indicator of the time expected until the population reaches critically low numbers (Drake et al. 2010). Rockfish species with low abundance are subject to the following risks: (1) environmental variation such as altered temperature regimes and circulation patterns that could disrupt food webs, larval dispersal, or juvenile rearing, (2) genetic processes such as the accumulation of negative mutations, (3) demographic unpredictability such as imbalanced gender ratios, (4) ecological feedback such as other fish species occupying the niche left by the depleted population, and (5) catastrophes such as oil spills that may disrupt benthic environments or larval/juvenile rearing habitats and food sources (McElhaney et al. 2000). Low abundance may also pose a risk to the species by making them vulnerable to depensatory processes (termed “Allee” effects) that occur when mates cannot find one another (Courchamp et al. 2008).

There is no single reliable historic or contemporary population estimate for any of the DPSs (Drake et al. 2010). Despite this limitation, there is clear evidence (based on catch data) that each species’ abundance has declined dramatically (Drake et al. 2010). The total rockfish population in the Puget Sound region is estimated to have declined approximately 3 percent per year for the past several

decades, which corresponds to an approximate 70 percent decline from 1965 to 2007 (Drake et al. 2010). Catches of yelloweye rockfish, canary rockfish, and bocaccio have declined as a proportion of the overall rockfish catch (Palsson et al. 2009; Drake et al. 2010).

Fishery-independent estimates of population abundance come from spatially and temporally limited research trawls, drop camera surveys, and underwater, remotely-operated vehicle (ROV) surveys conducted by WDFW. Using these methods, WDFW has estimated that 50,655 yelloweye rockfish, 20,449 canary rockfish, and 4,487 bocaccio inhabit the North Sound, while there are no population estimates for the rest of the Puget Sound region (NMFS 2011). Most of the fish WDFW observed (and used to inform population estimates) were in the North Sound portion of the DPSs. These population estimates have generally large variances (or standard errors), and thus there remains uncertainty regarding the total abundance and distribution of ESA-listed rockfish in the Puget Sound/Georgia Basin DPSs. In addition, there have been no historic or contemporary population estimates for any ESA-listed rockfish species in Puget Sound proper.

Productivity is the measurement of a population's growth rate through all or a portion of its life cycle. Life history traits of yelloweye rockfish, canary rockfish, and bocaccio suggest generally low levels of inherent productivity because they are long-lived and mature slowly, with sporadic episodes of successful reproduction (Tolimieri and Levin 2005; Drake et al. 2010). This naturally low-productivity can be exacerbated by fishery removals, environmental toxicity, and habitat changes derived from environmental regime changes.

Historic overfishing can have dramatic impacts on the size or age structure of a population, with effects that can influence ongoing productivity. Similarly, fishery bycatch (including derelict fishing nets) affects ongoing productivity by removing larger individuals from the population. When the size and age of females decline, there are negative impacts to reproductive success. These impacts, termed maternal effects, are evident in a number of traits. Larger and older females of various rockfish species have a higher weight-specific fecundity (number of larvae per unit of female weight) (Boehlert et al. 1982; Bobko and Berkeley 2004; Sogard et al. 2008). A consistent maternal effect in rockfishes relates to the timing of parturition. The timing of larval birth can be crucial in terms of coinciding with favorable oceanographic conditions because most larvae are released on only one day each year, with a few exceptions in the southern coastal populations and in yelloweye populations in Puget Sound (Washington et al. 1978). In several studies of rockfish species, larger or older females release larvae earlier in the season compared to smaller or younger females (Sogard et al. 2008; Nichol and Pikitch

1994). Larger or older females provide more nutrients to larvae by developing a larger oil globule, released at parturition, which provides energy to the developing larvae (Berkeley et al. 2004; Fisher et al. 2007) and enhances early growth rates (Berkeley et al. 2004).

Contaminants such as polychlorinated biphenyls (PCBs), chlorinated pesticides, polybrominated diphenyl ethers, polychlorinated dioxins/furans (collectively referred to as bioaccumulative chemicals) have been introduced into Puget Sound from industrial and non-point (e.g., roads) sources, and appear in rockfish collected in urban areas of Puget Sound, such as Port Gardner, Elliot Bay, and Commencement Bay (West et al. 2001; Palsson et al. 2009). While the highest levels of contamination are found in urban areas, toxins can be found in the tissues of salmon and forage fish throughout the region (Puget Sound Action Team 2007).

Reproductive function and therefore productivity of rockfish is likely affected by contaminants (Palsson et al. 2009). Adverse reproductive effects in rockfish could occur via maternal transfer of bioaccumulative chemicals to larvae.

Future climate-induced changes to rockfish habitat could alter their productivity (Drake et al. 2010). Harvey (2005) created a generic bioenergetic model for rockfish, showing that productivity of rockfish is highly influenced by climate conditions. For example, El Niño-like conditions generally lowered growth rates and increased generation time. The negative effect of the warm water conditions associated with El Niño appear to be common across rockfishes (Moser et al. 2000). Survival of juvenile rockfish may be correlated to climate conditions that occur across large areas of the ocean (Field and Rawson 2005). Exactly how climate influences rockfish in Puget Sound is unknown; however, given the general importance of climate to rockfish recruitment, it is likely that climate strongly influences the dynamics of the ESA-listed rockfish population productivity and therefore their overall population viability (Drake et al. 2010).

Spatial Structure and Connectivity

Spatial structure consists of a population's geographical distribution and the processes that generate that distribution (McElhaney et al. 2000). A population's spatial structure depends on habitat quality, spatial configuration, and dynamics as well as dispersal characteristics of individuals within the population (McElhaney et al. 2000).

The apparent steep reduction of ESA-listed rockfish in Puget Sound proper leads to concerns about the viability of these populations (Drake et al. 2010). Yelloweye rockfish spatial structure and connectivity is likely threatened by the apparently severe reduction of fish numbers throughout all or portions of Hood Canal and South Puget Sound, combined with their apparently small home ranges as adults. Similarly, several historically large aggregations of canary rockfish in Puget Sound have been depleted, including an area of historic distribution in South Puget Sound (Drake et al. 2010). Bocaccio were historically most abundant in the Central and South Puget Sound (Olander 1991), but are now rarely observed in these areas (Drake et al. 2010).

For canary rockfish and bocaccio, positive signs for improved spatial structure and connectivity come from the propensity of some adults and pelagic juveniles to migrate long distances, which could reestablish aggregations of fish in formerly occupied habitat (Drake et al. 2010).

Diversity

Rockfish diversity characteristics are fecundity, timing of the release of larvae and their condition, morphology, age at reproductive maturity and physiology, and molecular genetic characteristics. In spatially and temporally varying environments, there are three general reasons why diversity is important for species and population viability: (1) diversity allows a species to use a wider array of environments, (2) it protects a species against short-term spatial and temporal changes in the environment, and (3) genetic diversity provides the raw material for surviving long-term environmental changes. Though there are no genetic data for any of the listed DPSs, the unique oceanographic features and relative isolation of some of its basins may have led to unique adaptations, such as larval release timing (Drake et al. 2010).

ESA-listed rockfish size (and age) distributions have been truncated, which likely hampers diversity in terms of larval release timing and energy reserves. Recreationally caught yelloweye rockfish, canary rockfish, and bocaccio in the 1970s spanned a broad range of sizes. By the 2000s, there was evidence of proportionately fewer older fish (Drake et al. 2010). For each species, the reproductive burden may be shifted to younger and smaller fish. This shift could alter the timing and condition of larval release, which may be mismatched with habitat conditions in Puget Sound, potentially reducing the offspring's viability (Drake et al. 2010).

Incidental Catch in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities

Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives lists the total number of ESA-listed rockfish estimated to be taken under the various alternatives. Alternative 3 is the closest approximation to the number of ESA-listed yelloweye rockfish and canary rockfish taken in recent (pre-2010) recreational bottom fish fisheries because it does not include the 120-foot restriction. No bocaccio were reported as caught in pre-2010 recreational bottom fishing (WDFW 2011c).

There are a number of uncertainties related to catch estimates from the recreational bottom fish fishery, including anglers correctly identifying rockfish to species, and not all anglers being surveyed after every fishing trip. Anglers have a poor ability to correctly identify rockfish to species (Bargmann 1981). Catch estimates are subject to non-sampling bias, especially under-reporting as observed by Diewert et al. (2005) who found higher proportions of released rockfish in independently observed, released catch compared to released catch reported during creel checks. These uncertainties are greater for bocaccio than yelloweye rockfish and canary rockfish because, as described in Subsection 3.2.1.2, Current Status, they are less abundant than either species, thus anglers are less familiar with them. The 120-foot depth restriction was implemented in 2010; thus, bottom fish fisheries takes that occurred up to 2009 most approximate recent fisheries catch data. Year 2010 fisheries catch estimates for ESA-listed rockfish are not yet available.

3.2.2. Salmonids

ESA-listed salmonids in the action area include Puget Sound Chinook salmon, which were listed as threatened under the ESA on March 24, 1999 (64 Fed. Reg. 14308); Hood Canal summer chum salmon, which were listed as threatened under the ESA on March 25, 1999 (64 Fed. Reg. 14508); and Puget Sound steelhead, which were listed as threatened under the ESA on May 11, 2007 (72 Fed. Reg. 26722). All bull trout (*Salvelinus confluentus*) in the coterminous United States were listed as threatened under the ESA on November 1, 1999 (64 Fed. Reg. 58909). NMFS has adopted a recovery plan for the listed Puget Sound Chinook salmon ESU (Figure 2) in 2007 (72 Fed. Reg. 2493, January 19, 2007) and has proposed a recovery plan for the Hood Canal summer-run chum salmon ESU (Figure 2) (Hood Canal Coordinating Council 2006). Both of these documents provide detailed information on abundance, productivity, and spatial structure and diversity (collectively termed “viability criteria”) for populations of each species. Viability criteria for Puget Sound steelhead can be found within the NMFS

status review (Hard et al. 2007). Viability criteria for bull trout are discussed in the draft recovery plan for this species (USFWS 2004).

3.2.2.1. Puget Sound Chinook Salmon

Life History

Chinook salmon are anadromous, meaning they spawn as adults and rear as juveniles in fresh water, then travel to the ocean to feed and grow to maturity. After they hatch, juvenile Chinook salmon can remain in fresh water from several months to nearly 2 years prior to their movement to the ocean, and remain in the ocean from 1 to 6 years (Healey 1991). On an annual basis several million juvenile Chinook salmon use the nearshore and deeper waters of Puget Sound as they move toward oceanic feeding grounds (Rice 2007). Some juveniles remain in the Puget Sound for most or all of their lives prior to migration back into their natal rivers (Beamer et al. 2005). Adult Chinook salmon feed within the Puget Sound as they return to spawning grounds in the spring, summer, and fall.

Current Status

On March 24, 1999, NMFS listed Puget Sound Chinook salmon as a threatened species (64 Fed. Reg. 14308, March 24, 1999; 70 Fed. Reg. 37160, June 28, 2005). The ESU encompasses all runs of Chinook salmon (Figure 2) from rivers flowing into Puget Sound, including the Strait of Juan de Fuca from the Elwha River eastward, and rivers and streams flowing into Hood Canal, South Puget Sound, North Puget Sound, and the Strait of Georgia in Washington. A recovery plan for the ESU was adopted in 2007 (72 Fed. Reg. 2493, January 19, 2007; NMFS 2006). It describes the population structure, identifies populations essential to recovery of the ESU, and establishes recovery goals for each of the populations based largely on the recommendations of the Puget Sound Technical Recovery Team (TRT) (Ruckelshaus et al. 2002, 2006). The Puget Sound TRT identified 22 demographically independent populations within five geographic basins across the ESU, representing the primary historical spawning areas of Chinook salmon (Ruckelshaus et al. 2006). The Puget Sound TRT determined that all 22 populations are currently at high risk of extinction to varying degrees (NMFS 2006). Historic abundance has been estimated to be approximately 609,000 adult returns (Myers et al. 1998), while average recent abundance of natural origin spawners is 38,695 fish (Good et al. 2005). NMFS designated critical habitat for the Puget Sound Chinook salmon on September 2, 2006 (70 Fed. Reg. 52630). Critical habitat in the action area includes 2,182 miles (3,512 kilometers) of nearshore areas of Puget Sound from the line of extreme high tide out to a depth of 90 feet (30 meters).

Limiting factors in fresh water for the Puget Sound Chinook salmon populations include a range of adverse effects associated with land use activities including urbanization, past forestry practices, agriculture, and development. Limiting factors in the marine environment of Puget Sound include nearshore degradation and bioaccumulative contaminants within Chinook salmon prey. The severity and relative contribution of these factors varies by population.

3.2.2.2. Hood Canal Summer Chum Salmon

Life History

Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum salmon usually spawn in coastal areas, and juveniles out-migrate to seawater almost immediately after emerging from the gravel (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (e.g., coastal cutthroat trout, steelhead, coho salmon, and most types of Chinook salmon and sockeye salmon), that usually migrate to sea at a larger size, after months or years of freshwater rearing. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids that depend heavily on freshwater habitats) than on favorable oceanic conditions.

Current Status

The Hood Canal summer chum salmon ESU was listed as threatened under the ESA on March 25, 1999 (64 Fed. Reg. 14508). Of the 16 populations of summer chum salmon identified in this ESU, seven are considered to be "functionally extinct" (Skokomish, Finch Creek, Anderson Creek, Dewatto, Tahuya, Big Beef Creek, and Chimacum). The remaining nine populations are well distributed throughout the ESU, except for the eastern side of Hood Canal. The ESU has two geographically distinct regions: the Strait of Juan de Fuca and Hood Canal. Although the populations all share similar life history traits, the summer chum salmon populations in the two regions are affected by different environmental and harvest impacts and display varying survival patterns and stock status trends (WDFW and PNPTT 2000). NMFS designated critical habitat for Hood Canal chum salmon on September 2, 2006 (70 Fed. Reg. 52630). Critical habitat in the action area includes 377 miles (607 kilometers) of nearshore marine areas (including areas adjacent to islands) of Hood Canal and the Strait of Juan de Fuca (to Dungeness Bay) from the line of extreme high tide out to a depth of 90 feet (30 meters).

In the Hood Canal Basin, summer chum salmon are still found in the Dosewallips, Duckabush, Hamma Hamma, Big and Little Quilcene, and Union Rivers, and Lilliwaup Creek. Although abundance was

high in the late 1970s, abundance for most Hood Canal summer chum salmon populations declined rapidly beginning in 1979, and has remained at depressed levels. The terminal run size for the Hood Canal summer chum salmon stocks averaged 28,971 during the 1974-1978 period, declining to an average of 4,132 during 1979-1993 (WDFW and PNPTT 2000). Abundance during the 1995-1998 period improved, averaging 10,844. However, much of the increase in abundance can be attributed to a supplementation program for the Big/Little Quilcene River summer chum salmon stock that began in 1992. The observed reductions in the numbers of summer chum salmon in the basin are the result of the combined impacts of a number of factors (Johnson et al. 1997). Freshwater habitat degradation and loss from a variety of sources, including forest practices, road building, residential construction, stream flow alteration, diking, and channelization, have had major negative effects on summer chum salmon streams throughout the ESU.

3.2.2.3. Puget Sound Steelhead

Life History

Anadromous steelhead can be divided into two basic reproductive life histories, based on the state of sexual maturity at the time of river entry and duration of spawning migration. The summer-run or "stream-maturing" type enters fresh water in a sexually immature condition between May and October, and requires several months to mature and spawn. The winter-run or "ocean-maturing" type enter fresh water between November and April with well-developed gonads (reproductive glands) and spawn soon after. Steelhead generally leave fresh water to rear in the ocean as juveniles around age 2, bypassing the extended estuary transition stage that many other salmonids need, and spend between 2 to 7 years in the ocean before re-entering fresh water to spawn. Of the Pacific salmonids, *O. mykiss* exhibits the most diverse and complex life-history traits; they can be anadromous (steelhead) or freshwater residents (rainbow trout), and under some circumstances, yield offspring of the opposite life history form.

Current Status

The Puget Sound steelhead DPS was listed as threatened on May 11, 2007 (72 Fed. Reg. 26722). The DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations in streams in the river basins of Puget Sound, as well as the Green River natural and Hamma Hamma River winter-run steelhead hatchery stocks. The majority of hatchery stocks are not considered part of this DPS because they are more than moderately diverged from the local native populations (Hard et al. 2007). Resident steelhead occur within the range of Puget Sound steelhead but are not part of the DPS

because of marked differences in physical, physiological, ecological, and behavioral characteristics (71 Fed. Reg. 15666, March 29, 2006). The Puget Sound steelhead DPS includes more than 50 stocks of summer- and winter-run fish. Critical habitat for Puget Sound steelhead has not been designated.

Though there is a general dearth of abundance data for the DPS, an analysis of historical catch records from 1898 indicate that the catch peaked at 163,796 individuals in 1895 (Little 1898). Assuming a harvest rate of 30 to 50 percent, Little (1898) estimated that the peak run size ranged from 327,592 to 545,987 fish. In the 1990s the total run size for major stocks in this ESU was greater than 45,000, with total natural escapement of about 22,000. The adult returns of most populations have declined in the last few years; recent means for many populations are 50 to 80 percent of the corresponding long-term means (Hard et al. 2007).

NMFS identified the principal factor for decline of Puget Sound steelhead as the present or threatened destruction, modification, or curtailment of its habitat or range (72 Fed. Reg. 26722, May 11, 2007). Barriers to fish passage and adverse effects on water quality and quantity resulting from dams, the loss of wetland and riparian habitats, and agricultural and urban development activities have contributed, and continue to contribute, to the loss and degradation of steelhead habitats in Puget Sound. Previous harvest management practices likely contributed to the historical decline of Puget Sound steelhead, but NMFS concluded that the elimination of the direct harvest of wild steelhead in the mid 1990s largely addressed this threat.

3.2.2.4. Bull Trout

Life History

The bull trout is known to occur from the Yukon River in the Northwest Territories of Canada south to northern Nevada. Within the action area, bull trout occur throughout the Puget Sound and Strait of Juan de Fuca. The bull trout is a char, which includes several fish species of the genus *Salvelinus* that are related to trout and salmon (such as brook trout, lake trout, arctic char, and Dolly Varden) and are adapted to living in colder water than are other salmon species. Some bull trout use the Puget Sound for feeding and movement from one river basin to another. Bull trout reach sexual maturity at between 4 and 7 years of age and are known to live as long as 12 years. Adult bull trout typically begin migrating to spawning grounds in July, and spawn in fresh waters from August to December as water temperatures decrease. Bull trout have multiple life history forms, with resident, adfluvial, and anadromous forms found in Puget Sound. Bull trout may spawn every year or every other year. In

marine waters, bull trout typically occupy shallow, nearshore waters and feed on small invertebrates and fish found in the nearshore, such as surf smelt, Pacific herring, and sand lance in addition to juvenile salmonids (Goetz et al. 2004).

Current Status

In 2002, a draft recovery plan for the ESA-listed bull trout was published by the U.S. Fish and Wildlife Service (USFWS) that included the Puget Sound (USFWS 2002), and areas were also identified as critical habitat for the species (67 Fed. Reg. 71236, November 29, 2002). Critical habitat was then finalized in 2004 (69 Fed. Reg. 59995, October 6, 2004), revised in 2005 (70 Fed. Reg. 56212, September 26, 2005), and revised again in 2010 with changes to bull trout recovery units (75 Fed. Reg.63898, October 18, 2010). Critical habitat in the action area includes some nearshore marine areas from the line of extreme high tide out to a depth of 90 feet (30 meters) in Hood Canal and South Puget Sound, the Main Basin, and the Whidbey Basin. Bull trout are found in most of the major river systems of the Puget Sound.

Both the distribution and abundance of bull trout has declined, the causes of which have been attributed to degraded or fragmented aquatic habitats throughout the species' historical range and the introduction of non-native fish species that eat bull trout and also outcompete them for habitat and food (e.g., lake trout, brook trout, northern pike). Bull trout habitat degradation has occurred from land use actions (timber harvest, road development, agriculture/livestock production, and urbanization) and instream water uses (which have blocked or restricted access to critical habitat) (NRCS 2006; USFWS 2008 2010).

Freshwater temperature is a major factor influencing bull trout distribution, especially for spawning and early rearing. Other limiting factors leading to population declines include degradation of complex structural habitat, altered stream flow and temperature regimes, sedimentation of spawning grounds, redd scouring, loss of habitat connectivity, harvest, and decline or loss of juvenile salmon prey (NRCS 2006; USFWS 2008, 2010).

3.2.2.5. Incidental Catch of Salmonids in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities

Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives lists the total number of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, and bull trout estimated to be taken under the various

alternatives. Most salmonids taken within these activities would be juveniles (WDFW 2011c). The Proposed Action and Alternative 3 have the closest approximation to the number of ESA-listed salmon taken in recent (pre-2010) fisheries and research regimes.

3.2.3. Eulachon

Life History

The Pacific eulachon are members of the osmerid family (smelts) and are endemic to the northeastern Pacific Ocean from northern California to southwest and south-central Alaska and into the southeastern Bering Sea. In 2009, NMFS determined that eulachon comprise two or more DPSs, and the southern DPS is likely to become endangered within the foreseeable future throughout all of its range (74 Fed. Reg. 10857, March 13, 2009). Eulachon look similar to other forage fishes in Puget Sound, such as Pacific herring, surf smelt, and sand lance.

Eulachon are semelparous (spawn once and die). These fish typically spend 3 to 5 years in salt water before returning to fresh water to spawn from late winter through early summer. Spawning grounds are typically in the lower-most reaches of large rivers fed by snowmelt; in many rivers, spawning is limited to the part of the river that is influenced by tides. Eulachon eggs hatch in 20 to 40 days. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents. After leaving estuarine rearing areas, juvenile eulachon move from shallow nearshore areas to deeper areas over the continental shelf. Little information is currently available on their movements in nearshore marine areas and the open ocean. Eulachon do occur within Puget Sound, but are at very low abundance relative to coastal waters, and typically occupy deep waters (Donnelly and Burr 1995; 74 Fed. Reg. 10857, March 13, 2009).

Eulachon feed on zooplankton (mainly crustaceans such as copepods and euphausiids). Eulachon larvae and post-larvae eat phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, worm larvae, and eulachon larvae. In the ocean, adults and juveniles commonly forage at depths of 50 to 600 feet (15 to 182 meters) (74 Fed. Reg. 10857, March 13, 2009).

Predators of eulachon include numerous species of birds, and marine mammals such as baleen whales, orcas, dolphins, pinnipeds, and beluga whales. Current harvest levels of eulachon are substantially lower than historic harvest levels, and are mostly attributable to catches from fisheries that target other species.

Eulachon were historically an important food source for many Native American tribes and Canadian First Nations from northern California to Alaska. More recently, tribal members in the U.S. harvest eulachon under recreational fishing regulations, and Canadian First Nation members are typically authorized a small subsistence fishery by Fisheries and Oceans Canada (74 Fed. Reg. 10857, March 13, 2009).

Current Status

The abundance of eulachon in the Southern DPS has experienced an abrupt decline throughout its range. This decline is attributed to several factors, including degradation of freshwater habitats, changes in ocean conditions because of climate changes, commercial harvest, and bycatch in commercial fisheries (75 Fed. Reg. 13012, March 18, 2010). On March 18, 2010, NMFS listed the Southern DPS of eulachon as threatened under the ESA (75 Fed. Reg. 13012). Critical habitat designation was finalized on October 20, 2011, and encompasses select freshwater habitats (no marine waters are included) (76 Fed. Reg. 65324, October 20, 2011). There is no critical habitat designated for eulachon in the Puget Sound.

3.2.3.1. Incidental Catch of Eulachon in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities

Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives lists the total number of eulachon estimated to be taken under the various alternatives. The Proposed Action and Alternative 3 have the closest approximation to the number of eulachon taken in recent (pre-2010) fisheries and research regimes.

3.2.4. Green Sturgeon

Life History

Southern green sturgeon (*Acipenser medirostris*) is a long-lived, slow-growing species. Green sturgeon use both freshwater and marine habitats, and adults are found in marine waters from Mexico to Alaska (Moyle et al. 1995 *in* NMFS 2010a). Male green sturgeon are considered mature at approximately 15 years while females are not considered mature until approximately 17 years (NMFS 2010a).

Adult green sturgeon typically migrate into fresh water beginning in late February and spawn from March to July (NMFS 2010b). Green sturgeon are believed to spawn in the Rogue River, Klamath River Basin, and the Sacramento River; however, the Sacramento River is currently the only confirmed

spawning area (NMFS 2010a). Juvenile green sturgeon are believed to spend 1 to 3 years in fresh water before they enter the ocean (NMFS 2010b). Green sturgeon disperse widely in the ocean between their freshwater life stages (NMFS 2010b). Although little feeding data for green sturgeon exists, green sturgeon are known to eat benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle et al. 1995 *in* NMFS 2010a).

Current Status

The abundance of the Southern green sturgeon DPS has declined over time and is attributed to habitat loss and degradation, overharvest and bycatch as part of other fisheries, poaching, and entrainment (NMFS 2010a, 2010b). Very few green sturgeon have been found in Puget Sound, with only two confirmed observations in Puget Sound in 2006 (NMFS 2010b). On June 6, 2006, the Southern green sturgeon DPS was listed as threatened under the ESA (71 Fed. Reg. 17757, April 7, 2006). Critical habitat was then finalized in 2009 (74 Fed. Reg. 52300, October 9, 2009). Critical habitat in the action area includes marine waters of the North Sound westward of a line between Partridge Point on Whidbey Island and Point Wilson at Port Townsend.

3.2.4.1. Incidental Catch of Green Sturgeon in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities

Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives lists the total number of green sturgeon estimated to be taken under the various alternatives. The Proposed Action and Alternative 3 have the closest approximation to the number of green sturgeon taken in recent (pre-2010) fisheries and research regimes.

3.3. Non-listed Fish

3.3.1. Groundfish Species

Groundfish (often referred to as demersal fish, or bottom fish) make up the majority of the estimated 211 species of fish within Puget Sound (Donnelly and Burr 1995), and collectively occupy habitats ranging from intertidal zones to the deepest waters of the region. Essential Fish Habitat (EFH) has been designated by NMFS for 44 species of groundfish in the Puget Sound[6] (Appendix B: Species of Fishes

[6] The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires NMFS to designate EFH needed by fish to carry out their life cycles, and requires Federal action agencies to consult with NMFS on their actions that may adversely affect EFH. The MSA provides for cooperation among NMFS, fishery management councils, fishing participants, Federal and state agencies, and others in achieving EFH protection, conservation, and enhancement. Section 3 of the MSA defines EFH as "those waters and substrate necessary to fish for

with Designated EFH in the Action Area). Limiting factors for groundfish include derelict fishing gear that kill fish, and water quality impairments such as reduced levels of dissolved oxygen and inputs of toxins (e.g., metals and petroleum products) (Palsson et al. 2009) that may kill fish or result in physiological problems such as reproductive impairment.

There are two general types of groundfish. Benthic groundfish generally rest on the sea floor, and benthopelagic fish float in the water column near the sea floor (Donnelly and Burr 1995). Benthopelagic fish, such as rockfish, have neutral buoyancy, which allows them to suspend in the water column. Benthic fish, such as sole, have negative buoyancy so they can rest on the bottom. Benthic groundfish generally feed upon other groundfish species and/or prey living within the substrates of the sea floor, such as clams, worms, and other invertebrates. Benthopelagic fish also feed upon invertebrates and varied species of fish and are able to pursue pelagic prey that are suspended in the water column, such as herring. Within the two general groups of groundfish, the life histories of individual species are very diverse. Some species occupy relatively small areas throughout their adult lives (e.g., some rockfish species), while others are likely very mobile throughout their life cycle and occupy benthic areas of different depths on a seasonal basis (Donnelly and Burr 1995). Most groundfish are present at a variety of bottom depth-ranges in Puget Sound, but the largest overall number of species were found at depths from 69 feet to 164 feet (21 to 50 meters) (Donnelly and Burr 1995). The WDFW has estimated that the abundance of benthic bottom fishes in Puget Sound is 220 million pounds (WDFW 2010c).

A total of 28 species of rockfish have been documented in the Puget Sound region (Miller and Borton 1980; Palsson et al. 2009), including the three species of ESA-listed rockfish (Subsection 3.2.1.1, Rockfish Life History). From these, all but a few species (such as black rockfish and Puget Sound rockfish) are considered by NMFS to be depleted[7] within Puget Sound (Palsson et al. 2009). The total rockfish population in the Puget Sound region is estimated to have declined approximately 3 percent per year for the past several decades, which corresponds to an approximate 70 percent decline from 1965 to 2007 (Drake et al. 2010). Several rockfish species predominantly use deepwater habitats (i.e.,

spawning, breeding, feeding, or growth to maturity." If an action would adversely affect EFH, NMFS is required to provide the Federal action agency with EFH conservation recommendations (MSA section 305(b)(4)(A)). This consultation is based, in part, on information provided by the Federal agency and descriptions of EFH for Pacific coast groundfish, coastal pelagic species, and Pacific salmon contained in the Fishery Management Plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

[7] Depleted fish stocks have indices that are negative and exceed the American Fisheries Society vulnerability criteria for stock productivity, may not have effective management measures in place, and the stock has additional risk factors such as rarity, limited range, or specialized habitat requirements (Musick 1999).

deeper than 120 feet), including greenstriped rockfish (*Seb. elongates*), redstripe rockfish (*Seb. proriger*), silvergray rockfish (*Seb. brevispinis*), and shortspine thornyheads (*Seb. alascanus*) (Palsson et al. 2009). Additional groundfish species include at least 13 species of sole (Family Pleuronectidae), 12 species of sculpin that include cabezon (Family Cottidea), and 4 species of the family Hexagrammidae, including lingcod (Donnelly and Burr 1995). Other groundfish species of the Puget Sound include spiny dogfish (*Squalus acanthias)*, Pacific tomcod *(Microgadus proximus)*, walleye pollock *(Theragra chalcogramma)*, Pacific hake *(Merluccius productus)*, Pacific cod *(Gadus macrocephalus)*, and sablefish (*Anoplopoma fimbra*). Rockfish and other groundfish species eat the abundant shrimp species in the action area, including pink shrimp (*Pandalus eous*), dock shrimp (*Pandalus danae*), coonstripe shrimp (*Pandalus hypsinotus*), and sidestripe shrimp (*Pandalus dispar*) (Palsson et al. 2009). Each of these shrimp species are primarily found in sand or mud habitats (Roberts 2008). Aside from rockfish, the overall status of various groundfish in Puget Sound has not been comprehensively assessed; there have been no quantitative stock assessments that provide information about the current viability of various species of groundfish in Puget Sound. However, anecdotal reports have noted the decline of species such as Pacific tomcod, walleye pollock, Pacific hake, Pacific cod, and sablefish since the early 1990s (Olander 1991).

A total of 13 species of rockfish have been reported as caught by recreational anglers within the action area from 2003 to 2009 (WDFW 2011c). Most of these were copper rockfish (*Sebastes caurinus*) and quillback rockfish (*Sebastes maliger*). Aside from rockfish, at least 17 species or families of groundfish have been reported as caught by recreational anglers within the action area between 2003 and 2009 (WDFW 2011a), averaging 113,000 bottom fish caught in Puget Sound from 2004 to 2009 (WDFW 2011c). Of these, most caught fish were classified as within the sole (or "flatfish") family (Pleuronectidae). Lingcod and kelp greenling (*Hexagrammos decagrammus*) were also a common fish reported by recreational anglers (WDFW 2011c).

3.3.2. Non-groundfish Species

Non-groundfish species include pelagic fish of the Puget Sound region and forage fish. The most common pelagic fish include Chinook salmon, Puget Sound steelhead, coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), and chum salmon. Forage fish include herring, surf smelt (*Hypomesus prefiosus)*, Pacific sand lance (*Ammodytes hexapterus*), and eulachon. Herring are a key food source for many marine fish, mammals, and birds. The spawning biomass of herring in Puget Sound fluctuates widely, but has averaged approximately 12,000 to 15,000 tons in recent times (Stick 2011). These species occupy a variety of depths throughout Puget Sound (Donnelly and Burr 1995). Essential Fish

Habitat has been designated by NMFS for several non-groundfish species in Puget Sound (Appendix B: Species of Fishes with Designated EFH in the Action Area). Common limiting factors for non-groundfish species include derelict fishing gear, and water quality impairments such as reduced levels of dissolved oxygen that can kill fish and inputs of toxins (e.g., metals and petroleum products) (Palsson et al. 2009) that can result in physiological problems. Limiting factors for non-groundfish that use the nearshore (i.e., sand lance, salmonids, and herring) include development that has reduced or eliminated rearing or spawning habitats in portions of Puget Sound.

Almost all pelagic fish in the action area live within the epipelagic zone (surface waters to around 650 feet (200 meters)) that are influenced by the presence of light. Though most light in the action area is fully attenuated near 90 feet (27 meters), habitats below this zone are influenced by the presence of photosynthesis and nutrients in shallower waters. Like groundfish, pelagic fish have a wide variety of life histories. For instance, all salmonid species are anadromous (Subsection 3.2.2, Salmonids), while forage fish lay their eggs in the marine environment on aquatic vegetation that includes eel grass (herring), in bottom mud/sand habitats (sand lance), or in the upper intertidal zone (surf smelt). Pelagic fish are generally highly migratory, and can be found at various depths and basins throughout the action area. The diets of pelagic fish are often diverse; they feed upon species within the water column that include the smallest of zooplankton and other invertebrates, and other pelagic fish. Habitats and species assemblages among the basins of the action area are unique, and vary seasonally and temporally (Subsection 1.4, Action Area). For instance, the number of pelagic species is generally greater in the northern basins of the action area compared to the southern basins (Rice 2007). The overall status of many non-groundfish species in Puget Sound has not been comprehensively assessed; there have been no quantitative stock assessments that provide information about the current viability of these species in Puget Sound.

3.4. Marine Mammals and Turtles

Cetaceans are aquatic mammals that include whales and dolphins. Relatively common cetaceans within Puget Sound include Minke whale *(Balaenoptera acutorostrata)*, gray whale (*Eschrichtius robustus)*, harbor porpoise (*Phocoena phocoena)*, Dall's porpoise (*Phocoenoides dalli)*, and killer whale (*Orcinus orca).* Pinnipeds are aquatic carnivorous mammals whose four limbs are adapted as flippers. Common pinnipeds within Puget Sound include California sea lion (*Zalophus californianus)* and harbor seal (*Phoca vitulina)*. Steller sea lion (*Eumetopias jubatus)*, northern fur seal (*Callorhinus ursinus)*, and northern elephant seal (*Mirounga angustirostris*) also occur in Puget Sound, but are less abundant than

sea lions and harbor seals. Steller sea lions are listed as a threatened species under the ESA (62 Fed. Reg. 24345, February 5, 1997).

Marine mammals in Puget Sound feed on a wide variety of prey, and their diets vary not only according to each species' preferences, but also seasonally, depending on abundance and distribution of available prey. Rockfishes of all sizes are an important food resource for a variety of predators in Puget Sound, including some marine mammals (mostly pinnipeds) (Palsson et al. 2009).

Southern resident killer whales are observed in small pods of 3 to 40 individuals throughout Puget Sound (Kriete 2007). Transient killer whales are also occasionally observed in the region (Kriete 2007). Southern residents are primarily found in northern Puget Sound, and this group has been estimated at between 70 to 100 individuals since the 1970s. The southern resident population declined 20 percent from 1996 to 2001 (Krahn et al. 2004) and was listed as endangered under the ESA in 2005 (70 Fed. Reg. 69903, November 18, 2005). The causes of this decline are likely to include a combination of factors, such as exposure to bioaccumulative chemical contaminants, reduced availability of prey resources, and increased human activities (Krahn et al. 2004). Resident killer whales mainly feed on Chinook salmon, and to a lesser extent, chum salmon, and have been known to eat other fish species and squid (NMFS 2010c; Scheffer and Slipp 1948; Ford et al. 1998, 2000; Saulitis et al. 2000; Ford and Ellis 2006). Critical habitat for resident killer whales includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet (6 meters) deep relative to extreme high water (71 Fed. Reg. 69054, November 29, 2009). Rockfish are not known to be a substantial component of the Puget Sound resident killer whales' diet (Palsson et al. 2009). Transient killer whales feed on marine mammals such as harbor seals, Minke whales, sea lions, and porpoises (NMFS 2010c). Minke whales are also primarily observed in the same northern area as the killer whales, but their population size is unknown. Gray whales migrate past the Georgia Basin en route to or from their feeding or breeding grounds; a few of them enter Puget Sound during the spring through fall to feed (Krahn et al. 2004). Gray whales feed on benthic amphipods in sea floor sediments, while Minke whales opportunistically feed on crustaceans, plankton, and small schooling fish (e.g., anchovies, cod, herring, salmon) (NMFS 2010c).

Sea lion species feed on a variety of prey that includes rockfish, among other fish species, as well as squid and gastropods (snails) (NMFS 2010d). California sea lions, primarily males, reside in Puget Sound between late summer and late spring, and spend the remainder of the year at their breeding grounds in southern California and Baja California. Populations of the remaining species are quite low

in Puget Sound. Steller sea lions and elephant seals are transitory residents that are occasionally seen in Puget Sound. About 2,000 Steller sea lions occur seasonally in Washington waters, with dozens found in Puget Sound, particularly in the San Juan Islands (Palsson et al. 2009). Of 12 random Steller sea lions' scats analyzed, rockfish were found in one (8 percent) (Lance and Jeffries 2006).

Harbor seals are year-round residents, and their abundance has increased from in the 100s during the 1970s to more than 10,000 at present (Jeffries et al. 2003). The harbor seal is the only pinniped species that breeds in Washington waters. In Puget Sound, harbor seals are considered opportunistic feeders that consume seasonally- and locally-abundant prey, including a variety of fish species and crustaceans (Olesiuk et al. 1990; London et al. 2002; NMFS 2010d). Rockfish predation by harbor seals varies annually by location and time of the year (Palsson et al. 2009). Rockfish (of all species) occurred in 12 percent of diets of harbor seals in the San Juan Basin in 2006 and 2007, compared to 2.3 percent in 2005 and 2006 (Lance and Jeffries 2006; Palsson et al. 2009). Most of these rockfish were juveniles. Rockfish were found in 1 percent of seal scats in Hood Canal (Palsson et al. 2009; London et al. 2002).

Although harbor porpoises are also abundant in the eastern North Pacific and were common in greater Puget Sound 50 or more years ago, they are now rarely seen in Puget Sound (Calambokidis and Baird 1994). Low numbers of Dall's porpoise are observed in greater Puget Sound throughout the year, but little is known about their population size.

Sea-turtles are uncommon within the Puget Sound region, with only a few documented instances in waters off the Washington coast (Norberg 2009).

3.5. Marbled Murrelet

3.5.1. Life History

The marbled murrelet is a small seabird that inhabits the coastal forests and nearshore marine environment along the Pacific Coast of North America from southern California to southern Alaska and the Aleutian Islands. Throughout most of its breeding range the marbled murrelet uses old-growth forests for nesting and nearshore marine environments for foraging. In the Pacific Northwest, murrelets tend to forage near the coast during the breeding season, with somewhat greater dispersal during the non-breeding season. They lay a single egg clutch, with incubation and rearing occurring from late March (in California) or late April (Pacific Northwest) through the summer. Fledging ranges from late May (California) or late June (Pacific Northwest) through late summer and early fall (McShane et al. 2004). Marbled murrelets feed on a large variety of small fishes such as sand lance, anchovy, Pacific

herring, capelin, and smelt species (such as eulachon), and invertebrates. Foraging occurs primarily in shallow water (less than 98 feet (30 meters) deep), and feeding has been observed at depths from 9.8 to approximately 90 feet (3 to 27 meters) (McShane et al. 2004).

3.5.2. Current Status

The USFWS listed the Washington, Oregon, and California DPS of the marbled murrelet as threatened under the ESA in 1992 (57 Fed. Reg. 45328, October 1, 1992). The marbled murrelet recovery plan, "Recovery Plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California," was issued on September 24, 1997. A recent 5-year status review in 2009 recommended no changes to the threatened status, noting the listed portion of the species had declined in abundance since the prior (2004) status review and that the recovery criteria for the species had not been met (USFWS 2009b).

The USFWS designated critical habitat for the marbled murrelet in Washington, Oregon, and California on May 24, 1996 (61 Fed. Reg. 26256). Federal and non-Federal lands totaling 3,887,800 acres were designated to protect nesting habitats. The USFWS proposed to revise critical habitat for the marbled murrelet in June 2008 by removing approximately 250,000 acres in northern California and Oregon from the 1996 designation, based on new information indicating the areas did not meet the definition of critical habitat. This proposed rule has not been finalized and critical habitat for the marbled murrelet remains unchanged from the 1996 designation. Critical habitat in marine waters has not been designated.

The total marbled murrelet abundance in North America is estimated to be less than 900,000 birds, but most of these occur in Alaska (USFWS 2009b). The listed portion of the population has been declining since the initiation of monitoring programs in 2000 (USFWS 2009b). Terrestrial threats to marbled murrelet populations include the historic and ongoing loss and modification of nesting habitat through commercial timber harvests, human-induced fires, land conversions, and to a lesser degree, through natural causes, such as wild fires and wind storms. Marine threats to marbled murrelets include changes in the food web and prey quantity and quality, declining prey populations, commercial and recreational fisheries for some prey stocks, some continued (but not quantified) gill-net mortality, high body loads of PCBs in their prey base, and marine areas of low dissolved oxygen. During the most recent status review, these threats were somewhat ameliorated by a declining rate of annual habitat loss, particularly on Federal lands; improved regulatory mechanisms because of Federal and state listings and other state

and Federal regulation (especially the Northwest Forest Plan); and new gill-netting regulations in northern California and Washington, which reduced the threat to marbled murrelets (USFWS 2004).

3.6. Socioeconomics

The economy of the Puget Sound region includes manufacturing and technology sectors, forestry and agriculture, and tourism. The fishing industry is a major component of the local as well as the state-wide economy, with an estimated $1.1 billion generated annually in Washington State by recreational fishing[8]. Fishing for rockfish by settlers has occurred since the late 1800s and early 1900s, and reached a peak in popularity and catch rates among modern anglers in the 1970s and 1980s (Palsson et al. 2009; Williams et al. 2010). The decline of rockfish populations led to a gradual reduction of catch limits and reduced popularity of the fishery in the 1990s and 2000s (Palsson et al. 2009) (refer to Subsection 3.8, Tourism and Recreation, for a detailed analysis of the recreational fishery).

The Washington Department of Ecology (2008), Cleveland (2007), and TCW Economics (2008) have provided information regarding the Puget Sound economy, including:

- Puget Sound is part of the natural environment that attracts people to the region. The Sound helps drive $20 billion in economic activities annually.

- **Population** – Approximately 4.3 million people live in the 12 counties bordering Puget Sound. This figure includes about 1.6 million who live in the 90 cities and towns that directly border the Sound.

- **Fishing** – The net economic value and economic effects generated by the commercial fishery in Washington State in 2006 was $38 million, while the direct impact of spending in the recreational fishery sector was estimated at $165.7 million (and $392.9 million when indirect and induced impacts are included) (TCW Economics 2008).

- **Tourism** – The Puget Sound area provides $9.5 billion in tourism revenue, including 68,000 tourism-related jobs and $3 billion in income each year. The Puget Sound area generates approximately 80 percent of state-wide tourism revenues.

[8] For the purposes of this EA, the term recreational fishing will be used, and implies and includes the synonymous term sportfishing (WDFW 2010d).

A study by Responsive Management (2007) for the Washington State Recreation and Conservation Office consisted of focus groups of boating services providers, a telephone survey of boating services providers, a telephone survey of the general public in Washington, and a telephone survey of registered boaters in Washington. The assessment included information on the motivations for boating and preferred locations for boating.

Fishing was the most common activity in which boaters participated while boating in Washington (53 percent of boaters fished). Other common activities included sightseeing/fish and wildlife viewing (34 percent), water skiing (19 percent), relaxing or entertaining friends (17 percent), being with family and friends (17 percent), and water tubing (15 percent). When asked to say what motivates them to boat, boaters most commonly answered for relaxation (49 percent), followed by fishing (29 percent), to be with friends and family (26 percent), for general recreation (14 percent), and to be close to nature (11 percent).

Commercial fishing and fish processing, and the recreational fishing industry, are important components of the Puget Sound economy (as described above under Subsection 3.6, Socioeconomics, Fishing). In 2006, 505,185 fishing licenses were issued, of which 23,770 were saltwater licenses (WDFW 2010e). In odd numbered years only, pink salmon return in large numbers to Puget Sound and support a popular fishery. For example, in 2008-2009 (a non-pink salmon fishing season), 38,649 saltwater fishing licenses were issued to anglers fishing in Puget Sound; in 2009-2010 (a pink salmon fishing season), 51,083 saltwater fishing licenses were issued to Puget Sound anglers (S. Thiesfeld, pers. comm., Washington Department of Fish and Wildlife, Puget Sound Salmon Manager, October 12, 2010).

The commercial, non-treaty set net, set line, and bottom trawl fisheries proposed for permanent closure as part of the Proposed Action have all experienced a decline in ex-vessel values between 2005 and 2009. The otter bottom trawl ex-vessel value in 2005 was $256,995, declining to a low of $55,168 in 2007, but showing a slight increase in 2009 to $97,219. For the set line fishery, the average ex-vessel value for 2005 through 2008 was $41,164, with an ex-vessel value of only $1,697 in 2009. The ex-vessel value for the set net fishery in 2008 was $6,236 and $3,313 for 2009 (T. Tsou, pers. comm., Washington Department of Fish and Wildlife, June 16, 2011). The economic contribution of commercial and recreational fishing to three representative Puget Sound communities are discussed in more detail below.

Seattle, Washington, an important port city in central Puget Sound, was home to at least seven fish processors in 2000 who often hire processing workers through their Seattle-based administrative offices. Also important to Seattle's economy is the recreational fishing industry. There were at least eight salmon charter fishing businesses and one non-salmon charter fishing business in Seattle in 2000; fifteen licensed vendors were selling fishing permits; and marine anglers made 49,865 trips in the recreational salmon fishery in Catch Record Card Area 10. In 2003, there were 39,263 recreational fishing license transactions in Seattle (Norman et al. 2007).

Anacortes, Washington, located on the northern shore of Fidalgo Island and considered "the gateway to the San Juan Islands," was home to at least three seafood processor plants in 2000, which employed on average 107 people. The tribal commercial fishery in Anacortes also plays a substantial role in the local commercial fishing industry. As in Seattle, the recreational fishing industry is an important component of the Anacortes economy. There were five salmon charter fishing businesses and one non-salmon charter fishing business operating in Anacortes in 2003; two licensed vendors were selling fishing permits; and marine anglers made 30,627 trips in the recreational (sport) salmon fishery in Catch Record Card Area 7 (San Juan Islands). In 2003, there were 8,704 recreational fishing license transactions in Anacortes, valued at $121,250 (Norman et al. 2007).

Bellingham, Washington, located on Bellingham Bay in north Puget Sound, was home to at least nine seafood processors employing 676 individuals in 2000. The tribal commercial fishery plays a major role in the Bellingham economy, and the Lummi Natural Resource Department has offices in Bellingham. As in Seattle and Anacortes, the recreational fishing industry is an important component of the Bellingham economy. There were at least two salmon charter fishing businesses in Bellingham in 2003; nine licensed vendors selling fishing permits; and data for number of trips in the recreational (sport) salmon fishery were the same as for Anacortes because they are both in Catch Record Card Area 7. In 2003, there were 20,090 recreational fishing license transactions in Bellingham, valued at $339,527 (Norman et al. 2007).

As mentioned above, commercial and recreational fishing are important components of the Puget Sound economy. This EA specifically assesses the recreational bottom fish and commercial shrimp trawl fisheries as part of the Fishery Conservation Plan as described in the No-action Alternative, the Proposed Action, and Alternative 3 (Subsection 1.2, Description of the Proposed Action; Subsection 2.2, Alternatives). WDFW provided performance and value measures for the recreational bottom fish fishery and the commercial shrimp trawl fishery as part of their Application for an Individual Incidental

Take Permit under the Endangered Species Act of 1973 that covers yelloweye rockfish, canary rockfish, bocaccio, Puget Sound Chinook salmon, and eulachon[9]. As discussed in Subsection 2.2.2.1, Fishing Activities Under the Proposed Action, the recreational fishery averaged approximately 100,000 fishing trips in recent years, with a catch of over 130,000 bottom fish annually. The annual average economic value of this activity in 2008 and 2009 was approximately $5.6 million annually (WDFW 2011c; TCW Economics 2008). The shrimp trawl fishery produced an annual average catch in 2008 and 2009 of approximately 400,000 pounds with an average value of approximately $142,000 (WDFW 2011c). Table 3-1 and Table 3-2 below contain additional performance and value detail for these two fisheries.

Table 3-1. Catch, effort, and economic value associated with the recreational fishery for bottom fish and other fish within the Puget Sound DPS area.

	2008	2009	2008-2009 AVERAGE
CATCH (number of fish)	86,812	179,923	133,368
NUMBER OF ANGLER TRIPS	82,182	102,767	92,475
VALUE PER TRIP	$60	$60	$60
ANNUAL ECONOMIC VALUE	$4,930,920	$6,166,020	$5,548,470

Source: WDFW unpublished data 2011c; TCW Economics2008.

Table 3-2. Catch and economic value associated with the trawl fishery for shrimp within the Puget Sound DPSs area.

	2008	2009	2008-2009 AVERAGE
CATCH (pounds of shrimp)	630,787	217,380	424,084
ANNUAL ECONOMIC VALUE (ex-vessel)	$216,065	$69,620	$142,842

Source: WDFW unpublished data 2011c.

3.7. Environmental Justice

This section was prepared in compliance with Presidential Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (EO 12898), dated February 11, 1994, and Title VI of the Civil Rights Act of 1964. Both EO 12898 and Title VI address persons belonging to the following target populations:

[9] Because of the differences in the two fisheries, the performance and value are measured in different ways. Recreational fishing performance is measured in number of fish landed and the value in expenditures. The shrimp trawl fishery performance is measured in catch (pounds of shrimp) and value in the ex-vessel (as the catch is offloaded from the fishing vessel) in dollars (TCW Economics 2008). Because of changes in fishing opportunities, weather, and economic conditions, both the performance and value of these fisheries can change from year-to-year.

- Minority – all people of the following origins: Black, Asian, American Indian and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic.

- Low income – persons whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines.

Definitions of minority and low income areas were established on the basis of the Council on Environmental Quality (CEQ) document, Environmental Justice Guidance Under the Environmental Policy Act of December 10, 1997. CEQ's guidance states that "minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis." The CEQ further adds that "The selection of the appropriate unit of geographical analysis may be a governing body's jurisdiction, a neighborhood, a census tract, or other similar unit that is chosen so as not to artificially dilute or inflate the affected minority population." The CEQ guidelines do not specifically state the percentage considered meaningful in the case of low income populations. For this environmental analysis, the assumptions set forth in the CEQ guidelines for identifying and evaluating impacts on minority populations are used to identify and evaluate impacts on low income populations. More specifically, potential environmental justice impacts are assumed to occur in an area if the percentage of minority, Hispanic, and low income populations are meaningfully greater than the percentage of minority, Hispanic, and low income populations in the general population.

In addition, U.S. Environmental Protection Agency guidance specifically addresses environmental justice effects on Indian tribes:

> Federal duties under the Environmental Justice E.O., the Presidential directive on government-to-government relations, and the trust responsibility to Indian tribes may merge when the action proposed by a Federal agency or EPA potentially affects the natural or physical environment of a tribe. The natural or physical environment of a tribe may include resources reserved by treaty or lands held in trust; sites of special cultural, religious, or archeological importance, such as sites protected under the National Historic Preservation Act or the Native American Graves Protection and Repatriation Act; other areas reserved for hunting, fishing, and gathering (usual and accustomed), which may include "ceded" lands that are not within reservation boundaries. Potential effects of concern…may include ecological, cultural, human

health, economic, or social impacts when those impacts are interrelated to impacts on the natural or physical environment.

Through the NEPA process, NMFS will ensure that the requirements of Executive Order 12898 regarding environmental justice are implemented, including all appropriate tribal consultation activities.

Table 3-3. Minority and Hispanic populations in counties bordering inland waters of Washington from the 2000 U.S. Census.

	Total	White	Black or African American	Indian and Alaska Native	Asian	and Other Pacific Islander	Some other Race	Two or more races	Hispanic or Latino (of any race)	Percent Hispanic (%)	Percent minority (%)
Counties Bordering inland Waters of Washington											
Clallam County	64,525	57,505	545	3,303	731	104	761	1,576	2,203	3.41	10.88
Island County	71,558	62,374	1,691	693	3,001	314	1,025	2,460	2,843	3.97	12.83
Jefferson County	25,953	23,920	110	599	309	34	197	784	535	2.06	7.83
King County	1,737,034	1,315,507	93,875	15,922	187,745	9,013	44,473	70,499	95,242	5.48	24.27
Kitsap County	231,969	195,481	6,648	3,760	10,192	1,805	3,309	10,774	9,609	4.14	15.73
Mason County	49,405	43,705	587	1,840	519	221	1,036	1,497	2,361	4.78	11.54
Pierce County	700,820	549,369	48,730	9,963	35,583	5,922	15,410	35,843	38,621	5.51	21.61
San Juan County	14,077	13,372	36	117	125	12	128	287	338	2.40	5.01
Skagit County	102,979	89,070	450	1,909	1,538	163	7,381	2,468	11,536	11.20	13.51
Snohomish County	606,024	518,948	10,113	8,250	35,030	1,705	11,629	20,349	28,590	4.72	14.37
Thurston County	207,355	177,617	4,881	3,143	9,145	1,078	3,506	7,985	9,392	4.53	14.34
Whatcom County	166,814	147,485	1,150	4,709	4,637	235	4,159	4,439	8,687	5.21	11.59
County Average										4.79	13.62
Other Counties											
Gray's Harbor County	67,194	59,335	226	3,132	818	73	1,527	2,083	3,258	4.85	11.70
Yakima County	222,581	146,005	2,157	9,966	2,124	203	54,375	7,751	79,905	35.90	34.40
State											
Washington	5,894,121	4,821,823	190,267	93,301	322,335	23,953	228,923	213,519	441,509	7.49	18.19

Source: www.census.gov

Table 3-4. Low income information for Washington counties from 2004 estimates from the Annual Social and Economic Supplements of the Current Population Survey.

Counties Bordering Inland Waters of Washington	2004 Population Estimate	Number in Poverty	Percent in Poverty (%)
Clallam County	67,867	8,446	12.3
Island County	79,293	6,442	8.3
Jefferson County	28,110	3,076	10.9
Mason County	1,777,143	6,429	12.2
King County	239,138	176,928	10
Kitsap County	53,637	21,616	9.3
Pierce County	745,411	87,131	11.8
San Juan County	15,190	1,279	8.4
Skagit County	111,064	13,660	12.2
Snohomish County	644,274	61,500	9.5
Thurston County	224,673	21,309	9.4
Whatcom County	180,167	23,742	13.2
County Average	347,163	35,963	10.6
Surrounding Counties			
Gray's Harbor	70,338	10,807	15.8
Yakima	229,094	42,704	18.6
State			
Washington	6,203,788	715,271	11.6

Source: www.census.gov

The Native American tribes in the action area include (NWIFC 2010a):

- Lummi Nation
- Muckleshoot Tribe
- Nisqually Indian Tribe
- Nooksack Tribe
- Port Gamble S'Klallam
- Puyallup Tribe of Indians
- Sauk-Suiattle Tribe
- Skokomish Tribe
- Squaxin Island Tribe
- Stillaguamish Tribe
- Suquamish Tribe
- Swinomish Tribe
- Tulalip Tribes
- Upper Skagit Tribes

The native peoples of the Puget Sound historically harvested a diverse array of marine species, including various species of rockfish (Palsson et al. 2009). The Puget Sound is still of particular historic and cultural importance to the native tribes who continue to harvest marine species such as crab and other shellfish, and salmon within the action area. In contemporary times, rockfishes harvested by tribal fishermen have contributed less than 2 percent to the total Puget Sound harvest for most years since 1991 (Palsson et al. 2009).

Native American tribes are sovereign governments. In Washington State, each tribe manages its own fisheries according to guidelines developed jointly with WDFW. Each tribe issues and enforces its own fishing regulations. These regulations "specify fishery openings, gear restrictions, non-retention rules, and other requirements for harvesting a given species in marine and/or freshwater areas." Each tribe

fishes only in those marine and freshwater areas that have been legally defined by the court as their usual and accustomed area. In areas where two or more tribes operate, they issue identical regulations or develop agreements for sharing harvest (NWIFC 2010b, 2010c).

3.8. Tourism and Recreation

Tourism in the action area is centered on the region's natural beauty and historical attributes related to the natural environment. Tourists visit several national and state parks throughout the Puget Sound region, as well as urban centers such as Seattle, Washington. Tourism associated with Puget Sound includes day-cruises centered near major cities such as Seattle and Bellingham, and whale watching, which is concentrated within the San Juan Basin and the North Puget Sound. Recreational fishing in the Puget Sound is an important component to the tourism industry (refer to Subsection 3.6, Socioeconomics, for additional detail), though most tourist-based recreational fishing is associated with salmon fishing because opportunities to fish for other species such as cod and rockfish have diminished in the past few decades (Olander 1991; Martinis 2008; WDFW 2010b). Additionally, WDFW promotes scuba diving in Puget Sound waters, and specifically lists rockfish among the "amazing diversity of sea life" that recreational scuba divers may encounter (WDFW 2010f).

3.8.1. Recreational Rockfish Fisheries

Several recreational fisheries have targeted rockfish within the past several decades. They include anglers on boats with a hook-and-line, the recreational dive-spear fishery, and the shore-based hook-and-line fishery (Palsson et al. 2009). Rockfish have also been bycatch to other recreational fishing activities such as halibut and lingcod fishing or salmon fishing using mooching or downriggers. Palsson et al. (2009) report that historical (prior to the 1970s) recreational harvests of rockfish in Puget Sound were likely minimal. There are no specific economic data for historic or recent rockfish fisheries, as this data has been grouped within the overall groundfish category by WDFW.

A number of rockfish species, including yelloweye rockfish and canary rockfish, were more commonly caught in North and South Puget Sound during the 1960s than subsequent decades (Palsson et al. 2009). Recreational harvests of rockfish in Puget Sound averaged 261,000 pounds per year between 1970 and 1993. Between 2004 and 2007, recreational harvests of rockfish averaged 37,000 pounds per year (an 86 percent reduction from earlier years) (Palsson et al. 2009).

Since 1983, regulations for rockfish fishing in Puget Sound have become more restrictive, with a one fish daily retention limit and the prohibition of spearfishing of rockfish enacted in 2004 (Palsson et al.

2009). Since 2002, regulations prohibited the retention of yelloweye rockfish and canary rockfish. Yelloweye rockfish comprised between 2 and 5 percent of the North Sound recreational harvest prior to 2001, and are still caught by anglers targeting salmon and other marine species (WDFW 2011c); canary rockfish constituted an average 1.4 percent of the recreational catch from 1980 to 1989, but their frequency decreased to an average of 0.6 percent of the catch from 1996 until 2002 when their retention was prohibited; bocaccio comprised less than 0.2 percent of the recreational rockfish catch between 1980 and 2007 (Palsson et al. 2009). In the South Sound, canary rockfish comprised an average 1.0 percent and 1.4 percent of the recreational rockfish catch for 1980 to 1989 and 1996 to 2002, respectively; bocaccio averaged 0.2 percent during the 1980s (Palsson et al. 2009), and have only been sporadically encountered within Puget Sound in the past 15 years.

Currently, Puget Sound is closed to rockfish fishing; no targeted fishing for or retention of any species of rockfish is allowed in Marine Areas 5 through 13. Additionally, fishing for bottom fish in waters deeper than 120 feet is prohibited because of the resulting injuries and mortality from this fishery (WDFW 2010b) (Subsection 1.5, Relationship to Other Plans and Policies). When rockfish are brought from depths of deeper than 60 feet (18 meters), the rapid decompression causes over-inflation and/or rupture of the swim bladder (termed barotrauma), which can result in multiple direct injuries. In addition, these injuries cause various levels of disorientation among rockfish species, which can result in fish remaining at the surface for various periods after they are released (Hannah and Matteson 2007). These injuries are generally more pronounced in fish brought up from deeper waters. Rockfish at the surface are susceptible to predation by birds, sharks, or marine mammals; damage from solar radiation; and gas embolisms (Palsson et al. 2009). These factors, separately or in combination, often result in death.

4. ENVIRONMENTAL CONSEQUENCES

The following analyses address the seven resources identified as having the potential to be impacted by the alternatives. The analyses describe expected direct and indirect effects under the three alternatives when compared to the affected environment or existing conditions described in Section 3.0, Affected Environment. Cumulative impacts are analyzed in Section 5.0.

The terms "effect" and "impact" are used synonymously under NEPA; consequently, both terms are used in the following analyses (40 CFR 1508.8). Impacts include effects on the environment that are direct, indirect, or cumulative. Direct effects are caused by the action itself and occur at the same time and place (40 CFR 1508.8). Indirect effects are caused by the action and are later in time or farther removed in distance than direct impacts, but are still reasonably foreseeable (40 CFR 1508.8). Cumulative impacts are those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This Environmental Assessment analyzes in detail three alternatives: the No-action Alternative, the Proposed Action, and a Similar to Proposed Action Alternative but with Fewer Restrictions, as described in Subsection 1.2, Description of the Proposed Action and Subsection 2.2, Alternatives. Under Alternative 2 (Proposed Action) and Alternative 3 (Similar to Proposed Action Alternative), WDFW would be committed to the activities described below and in Subsection 1.2, Description of the Proposed Action and Subsection 2.2, Alternatives, for a period of 5 years. Under the No-action Alternative, WDFW's commitment to these activities would be uncertain, and WDFW could suspend the fishery closures or fishing regulations of the listed fisheries at any time as deemed appropriate.

The Proposed Action is for NMFS to issue the requested permits and for WDFW to implement the proposed Fishery Conservation Plan and Puget Sound fish research program. Specifically:

1) NMFS would issue a permit under section 10(a)(1)(B) of the ESA, which would cover the incidental take of ESA-listed rockfish, Chinook salmon, and eulachon in two state-authorized fisheries in Puget Sound—the recreational bottom fish fishery and the commercial shrimp trawl fishery. Pursuant to the Fishery Conservation Plan, WDFW would implement the following measures:

a. Continue the closure, by regulation, of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries;

b. Continue to prohibit fishing for rockfish in Marine Areas 5 through 13;

c. Continue to prohibit retention of rockfish caught in any fishery in Marine Areas 5 through 13;

d. Continue to prohibit bottom fishing in waters deeper than 120 feet throughout the range of the U.S. waters of the Puget Sound/Georgia Basin rockfish DPSs (halibut and salmon fisheries would still be allowed in waters deeper than 120 feet);

e. Require permit holders in the shrimp trawl fishery to have on-board observers on 10 percent of all trips, who would identify and track bycatch; and

f. Continue to allow only beam trawls in the shrimp trawl fishery (no rockhopper gear).

2) NMFS would issue a permit under section 10(a)(1)(A) of the ESA, which would cover the direct and incidental take of ESA-listed rockfish, Chinook salmon, and eulachon resulting from WDFW research activities on Puget Sound bottom fish and other fish. Activities for the Puget Sound fish research program would include continuation of a bottom fish trawl census that has occurred on an annual basis since the late 1980s, a midwater trawl survey, an acoustic trawl survey of Pacific herring, and hook-and-line and tagging studies of non-listed rockfish.

3) WDFW would report to NMFS annually on the above activities and adapt future fisheries and research activities as necessary.

The proposed permits, Fishery Conservation Plan, and research activities would continue for a period of 5 years.

4.1. Marine Ecosystem and Habitat

4.1.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, no activities would occur in the marine ecosystem related to gear and vessels for recreational bottom fishing or commercial shrimp trawling; WDFW research; and the set

net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because WDFW would no longer permit or conduct these activities. Critical habitat for resident killer whales, green sturgeon, Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout, and essential fish habitat would not be altered by these closed fisheries and research activities.

The cessation of WDFW-conducted research about stock status, abundance, and distribution of Puget Sound fishes would result in less information for management of fisheries (such as the Puget Sound Chinook salmon fishery) described in Subsection 1.5, Relationship to Other Plans and Policies, and thus would provide less information for designing management actions (such as restoration projects, fisheries, development projects) that could affect the marine ecosystem.

The No-action Alternative could result in a slight reduction in the level of new contaminants within the marine environment that impact rockfish and other salmonids, groundfish, and forage fish such as herring, from the lack of recreational bottom fishing trips and the shrimp trawl fishery, and possible spills of fuels and inputs of PAHs from these boats. However, as discussed in Subsection 3.1, Marine Ecosystem and Habitat, these contaminants would continue to be introduced mostly through sources unrelated to the fisheries and research activities associated with the No-action Alternative. The marine ecosystem would also not be exposed to any lost fishing gear from these closed fisheries. The overall status of the marine ecosystem, as described in Subsection 3.1, Marine Ecosystem and Habitat, would remain the same under the No-action Alternative. Threats such as nearshore development, derelict fishing gear, and water quality problems such as low dissolved oxygen and inputs of bioaccumulative chemicals would continue.

4.1.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Under the Proposed Action, there would be increased activity in the marine ecosystem as a result of the authorized bottom fish fishery, shrimp trawl fishery, and WDFW research activities compared to the No-action Alternative. Similar to the No-action Alternative, there would be no change to the marine ecosystem related to the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

As described in Subsections 2.2.2.1, Fishing Activities Under the Proposed Action, and 2.2.2.2, Research Activities Under the Proposed Action, research trawls include mid-water and bottom trawls. Mid-water trawls would not come into contact with benthic habitats and, therefore, would not cause any habitat alterations. Research bottom trawls would result in over 100 tows annually that would occur in each of the major basins of Puget Sound, and the shrimp trawl fishery would result in approximately 965 shrimp tows annually in North Sound (WDFW 2011d). As described in Section 3.0, Affected Environment, these trawls would occur in portions of areas designated as critical habitat for resident killer whales, green sturgeon, Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout. Similarly, these trawls would occur in areas designated as EFH for 44 species of groundfish, several salmonids, and coastal pelagic species (Appendix B: Species of Fishes with Designated EFH in the Action Area). Critical habitat for green sturgeon and salmonids, and EFH for several salmonids and groundfish would be altered in several ways because of the shrimp trawl fishery and research trawls. As described in Subsection 2.2.2, Alternative 2: Proposed Action, the shrimp trawls use beam trawl gear (no rockhopper gear would be allowed) and thus would not alter areas of rocky bottoms. Trawl gear would be used in sandy, muddy/cobble habitats and would alter portions of the sea floor of Puget Sound (mostly concentrated in North Sound) by suspending sediment and changing habitat complexity, smoothing of sand waves, and changing bottom roughness in localized areas. Trawls in less structurally complex habitats, such as areas fished by the commercial shrimp trawlers, are less affected than areas of more complex habitat (Roberts 2008). The effect of suspended sediment would be small and temporary as sediment would re-settle to local habitats. Effects to EFH for coastal pelagic EFH would be minimal because trawl gear does not alter the pelagic environment.

For the shrimp trawl fishery, temporary sediment suspension would not alter light levels (and thus, would not interrupt photosynthesis or affect species such as eelgrass or kelp) because this suspended sediment is limited to waters deeper than 120 feet, which are deeper than the photic zone. Some WDFW research trawls would occur in the photic zone (such as the nearshore of Puget Sound); thus, temporary sediment suspension could reduce light levels on a short-term basis. Temporarily reduced light levels would be unlikely to alter benthic habitats because, as mentioned in Subsection 3.1, Marine Ecosystem and Habitat, habitat conditions and sediment levels in the nearshore are naturally dynamic. It is possible that a research or shrimp trawl net could be lost and subsequently kill marine fish and invertebrates. However, as described in Subsection 3.1, Marine Ecosystem and Habitat, only two of 902 recovered nets were from trawl fisheries. Based on this evidence, the probability of the future loss of a trawl net from research activities or the commercial shrimp trawl fishery is considered discountable.

As described in Subsection 2.2.2.1, Fishing Activities Under the Proposed Action, the recreational bottom fish fishery in all waters of Puget Sound shallower than 120 feet would likely result in approximately 100,000 angler trips annually. In addition, as discussed in Subsection 2.2.2.2, Research Activities under the Proposed Action, some WDFW research activities would use recreational fishing methods. Jigs, weights, and hooks used by anglers have the potential to alter benthic habitats by snagging structure, and some gear can be lost. However, adverse effects to the seafloor from lost recreational fishing gear have not been observed in WDFW habitat surveys (Pacunski 2011).

Unlike the No-action Alternative, the additional information available from WDFW-conducted research about stock status, abundance, and distribution of Puget Sound fishes under the Proposed Action would be available to inform adaptive management of fisheries and other rockfish recovery efforts. These management efforts could subsequently influence the overall condition of the Puget Sound marine ecosystem and its habitats.

Similar to the No-action Alternative, the overall status of the marine ecosystem, as described in Subsection 3.1, Marine Ecosystem and Habitat, would remain the same. Threats such as nearshore development, water quality problems such as low dissolved oxygen, and input of bioaccumulative chemicals would continue. Unlike the No-action Alternative, a slight increase in the level of new contaminants within the marine environment could occur from fuel spills and PAHs associated with recreational vessels used on bottom fishing trips and the shrimp trawl fishery. However, as discussed in Subsection 3.1, Marine Ecosystem and Habitat, contaminants are introduced mostly through sources unrelated to the fisheries and research activities associated with the Proposed Action, and the effects of any additional contaminants from fishing activities would be a small proportion of all boating activity in the rockfish DPSs. The research activities and fisheries occurring under the Proposed Action would not degrade the overall condition of the marine ecosystem of Puget Sound and its habitats because they are unlikely to result in changes to habitat structure and function beyond short term and transitory effects.

4.1.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to the marine ecosystem under Alternative 3 would be similar to those described under the Proposed Action compared to the No-action Alternative. However, under Alternative 3, the 120-foot

depth restriction for the recreational bottom fishery would not be in effect. This alteration could result in more angler trips for bottom fish, and result in fishing in waters deeper than 120 feet. The few additional fishing trips and fishing gear in waters deeper than 120 feet would result in additional lost recreational fishing gear in deeper waters, and a greater potential for fuel spills and input of PAHs. However, adverse effects to the seafloor from lost recreational fishing gear have not been observed in WDFW habitat surveys (Pacunski 2011), contaminants are introduced mostly through sources unrelated to the fisheries and research boating activities, and the effects of any additional contaminants from boating activities would be a small proportion of all boating activity in the action area. As such, effects to the marine ecosystem and to critical habitat for resident killer whales, green sturgeon, Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout, and EFH for 44 species of groundfish from the lack of a 120-foot fishing restriction would be small.

Similar to the Proposed Action and the No-action Alternative, the overall status of the marine ecosystem, as described in Subsection 3.1, Marine Ecosystem and Habitat, would remain the same. Threats such as nearshore development and water quality problems (e.g., low dissolved oxygen and bioaccumulative chemicals) would continue. The research activities and fisheries would not degrade the overall condition of the marine ecosystem of Puget Sound and its habitats because they are unlikely to result in changes to habitat structure and function beyond short-term and transitory effects.

4.2. ESA-listed Fish

4.2.1. Rockfish Species

4.2.1.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Life History

Under the No-action Alternative, there would be no injury to or mortality of ESA-listed rockfish in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries, as these fisheries would remain closed. There would also be no change in life history expression or injury to or mortality of ESA-listed rockfish through either direct or indirect take from recreational bottom fish fisheries or commercial shrimp trawl fisheries in Puget Sound because WDFW would not authorize these fisheries (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). Additionally, WDFW would no longer conduct research activities that may catch ESA-listed rockfish so none would be injured or killed in research actions. The closure of the

shrimp trawl fishery would also result in no removals of shrimp, which are prey for rockfish, from the North Sound.

Abundance and Productivity

The No-action Alternative would not impact the abundance and spatial structure of yelloweye rockfish, canary rockfish, and bocaccio because bycatch from closed recreational and commercial fisheries and Puget Sound fish research program activities would be eliminated. The result of these closures would protect some mature yelloweye rockfish, canary rockfish, and bocaccio from being killed, and therefore these species would continue to produce larvae. In particular, the preservation of larger rockfish that are typically taken in recreational fisheries, as described in Subsection 3.2.1.2, Current Status, would in turn lead to enhanced productivity as they release more and larger larvae. As discussed in Subsection 3.1, Marine Ecosystem and Habitat, the No-action Alternative could result in a slight reduction of the level of contaminants within the marine environment that impact rockfish or their prey, though as discussed in Subsection 3.2.1.2, Current Status, most of these contaminants are/have been introduced through sources unrelated to the fisheries and research activities associated with the No-action Alternative. Similarly, the No-action Alternative would have no impact on other habitat limiting factors such as derelict fishing gear and nearshore degradation. Habitat limiting factors and the legacy effects of past overfishing would remain as threats to the viability of yelloweye rockfish, canary rockfish, and bocaccio.

Though abundance and productivity would be expected to improve under the No-action Alternative for yelloweye rockfish, canary rockfish, and bocaccio, pre-existing habitat limiting factors, as described in Subsection 3.2.1.2, Current Status, including derelict fishing gear, degraded water quality from excess nutrients and bioaccumulants, and nearshore development would remain. These factors, in addition to bycatch associated with recreational salmon and halibut fisheries (as described in Subsection 2.2.2.1, Fishing Activities under the Proposed Action, and Subsection 3.2.1.2, Current Status) would continue to limit the full recovery of abundance and productivity for these species under the No-action Alternative because rockfish experience naturally low productivity levels that are exacerbated by fishery removals (that affect size and age structures of these species), environmental toxicity (that can affect reproduction function), and habitat changes derived from environmental regime changes (that affect the dynamics of population productivity).

Spatial Structure and Connectivity

The elimination of bycatch from the closed fisheries associated with the No-action Alternative would incrementally improve spatial structure of listed rockfish and, therefore, viability of these species. As discussed in Subsection 3.2.1.2, Current Status, some canary rockfish and bocaccio can migrate long distances and colonize habitats while yelloweye rockfish are thought to have smaller home ranges. The lack of bycatch associated with the closed fisheries would thus enable possible natural colonization and improvement of spatial structure for canary rockfish and bocaccio, and to a lesser degree yelloweye rockfish.

Diversity

The No-action Alternative would incrementally improve some diversity parameters that include life-history characteristics (such as timing of reproduction, ability to adjust to habitat changes, and habitat usage) as described in Subsection 3.2.1.2, Current Status, because some mature fish would not be caught and, therefore, continue to reproduce young; in turn, this would enable a greater likelihood that adaption to changing habitat conditions could occur over the long term. The No-action Alternative would have no impact on molecular genetic characteristics because, as described in Subsection 3.2.1.2, Current Status, they are only influenced by longer term factors such as environmental variation.

Because WDFW would not conduct some of its planned research of ESA-listed rockfish, the only available information about stock status, abundance, and distribution would be available from research that could be conducted without risk of take. This would limit acquisition of new information to understand the abundance, spatial structure, and habitat associations of rockfish.

4.2.1.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, under the Proposed Action there would be no injury to or mortality of ESA-listed rockfish in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries, as these fisheries would remain closed for a period of 5 years. There would be a small change in life history expression from mortality of ESA-listed rockfish through direct take from recreational bottom fish fisheries or commercial shrimp trawl fisheries (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). These

fisheries would kill some sub-adult and mature adult fish, thus slightly reducing reproductive output for the species as a whole.

Bycatch of ESA-listed rockfish would increase relative to the No-action Alternative, as the recreational bottom fish fishery and commercial shrimp trawl fishery would be open. Under the Proposed Action, these takes from bycatch would be an estimated 152 yelloweye rockfish, 138 canary rockfish, and 43 bocaccio annually (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). As mitigation, recreational bottom fish and commercial shrimp trawl fisheries could be modified to reduce rockfish bycatch during the 5-year term as a result of information gained through research and monitoring from on-board observers, so these levels of injury and mortality could be less during the term of the action. Because of the likelihood that most incidentally caught rockfish would die, this analysis assumes 100 percent mortality of incidentally caught fish.

The increased mortality of ESA-listed rockfish from the fisheries and research activity compared to the No-action Alternative would have a minor negative effect on the abundance and productivity of each species because the overall number of fish killed would be a small proportion of the overall population. Although these species are listed under the ESA, they are sufficiently abundant that they can withstand a small number of mortalities. Productivity would be slightly reduced by the loss of adult fish (particularly larger adults) resulting from bycatch. Mature fish produce larvae, but rockfish populations experience naturally low productivity levels. Further, rockfish species have been suppressed by the legacy effects of past overfishing, which would continue to impact this species when combined with fishing activities under the Proposed Action.

Similar to the No-action Alternative, the Proposed Action would have no impact on the level of habitat limiting factors, such as derelict fishing gear and nearshore degradation. As discussed in Subsection 4.1, Marine Ecosystem and Habitat, the input of some contaminants from fishing and research vessel activities would increase relative to the Proposed Action, though this input would be small compared to all boating activity in the action area. Habitat limiting factors and the legacy effects of past overfishing would remain threats to the viability of yelloweye rockfish, canary rockfish, and bocaccio.

The spatial structure of listed rockfish, described in Subsection 3.2.1.2, Current Status, would be slightly negatively impacted by the death of listed rockfish in various basins of Puget Sound and from the shrimp trawl fishery in North Sound. Similarly, diversity parameters that include life-history characteristics such as timing of reproduction, ability to adjust to habitat changes, and habitat usage

would be slightly negatively influenced by the removal of some sub-adult and adult fish. As discussed above, the removal of reproductively mature fish affects life-history expression and diversity.

Listed rockfish would still be vulnerable to risks discussed in Subsection 3.2.1.2, Current Status, including environmental variation such as altered temperature regimes and circulation patterns, genetic processes such as the possible accumulation of negative mutations, demographic unpredictability such as imbalanced gender ratios, ecological feedback such as other fish species occupying the niche left by the depleted population, and catastrophes such as oil spills that may disrupt benthic environments or larval/juvenile rearing habitats and food sources (McElhaney et al. 2000). Low abundance may also continue to pose a risk to the species by making them vulnerable to depensatory processes (termed "Allee" effects). The relative risks associated with these factors are imprecise, as they have not been quantified for listed rockfish in Puget Sound, but such risks are anticipated to continue under the Proposed Action.

Under the Proposed Action, the combined effects to yelloweye rockfish, canary rockfish, and bocaccio from fishing, research activities, and other continued risk factors would likely result in a small reduction in abundance and productivity, spatial structure, and diversity. This small reduction is unlikely to exceed levels that would hinder population viability.

Compared to the No-action Alternative, the Proposed Action would result in additional information about stock status, abundance, and distribution of ESA-listed rockfish. This information would come from two sources. The first would be the Puget Sound fish research program. The second would be from fisheries data. Although the bottom fish fishery and shrimp trawl fishery would kill and injure rockfish, the monitoring and reporting from these fisheries (enabled for the shrimp trawl fishery by on-board observers) would also provide information about abundance, spatial structure, and habitat associations.

4.2.1.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Compared to the No-action Alternative, impacts to ESA-listed rockfish under Alternative 3 would be the same as those described under the Proposed Action, with two exceptions. Bycatch levels for ESA-listed rockfish from anglers targeting bottom fish would be similar to recent years, with an annual estimated total of 219 yelloweye rockfish and 194 canary rockfish caught under Alternative 3. These

numbers of take would be greater than under the Proposed Action because of the lack of a 120-foot depth restriction described in Subsection 1.2, Description of the Proposed Action, and would be similar to catch levels that occurred prior to implementation of this restriction (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). The number of bocaccio that would be taken by recreational bottom fishing under Alternative 3 is undetermined because of a number of uncertainties described in Subsection 3.2.1.2, Current Status, Incidental Catch in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities, but the lack of the 120-foot depth restriction would place them at greater risk of bycatch compared to the Proposed Action because adults typically occupy water deeper than 120 feet (Subsection 3.2.1.1, Rockfish Life History).

Consequently, impacts related to life history, abundance and productivity, spatial structure, and diversity when combined with fishing activities and expected increases in bycatch when compared to the Proposed Action, would result in greater risks to the overall viability of each species in each of the basins of the DPSs. The lack of a depth restriction for recreational fishing could result in more fishing trips and, therefore, a greater potential for fuel spills and input of PAHs. However, contaminants are introduced mostly through sources unrelated to the recreational bottom fish activities and the effects of any additional contaminants would be a small proportion of the total occurring from boating activity in the rockfish DPSs.

Bycatch impacts from the shrimp trawl fishery would also be similar to the Proposed Action, compared to no bycatch under the No-action Alternative (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). However, information about bycatch levels from the shrimp trawl fishery would be less precise under Alternative 3 than under the Proposed Action, because no monitoring of bycatch by on-board observers would occur under Alternative 3. The absence of on-board observers would require that commercial shrimp trawl fishers document their own bycatch. There are 28 species of rockfish within Puget Sound, many of which look similar to each other (Palsson et al. 2009). Thus, without the assistance of trained observers, the identification of rockfish to species would likely be imprecise and thus hinder the reliability of information that would enable adaptive management measures to further reduce ESA-listed rockfish bycatch, as necessary.

Compared to the No-action Alternative, impacts to ESA-listed rockfish from research activities under Alternative 3 would be the same as those described under the Proposed Action.

4.2.2. Salmonids

The following analysis of each alternative's relative effect on listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, and bull trout is less comprehensive compared to listed rockfish. This is because the fishery conservation plan was developed for the purpose of reducing bycatch of rockfish from state-authorized fisheries, and the closed set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries likely catch few, if any, salmonids. Further, of the four listed species, Chinook salmon is the only species caught in recreational bottom fisheries or the commercial shrimp trawl fisheries. Thus, fishery closures would have little conservation benefit to listed salmonids. In addition, the relative bycatch of listed salmonids from fisheries and research activities, where they occur, is a much smaller fraction of the overall population compared to rockfish.

4.2.2.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no change in life history, as described in Subsection 3.0, Affected Environment, or injury to or mortality of Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, or bull trout in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries, as these fisheries would remain closed. There would also be no change in life history, or injury to or mortality of these ESA-listed salmonids in recreational bottom fisheries or commercial shrimp trawl fisheries in Puget Sound because WDFW would not authorize these fisheries.

Because no research activities would occur under the No-action Alternative, no ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, or bull trout would be incidentally captured by WDFW Puget Sound fish research activities (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives), and no ESA-listed rockfish would be directly taken by research activities. Similarly, no ESA-listed salmon, steelhead, or bull trout would be incidentally taken in the recreational bottom fish fishery or the shrimp trawl fishery because these fisheries would be closed.

The overall status and abundance of the 22 populations of Puget Sound Chinook salmon, 9 populations of Hood Canal summer chum salmon, and approximately 50 stocks of Puget Sound steelhead (some of which are currently at high risk of extinction) (Subsection 3.2.2, Salmonids) would slightly improve

under the No-action Alternative. This improvement would occur because a small number of fish (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives) would not be killed during research or fisheries activities.

The No-action Alternative would not alter the limiting factors discussed in Subsection 3.2.2, Salmonids, which include land use activities such as urbanization, past forestry practices, agriculture, and development. Limiting factors in the marine environment of Puget Sound that include nearshore degradation and bioaccumulative contaminants would continue. This is because these limiting factors are unaffected by the closed fisheries and research activities. As a result, these limiting factors would continue to affect the viability of listed salmonids, although implementation of recovery plans for Puget Sound Chinook salmon and Hood Canal chum salmon (in draft) may reduce the magnitude of some of these limiting factors. Thus, the closure of fisheries and research activities would not change the overall viability of listed Puget Sound Chinook salmon, Hood Canal chum salmon, or Puget Sound steelhead. Similarly, bull trout habitat limiting factors that include elevated fresh water temperatures, the introduction of non-native species in fresh water, and habitat degradation (Subsection 3.2.2, Salmonids), would not be affected by the closure of research activities and fisheries.

As described in Subsection 3.2.2, Salmonids, critical habitat is designated along the nearshore of portions of Puget Sound for Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout. The closure of the applicable fisheries and research activities would not alter the critical habitat for each of these species because, as discussed in Subsection 3.1, Marine Ecosystem and Habitat, fisheries and research activities only result in short-term and spatially isolated effects that do not alter essential habitat features for salmonids; therefore, closures would not result in any measurable benefit to critical habitat conditions.

Because WDFW would not conduct some of its planned research of Puget Sound fishes, less information would be available about salmonid stock status, abundance, and distribution in Puget Sound. This would limit acquisition of new information to understand the abundance, spatial structure, and habitat associations of salmonid species.

4.2.2.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, under the Proposed Action there would be no change in life history, or injury to or mortality of listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, or bull trout in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term.

Under the Proposed Action, WDFW would authorize recreational bottom fish fisheries in waters shallower than 120 feet and commercial shrimp trawl fisheries. Thus, compared to the No-action Alternative, the Proposed Action would result in a small amount of bycatch and mortality to Puget Sound Chinook salmon because of WDFW authorizing these two fisheries. Most of the Puget Sound Chinook salmon that are bycatch in these two fisheries would be juveniles because, as described in Subsection 3.2.2.1, Puget Sound Chinook Salmon, they are much more abundant in Puget Sound than adults (Rice 2007). The small number of deaths of Puget Sound Chinook salmon would not result in any change of life history expression to the overall population.

A small number of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, and Puget Sound steelhead are captured as a result of WDFW Puget Sound fish research activities, and some of those captured die as a result (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). Thus, compared to the No-action Alternative, the Proposed Action would result in a slight increase in mortality of salmonids because of WDFW's Puget Sound fish research activities.

Conditions for bull trout would be the same under any alternative. Bull trout have not been captured in over 1,700 research trawls conducted by WDFW (Pacunski 2011a) or captured in observed shrimp trawls (O'Toole 2011). Bull trout are unlikely to be caught in WDFW research trawls and commercial shrimp trawl because, as described in Subsection 3.2.2.4, Bull Trout, Current Status, they occupy shallow nearshore waters (away from trawl locations) (Goetz et al. 2004). Bull trout are also unlikely to be caught from recreational fishing gear because, as discussed in Subsection 3.2.2.4, Bull Trout, they eat smaller invertebrates and fishes (Goetz et al. 2004). Consequently, bull trout are not vulnerable to recreational bottom fishing gear because the lures or bait used by bottom fish anglers are larger than natural food sources.

The increased mortality from the fisheries and research activities under the Proposed Action would not be enough to impact viability of the ESA-listed 22 populations of Puget Sound Chinook salmon, 9

populations of Hood Canal summer chum salmon, and 50 stocks of Puget Sound steelhead because of the extremely small fraction of fish that would be killed relative to the overall estimated population.

Similar to the No-action Alternative, the Proposed Action would not alter the limiting factors discussed in Subsection 3.2.2, Salmonids, which include land use activities such as urbanization, past forestry practices, agriculture, and development. Similarly, limiting factors in the marine environment of Puget Sound that include nearshore degradation and bioaccumulative contaminants would continue because these limiting factors are unaffected by fisheries and research activities. As a result, these limiting factors would continue to affect listed salmonids' viability, although implementation of recovery plans for Puget Sound Chinook salmon and Hood Canal chum salmon (in draft) may reduce the magnitude of some of these limiting factors. However, the combined effect of these limiting factors and the death of a few listed salmonids in fisheries and research activities would not meaningfully impact the viability of listed Puget Sound Chinook salmon, Hood Canal chum salmon, or Puget Sound steelhead. Similarly, bull trout habitat limiting factors that include elevated fresh water temperatures, the introduction of non-native species in fresh water, and habitat degradation (Subsection 3.2.2, Salmonids) would not be affected by the closure of research activities and fisheries.

As described in Subsection 3.2.2, Salmonids, critical habitat of Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout is designated along portions of the nearshore of Puget Sound. The recreational bottom fish fishery, commercial shrimp trawl fishery, and WDFW Puget Sound fish research activities would not alter the condition of critical habitat for each of these species because these activities, as described in Subsection 2.2.2.1, Fishing Activities under the Proposed Action, and Subsection 2.2.2.2, Research Activities under the Proposed Action, would not tangibly affect habitat conditions along the nearshore (see Subsection 4.1, Marine Ecosystem and Habitat, for additional analysis). Further, the shrimp trawl fishery is not authorized to occur in nearshore waters shallower than 90 feet (30m) deep and, therefore, does not occur in bull trout critical habitat.

Compared to the No-action Alternative, the Proposed Action would result in additional information about stock status, abundance, and distribution of ESA-listed Puget Sound Chinook salmon, Hood Canal chum salmon, and Puget Sound steelhead from the Puget Sound fish research program. This additional data would provide information about ESA-listed salmonid distribution, abundance, and trends.

4.2.2.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, and bull trout under Alternative 3 would be the same as those described under the Proposed Action. Puget Sound Chinook salmon are likely to be the only ESA-listed salmonid to be caught in the recreational bottom fish fishery or shrimp trawl fishery, and most of these fish would be juveniles (Subsection 3.2.2.5, Incidental Catch of Salmonids in Current Recreational Bottom Fisheries, Commercial Shrimp Fisheries, and Research Activities). Alternative 3 would not have the 120-foot depth restriction, but no additional Puget Sound Chinook salmon would be expected to be caught as a result of fishing at greater depths compared to the Proposed Action because, as described in Subsection 3.2.2.1, Puget Sound Chinook Salmon, most juvenile Chinook salmon generally occupy the nearshore (Rice 2007), which is shallower than 120 feet. A small number of Puget Sound Chinook salmon would be caught as a result of Alternative 3, compared to none under the No-action Alternative (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives).

Bycatch of listed salmonids under the Proposed Action and Alternative 3 would be identical; thus, increased mortality from the fisheries and research activities under Alternative 3 relative to the No-action Alternative would not be enough to impact viability of ESA-listed Puget Sound Chinook salmon, Puget Sound steelhead, or Hood Canal summer chum salmon because of the extremely small fraction of fish killed relative to the overall estimated population.

Similar to the Proposed Action, Alternative 3 would not alter the limiting factors discussed in Subsection 3.2.2, Salmonids, that include land use activities such as urbanization, past forestry practices, agriculture, and development. Similarly, limiting factors in the marine environment of Puget Sound that include nearshore degradation and bioaccumulative contaminants would continue because these limiting factors are unaffected by fisheries and research activities, although implementation of recovery plans for Puget Sound Chinook salmon and Hood Canal chum salmon (in draft) may reduce the magnitude of some of these limiting factors. As a result, these limiting factors would continue to affect the viability of listed salmonids. However, the combined effect of these limiting factors and the death of a few listed salmonids in fisheries and research activities would not meaningfully impact the viability of listed Puget Sound Chinook salmon, Hood Canal chum salmon, or Puget Sound steelhead.

Similarly, bull trout habitat limiting factors that include elevated fresh water temperatures, the introduction of non-native species in fresh water, and habitat degradation (Subsection 3.2.2, Salmonids) would not be affected by the closure of research activities and fisheries.

Similar to the Proposed Action, there would be no effects to critical habitat designated along the nearshore of Puget Sound for Puget Sound Chinook salmon, Hood Canal chum salmon, and bull trout from the authorized fisheries and research.

Compared to the No-action Alternative, impacts to ESA-listed salmonids for research activities under Alternative 3 would be the same as those described under the Proposed Action.

4.2.3. Eulachon

4.2.3.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no change in life history, injury to or mortality of eulachon from the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because they are closed. There would be no bycatch of ESA-listed eulachon in the shrimp trawl fishery or recreational bottom fish fishery because these fisheries would be closed by WDFW. Because the shrimp trawl fishery would be closed, no on-board observers would be necessary. Also, under the No-action Alternative, no ESA-listed eulachon would be incidentally captured by WDFW research activities (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives).

The No-action Alternative would have no effect on freshwater habitat used by eulachon, described in Subsection 3.2.3, Eulachon, because the closed fisheries and research activities would not occur in freshwater habitats. Similarly, it would have no effect on food sources of eulachon in marine waters, described in Subsection 3.2.3, Eulachon, because these closed fisheries and research activities would not catch eulachon food sources. The No-action Alternative would not alter eulachon critical habitat, as described in Subsection 3.2.3, Eulachon, because critical habitat is not designated in marine waters.

The No-action Alternative would not alter the limiting factors discussed in Subsection 3.2.3, Eulachon, which include freshwater habitat degradation, changing ocean conditions, and commercial harvest. This is because these limiting factors are unaffected by the closed recreational and shrimp trawl fisheries

and research. As a result, these limiting factors would continue to affect listed eulachon viability. However, the No-action Alternative would result in less commercial bycatch of eulachon. As such, the overall status of eulachon could be slightly improved by the No-action Alternative, as the closure of the commercial shrimp trawl fishery would eliminate any bycatch. However, on-going limiting factors would continue to affect eulachon status throughout their range.

No data would be collected by WDFW on stock distribution and abundance, status, and life history of ESA-listed eulachon in the Puget Sound/Georgia Basin under the No-action Alternative. Because WDFW would not conduct their planned research that would take eulachon, the only available information about stock status, abundance, and distribution would be available from research that could be conducted without risk of take. This would limit acquisition of new information to understand the abundance, spatial structure, and habitat associations of eulachon in the Puget Sound.

4.2.3.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, there would be no change in life history, or injury to or mortality of eulachon in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action. Compared to the No-action Alternative, a relatively small number of eulachon would be incidentally killed by the commercial shrimp trawl fishery in North Sound (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). Because they are small and fragile, eulachon that are incidentally caught in the shrimp trawl fishery would die (WDFW 2011d).

Similar to the No-action Alternative, the Proposed Action would not alter most of the limiting factors discussed in Subsection 3.2.3, Eulachon, which include freshwater habitat degradation, changing ocean conditions, and commercial harvest. This is because these limiting factors are unaffected by the fisheries and research as they collectively would not occur in freshwater habitats used by eulachon, would not alter ocean conditions, or result in targeted commercial harvest. As such, these limiting factors would continue to affect listed eulachon viability. The WDFW research trawls and the shrimp trawl fishery in the North Sound would result in bycatch of only a small number of eulachon. As such, life-history expression would not be altered, and the overall status of eulachon would be only slightly

impacted by this bycatch because of the extremely small fraction of fish killed relative to the overall estimated population. The fisheries and research authorized under the Proposed Action would not alter eulachon critical habitat because, as described in Subsection 3.2.3, Eulachon, critical habitat is not designated in marine waters.

Compared to the No-action Alternative, additional information regarding eulachon distribution, habitat use, and abundance of eulachon in Puget Sound would be gained by WDFW's research activities under the Proposed Action. Also, use of observers in the shrimp trawl fishery would provide data regarding the distribution and abundance of ESA-listed eulachon, as compared to the No-action Alternative, which would have no shrimp trawl fishery (and no on-board observers).

4.2.3.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Compared to the No-action Alternative, impacts to ESA-listed eulachon under Alternative 3 would be the same as those described under the Proposed Action, with one exception. Under Alternative 3, the numbers of eulachon bycatch would be less certain because on-board observers for the shrimp trawl fishery would not be required, and the fishers would self-report all bycatch (Subsection 2.2.3, Alternative 3). As described in Subsection 3.2.3, Eulachon, eulachon look similar to several other more common forage fish within Puget Sound, including Pacific herring, surf smelt, and sand lance. Thus, reliable identification and enumeration of eulachon caught in the commercial shrimp trawl fishery in the North Sound would be questionable under this alternative. This uncertainty would in turn hinder adaptive management steps to reduce eulachon bycatch in the future as necessary.

4.2.4. Green Sturgeon

4.2.4.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no change in life history, or injury to or mortality of green sturgeon in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because these fisheries would be closed. Further, no ESA-listed green sturgeon would be incidentally caught in Puget Sound recreational bottom fisheries or commercial shrimp trawl fisheries because these

fisheries would be closed. The closure of these fisheries and research activities would not affect green sturgeon critical habitat.

The No-action Alternative would have no effect on habitat limiting factors (entrainment in water projects, pollution, exotic species, impassible barriers, and elevated water temperatures) for green sturgeon, described in Subsection 3.2.4, Green Sturgeon. The lack of catches from fisheries and research activities would incrementally improve the abundance of green sturgeon in the action area, though the overall improvement to the population would be negligible because green sturgeon would remain at risk from pre-existing limiting factors.

Because WDFW would not conduct some of its planned research in Puget Sound, the only available information about stock status, abundance, and distribution would be available from research that could be conducted without risk of take. This would limit acquisition of new information to understand the distribution of green sturgeon.

4.2.4.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

As under the No-action Alternative, there would be no change in life history, injury to or mortality of green sturgeon in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Compared to the No-action Alternative, in which no green sturgeon would be incidentally caught in fisheries or research activities, the Proposed Action could result in a small number of ESA-listed green sturgeon incidentally captured in WDFW research activities (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives). There is no information regarding any past catch of green sturgeon in the shrimp trawl fishery or bottom fish fishery, though given the scarcity of green sturgeon in the action area, catches in these fisheries are unlikely (WDFW 2011d). Most green sturgeon captured during research activities would be released alive, but it is possible one captured specimen could die as a result of this activity annually (WDFW 2011d). The numbers of green sturgeon caught would likely be low to nonexistent because, as described in Subsection 3.2.4, Green Sturgeon, they are very rare in Puget Sound, and mortalities as a result of

encounters during research activities would be even lower because few if any that are caught would die (WDFW 2011c).

Similar to the No-action Alternative, the Proposed Action would have no effect on freshwater habitat limiting factors (entrainment in water projects, pollution, exotic species, impassible barriers, and elevated water temperatures) for green sturgeon, described in Subsection 3.2.4, Green Sturgeon, because fisheries and research only occur in marine waters.

Unlike the No-action Alternative, the Proposed Action would enable the shrimp trawl fishery and bottom trawl research activities in the North Puget Sound where critical habitat is designated for green sturgeon, as described in Subsection 3.2.4, Green Sturgeon. The shrimp trawl fishery and bottom trawl research activities that occur in the North Sound would alter portions of green sturgeon critical habitat by affecting sediment quality and available food resources (NMFS 2009). The effects of bottom trawling on benthic habitats are discussed in more detail in Subsection 3.1, Marine Ecosystem and Habitat, and include sediment disruption, smoothing of sand waves, and general bottom roughness. Trawling would result in a small decrease of benthic invertebrates and small fish that green sturgeon eat. However, bottom trawling may result in positive effects on food resources by digging up and making prey resources more available for green sturgeon (NMFS 2009). The overall effects of the Proposed Action on green sturgeon would be negligible; a few green sturgeon could be captured in research and shrimp trawls, but are expected to survive. If a few green sturgeon are killed, the overall effects to the species, in combination with pre-existing freshwater limiting factors, are unlikely to impact species viability beyond current conditions.

Compared to the No-action Alternative, the Proposed Action would result in additional information about green sturgeon distribution from the Puget Sound fish research program.

4.2.4.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to ESA-listed green sturgeon under Alternative 3 would be the same as those described under the Proposed Action because the Puget Sound fish research program and commercial shrimp trawl fishery would be the same under each alternative. The lack of on-board observers in the commercial shrimp trawl fishery under Alternative 3 would result in no documentation of green sturgeon bycatch,

which would eliminate any possible adaptive management measures to modify the fishery as necessary to decrease green sturgeon bycatch.

4.3. Non-listed Fish

4.3.1. Groundfish Species

4.3.1.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

There would be no change of life history, injury to or mortality of groundfish species in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because they would be closed.

Because WDFW would close the recreational bottom fish fishery and the shrimp trawl fishery under the No-action Alternative, there would be no direct or incidental harvest of benthic or benthopelagic groundfish associated with these fisheries. Because there would be no commercial shrimp trawl fishery, there would be no effect on potential food sources (three species of *Pandalus* shrimp, small fish, and other invertebrates) for benthic and benthopelgic groundfish in North Sound. The closure of the recreational bottom fish fishery would result in no groundfish caught and thus could improve many non-listed groundfish species' viability by allowing mature fish to continue reproduction. Similarly, the closure of the recreational bottom fish fishery would result in no targeted catch of groundfish. However, limiting factors such as derelict fishing gear and water quality problems that include reduced levels of dissolved oxygen and inputs of toxins such as metals and petroleum products would continue to affect recovery of those depleted groundfish populations..

The fisheries and research activities would not affect EFH designated for 44 species of groundfish in the action area because each would be closed under the No-action Alternative.

Because WDFW would not conduct some of its planned research that would take some ESA-listed species, the only available information about stock status, abundance, and distribution of non-listed groundfish would be from research that could be conducted without risk of take. This would limit acquisition of new information to understand the abundance, spatial structure, and habitat associations of most of the groundfish species assemblages within Puget Sound, as described in Subsection 3.3.1, Groundfish Species.

4.3.1.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, there would be no change in life history, injury to or mortality of groundfish in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Under the Proposed Action, WDFW's authorization of the recreational bottom fish fishery in waters shallower than 120 feet and the commercial shrimp trawl fishery would result in increased injury and mortality of benthic and benthopelagic groundfish in Puget Sound from bycatch, compared to the No-action Alternative in which these fisheries would not occur. The shrimp trawl fishery has caught an average of 16.3 pounds of bycatch per individual tow, most of which is composed of benthic groundfish but includes small numbers of other non-groundfish species such as herring. As discussed in Subsection 2.2.2.1, Fishing Activities under the Proposed Action, from 2005 to 2010, the shrimp trawl fishery has averaged 193 individual trips, with an average of 5 tows per trip (WDFW 2011d). Thus, the commercial shrimp trawl fishery would result in an estimated 15,759 pounds of fish caught as bycatch annually, compared to the No-action Alternative where no bycatch would occur. This is a small fraction of the over 220 million pounds of groundfish estimated to occur in Puget Sound. However, limiting factors such as derelict fishing gear and water quality problems that include reduced levels of dissolved oxygen and inputs of toxins (e.g., metals and petroleum products) would continue to affect non-listed groundfish. Combined, bycatch levels (although small in comparison to the pounds of groundfish estimated to occur in Puget Sound) and limiting factors would result in continued negative effects to some groundfish species (particularly the non-listed rockfish species) under the Proposed Action.

Unlike the No-action Alternative, the commercial shrimp trawl fishery in North Sound would catch shrimp, small fish, and other invertebrates that would be otherwise available as the prey of groundfish. The loss of this potential prey would be proportionally small and have little effect on benthic and benthopelagic groundfish because of their diverse diets that include varied species of fish and invertebrates (Subsection 3.3.2, Non-groundfish Species).

As discussed in Subsection 3.3.1, Groundfish Species, catch levels for groundfish by recreational bottom fish anglers averaged 113,000 fish in Puget Sound from 2004 to 2009 (WDFW 2011a). Flatfish species were 68 percent of the bottom fish annual average harvest during this time period (WDFW 2011c). The overall number of groundfish species caught by recreational bottom fish anglers would be small, as 113,000 harvested fish (non-rockfish species) would be a fraction of the estimated 220 million pounds of bottom fish in Puget Sound[10]. The 120-foot depth restriction for recreational bottom fishing, described in Subsection 1.2, Description of the Proposed Action, would protect deepwater benthic or benthopelagic bottom fish from catches (e.g., greenstriped rockfish (*Seb. elongates*), redstripe rockfish (*Seb. proriger*), silvergray rockfish (*Seb. brevispinis*), and shortspine thornyheads (*Seb. alascanus*)), which would likely improve the depleted status of these species. Catches of non-listed rockfish would be greater than under the No-action Alternative.

Unlike the No-action Alternative, a small number of non-listed benthic and benthopelagic groundfish would be captured by WDFW research activities. These fish would be caught in isolated areas within each of the basins of the Puget Sound/Georgia Basin where trawl surveys occur. These catches would be small relative to the overall estimated biomass of 220 million tons of groundfish in Puget Sound. Therefore, the research activities permitted under the Proposed Action would not have a substantial effect on groundfish in Puget Sound because the amount of fish caught would be small relative to the overall biomass of fish.

The research and commercial shrimp trawls would occur in areas designated as EFH for 44 species of groundfish in the action area. The effects of bottom trawling on EFH and benthic habitats are discussed in more detail in Subsection 3.1, Marine Ecosystem and Habitat, and include sediment disruption, smoothing of sand waves, and general bottom roughness. In addition, the catch of some prey species may affect EFH. These effects would likely adversely affect EFH for these groundfish species, although effects would be over small spatial and temporal scales, and habitat conditions would return to functional condition soon after trawling activities cease. The catch of prey species would not adversely affect EFH because of the small amount of bycatch relative to the overall biomass of groundfish in Puget Sound.

Under the Proposed Action, information regarding stock status, abundance, and distribution of non-listed benthic and benthopelagic groundfish would be available as a result of WDFW research activities

[10] If the average weight of harvested groundfish is 2 pounds, 113,000 harvested fish would equal approximately 0.001 percent of the overall pounds of groundfish in Puget Sound.

as compared to the No-action Alternative where this information would not be collected. The additional information available from WDFW-conducted research about stock status, abundance, and distribution of groundfish under the Proposed Action would be available to inform adaptive management of bottom fish fisheries to further minimize effects on groundfish.

4.3.1.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to groundfish under Alternative 3 would be the same as those described under the Proposed Action, with one exception. Under Alternative 3, catch levels of groundfish in waters deeper than 120 feet would be greater than under the Proposed Action because fishing at depths greater than 120 feet would not be restricted. This would result in deeper water species, such as greenstriped rockfish, redstripe rockfish, silvergray rockfish, and shortspine thornyheads, to be caught more frequently (and die of barotraumas) than under the Proposed Action (as discussed in Subsection 3.8.1, Recreational Rockfish Fisheries, the effects of barotrauma are increased with increased depth of capture). The increased catch of these species could impact their overall status.

4.3.2. Non-groundfish Species

4.3.2.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no change in life history, or injury to or mortality of non-listed, non-groundfish species in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because these fisheries would be closed. There would also be no bycatch of non-groundfish species, such as Pacific herring and other forage fish, in the recreational bottom fish fishery and commercial shrimp trawl fishery because they would both be closed. The WDFW-led research activities catch a small number of pelagic fish, such as herring; these catches would no longer occur under the No-action Alternative. There would also be no activities occurring in the epipelagic zone and thus, no change to light sources from fishing or research activities.

The cessation of these fisheries and research activities would avoid the death of any forage fish, as described in Subsection 3.3.2, Non-groundfish Species, which are a key food source for other non-groundfish species including salmonids. The cessation of these fisheries and research activities would

not alter the abundance of smaller food sources for non-groundfish species, such as zooplankton, because these organisms are not caught on hooks or within commercial nets. The status of Pacific herring is not expected to change as a result of the No-action Alternative, as described in Subsection 3.3.2, Non-groundfish Species, because there is an average annual spawning biomass of 12,000 to 15,000 tons. For other non-groundfish species' status, there would be no change under the No-action Alternative as, most likely, the closed fisheries historically resulted in little catch of these species.

Fisheries and research activities would not result in effects to EFH designated for several species of non-groundfish in the action area because each would be closed under the No-action Alternative.

Under the No-action Alternative, no data would be collected by WDFW on stock distribution and abundance, status, and life history of non-groundfish species in Puget Sound under the No-action Alternative. This would limit acquisition of new information on habitat associations and status of non-groundfish species in Puget Sound.

4.3.2.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, there would be no change in life history, or injury to or mortality of non-listed, non-groundfish species in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action. Under the Proposed Action, bycatch of non-groundfish species would increase, compared to the No-action Alternative, because they would be captured in several fisheries. Based on available information, bycatch of non-groundfish species in the commercial shrimp trawl fishery would be a small fraction of the 15,759 pounds of fish and invertebrates caught annually (refer to Subsection 2.2.2.1, Fishing Activities under the Proposed Action). Pacific herring have been documented to occur as bycatch in the commercial shrimp trawl fishery at a rate of approximately 107 fish annually (NMFS 2011); WDFW research trawls would catch approximately 800 fish annually (Pacunski 2011a). The catch of nearly 1,000 fish would remove only a small fraction of the 12,000 to 15,000 tons of annual spawning biomass of Pacific herring, and therefore not impact species viability.

Most non-groundfish species are not caught by recreational bottom fishing because many of these species occur suspended in the water column (and not in close proximity to the bottom) and thus, are not exposed to lures or bait. Non-groundfish species that could be caught by recreational bottom fishing

could include spiny dogfish, Pacific tomcod, walleye pollock, Pacific hake, Pacific cod, and sablefish (Olander 1991).

Similar to the No-action Alternative, the fisheries and research activities under this alternative would not alter the abundance of smaller food for non-groundfish species, such as zooplankton, because these organisms are not caught on hooks or within commercial nets. Compared to the No-action Alternative, the Proposed Action would result in the death of more non-groundfish species, such as small numbers of Pacific herring, from research and commercial shrimp trawls. The impact from these deaths and subsequent loss of food for other non-groundfish species would be small. However, limiting factors such as derelict fishing gear and water quality problems that include reduced levels of dissolved oxygen and inputs of toxins such as metals and petroleum products would continue to affect non-listed groundfish.

Research activities and commercial shrimp trawls would occur in areas designated as EFH for several species of non-groundfish in the action area, including coastal pelagic species (Appendix B: Species of Fishes with Designated EFH in the Action Area). The effects of bottom trawling on EFH and benthic habitats are discussed in more detail in Subsection 3.1, Marine Ecosystem and Habitat, and include sediment disruption, smoothing of sand waves, and general bottom roughness. In addition, the catch of some prey species may affect EFH. These effects would not adversely affect non-groundfish species' EFH because they would occur over small spatial and temporal scales, and habitat conditions would return to functional condition soon after trawling activities cease. The catch of prey species would not adversely affect EFH because of the small amount of bycatch relative to the overall spawning biomass of non-groundfish in the Puget Sound.

Under the Proposed Action, information regarding stock status, abundance, and distribution of non-groundfish would be available as a result of WDFW research activities as compared to the No-action Alternative where this information would not be collected.

4.3.2.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to non-listed, non-groundfish species under Alternative 3 would be the same as those described under the Proposed Action.

4.4. Marine Mammals and Turtles

4.4.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no recreational bottom fish fishery and no commercial shrimp trawl, set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries; thus, there would be no impact from these fisheries on southern resident killer whale critical habitat, marine mammal life history, abundance, or fish and invertebrate prey that could be eaten by marine mammals that include minke whales, grey whales, killer whales, Steller sea lions, northern fur seals, elephant seals, and harbor seals. Under the No-action Alternative, WDFW research activities would not catch fishes that could be eaten by marine mammals. Similarly, there would be no interaction between fishing gear or vessels and marine mammals from these closed fisheries. The presence of bioaccumulative contaminants within prey along with other limiting factors affecting abundance of marine mammals would continue to threaten marine mammal health under the No-action Alternative.

Turtles are very rare within the action area and, therefore, are not likely to be affected by any of the alternatives.

4.4.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, there would be no set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries; thus, there would be no impact from these fisheries on southern resident killer whale critical habitat, marine mammal life history, abundance, or fish and invertebrate prey that could be eaten by marine mammals that include minke whales, grey whales, killer whales, Steller sea lions, northern fur seals, elephant seals, and harbor seals. There would also be no interaction between fishing gear or vessels and marine mammals from these closed fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Under the Proposed Action, the authorized recreational bottom fish fishery, authorized commercial shrimp trawl fishery, and WDFW research activities would occur in portions of southern resident killer

whale critical habitat and result in a small decrease in the amount of some prey available for marine mammals, compared to the No-action Alternative. As described in Subsection 3.3.1, Groundfish Species, the decrease of groundfish available to marine mammals because of the shrimp trawl fishery (approximately 15,759 pounds annually) and the recreational bottom fish fishery (approximately 113,000 fish annually) would be very small relative to the estimated amount of groundfish available to marine mammals in Puget Sound (220 million pounds). Similarly, fisheries and research activities associated with the Proposed Action would kill a small number of ESA-listed salmonids (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives) that would otherwise be available as prey. As described in Subsection 3.4, Marine Mammals and Turtles, southern resident killer whales rely upon Puget Sound Chinook salmon as prey, and to a lesser extent chum salmon, as primary prey within Puget Sound. As described in Subsection 4.2.2, Salmonids, the number of Puget Sound Chinook salmon (Appendix A: Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives) and chum salmon killed under the Proposed Action would be an extremely small fraction of the overall populations and, therefore, would not appreciably reduce prey for southern resident killer whales or alter their critical habitat.

Because the decrease of prey represents an unmeasurable, small fraction of that available in the action area, the prey decrease would be unlikely to meaningfully affect any marine mammal species. Similarly, the fisheries and research activities would not catch appreciable numbers of small fish, benthic invertebrates, or crustaceans that some marine mammals eat (Subsection 3.4, Marine Mammals and Turtles).

Commercial and recreational fishermen would be required to comply with the Marine Mammal Protection Act (MMPA, 16 U.S.C. 1361 *et seq.*) and the recently issued Protective Regulations for Killer Whales in the Northwest Region (76 Fed. Reg. 20870, April 14, 2011). As compared to the No-action Alternative, slightly more vessels would be present in the action area under the Proposed Action. Additionally, there would be a few more WDFW research vessels than under the No-action Alternative. The few additional vessels from fisheries and research activities would not tangibly increase the risk to marine mammals from harassment, vessel strikes, or noise, and would be in compliance with all laws and regulations.

4.4.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to marine mammals under Alternative 3 would be similar to those described under the Proposed Action. However, under Alternative 3, the 120-foot depth restriction would not be in effect and the numbers of deepwater rockfish and lingcod (as described in Subsections 4.2.1, Rockfish Species, and Subsection 4.3.1, Groundfish Species) caught by anglers would increase. The rockfish would be released per state law, and thus would remain available as marine mammal prey (even if they die because of barotraumas). The number of lingcod that would be caught, and therefore unavailable as marine mammal prey, could be slightly greater than under the Proposed Action, but lingcod make up a small component of marine mammal diets (e.g., for harbor seals, less than 1 percent) (Lance and Jeffries 2006) and their retention by anglers would not appreciably affect the overall prey abundance for marine mammals.

Impacts to marine mammals regarding harassment, vessel strikes, or noise would be substantially the same as described for the Proposed Action. Under Alternative 3, a slightly greater number of recreational vessels could be present in the action area because there would not be a restriction on fishing at depths greater than 120 feet. However, this difference is uncertain, and if it did occur, would be very slight and would not tangibly increase the risk to marine mammals. All vessels in the action area related to this alternative would comply with applicable laws and regulations.

4.5. Marbled Murrelet

4.5.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no recreational bottom fish fishery and no commercial shrimp trawl, set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries; thus, there would be no impact from these fisheries on marbled murrelet critical habitat; life history that includes foraging and nesting, and overall abundance; or fish and invertebrate prey. Under the No-action Alternative, WDFW research activities would not catch fish that could be eaten by marbled murrelets. Similarly, there would be no interaction between fishing gear or vessels from these closed fisheries and marbled murrelets.

Under the No-action Alternative, marbled murrelets would still be subjected to terrestrial threats that include the historic and ongoing loss and modification of nesting habitat through commercial timber harvests, human-induced fires, land conversions, and natural disturbance events (Subsection 3.5, Marbled Murrelet). Marbled murrelets would still be subjected to marine threats that include changes in the food web and prey quantity and quality, declining prey populations, commercial and recreational fisheries for some prey stocks, some continued (but not quantified) gill-net mortality, high body loads of PCBs in their prey base, and marine areas of low dissolved oxygen (Subsection 3.5, Marbled Murrelet). However, these threats have been reduced by a declining rate of annual habitat loss, particularly on Federal lands; improved regulatory mechanisms because of Federal and state listings and other state and Federal regulations (especially the Northwest Forest Plan); and new gill-netting regulations in northern California and Washington. Regardless, the listing status of the marbled murrelet would not be affected by the No-action Alternative.

4.5.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Similar to the No-action Alternative, there would be no set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries; thus, there would be no impact from these fisheries on marbled murrelet critical habitat, life history that includes foraging and nesting, abundance, or reduction of fish and invertebrate prey. There would also be no interaction between fishing gear or vessels from these closed fisheries and marbled murrelets for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Under the Proposed Action, the authorized recreational bottom fish fishery and commercial shrimp trawl fishery, and WDFW research activities would occur, but not in areas designated as critical habitat for marbled murrelet and, therefore, would not affect these areas. The commercial shrimp trawl fishery and some research activities would cause a small decrease in the amount of some prey available for marbled murrelets, which would be documented by observers or scientists, compared to the No-action Alternative. As described in Subsection 4.3.2, Non-groundfish Species, Pacific herring have been documented to occur as bycatch in the commercial shrimp trawl fishery at a rate of approximately 107 fish annually (NMFS 2011), and WDFW research trawls would catch approximately 1,000 fish annually (Pacunski 2011a). Though decreased prey is a limiting factor of marbled murrelets, the catch

of just over 1,000 fish would remove a small fraction of the 12,000 to 15,000 tons of annual spawning biomass of Pacific herring and would not have a noticeable effect on the total amount of prey available.

Similarly, as described in Subsection 4.2.3, Eulachon, fisheries and research associated with the Proposed Action would kill a small number of ESA-listed eulachon that would otherwise be available as prey for the marbled murrelet. The death of some prey is unlikely to affect marbled murrelets for several reasons, as discussed in Subsection 3.5, Marbled Murrelet. Marbled murrelets generally forage in water shallower than the shrimp trawl is allowed to occur. Further, because the decrease of prey as a result of bycatch represents a small fraction of prey available in the action area, it would be unlikely to affect marbled murrelets. Similarly, the fisheries and research activities would not catch appreciable numbers of small fish, benthic invertebrates, or crustaceans that, as described in Subsection 3.5, Marbled Murrelet, are food sources for marbled murrelets.

Marbled murrelets have not been captured in WDFW research activities (Pacunksi 2011) or shrimp fisheries (Roberts 2008) and would not be incidentally captured from fisheries and research activities under the Proposed Action. Similar to the No-action Alternative, under the Proposed Action, marbled murrelets would still be subjected to terrestrial threats that include the historic and ongoing loss and modification of nesting habitat through commercial timber harvests, human-induced fires, land conversions, and natural disturbance events. Marbled murrelets would still be subjected to marine threats that include changes in the food web, prey quantity and quality, declining prey populations, commercial and recreational fisheries for some prey stocks, some continued gill-net mortality, high body loads of PCBs in their prey base, and marine areas of low dissolved oxygen. However, these threats have been reduced by a declining rate of annual habitat loss, particularly on Federal lands; improved regulatory mechanisms because of Federal and state listings and other state and Federal regulations (especially the Northwest Forest Plan); and new gill-netting regulations in northern California and Washington. Regardless, the listing status of the marbled murrelet would not be affected by the Proposed Action.

4.5.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to marbled murrelets under Alternative 3 would be the same as those described under the Proposed Action because the research bottom trawl activities and commercial shrimp trawl fishery

would be the same under each alternative. The lack of observers on the commercial shrimp trawl fishery under Alternative 3 would result in no documentation of bycatch of forage fish, such as eulachon and Pacific herring, that marbled murrelets eat. Consequently, documentation of bycatch of marbled murrelet prey would not occur, which would preclude an enumeration of bycatch of their prey. As a result, there would be no way to know the actual number of eulachon and Pacific herring caught, and no basis for modifying the fishing activities if the numbers are larger than expected.

4.6. Socioeconomics

4.6.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative there would be no set net, set line, bottom fish trawl, bottom fish pot, or scallop trawl fisheries because these fisheries would remain closed under the regulation (Subsection 1.1, Introduction and Background). Consequently, closures would result in decreased economic benefits to the Puget Sound economy and to the three representative commercial and recreational fishing communities discussed in Subsection 3.6, Socioeconomics. Each of these fisheries has experienced a decline in ex-vessel values between 2005 and 2009; closures under the No-action Alternative would result in continued economic reduction trends.

Additionally, under the No-action Alternative, WDFW would not authorize the recreational bottom fish fishery or the commercial shrimp trawl fishery. Thus, no economic benefit would occur to commercial fishers, fish processors, and local economies generated from these fisheries, such as the three representative fishing communities discussed in Subsection 3.6, Socioeconomics (Seattle, Anacortes, and Bellingham, Washington). The number of angler trips targeting bottom fish ranged between 68,000 and 105,000 annually between 2004 and 2009, with an average economic value of approximately $5.6 million annually in recent years (Subsection 2.2.2.1, Fishing Activities under the Proposed Action; Subsection 3.6, Socioeconomics) (Table 3-1). Fishing trip opportunities targeting bottom fish would decline to zero, and on average, fishing communities in Puget Sound would lose approximately $5.6 million annually from closures under the No-action Alternative. This would include impacts to sales of fishing licenses and tackle, bottom fisheries-related tourism expenditures, and charter fishing businesses. However, as discussed in Subsection 3.6, Socioeconomics, the approximate $5.6 million lost annually from bottom fish fishery closures represents less than 1 percent of the total economic

value of the recreational fishery in Washington State (WDFW 2011c and TCW Economics 2008 as reported in the Application for an Individual Take Permit for ESA-listed species).

Similar impacts would occur to the shrimp trawl fishery where an average annual value of approximately $142,000 would be lost to communities that support this fishery (Subsection 3.6, Socioeconomics) (Table 3-2). However, as discussed in Subsection 3.6, Socioeconomics, because the overall commercial fishing economy regionally is an estimated $38 million annually, the loss of the economic benefit from the shrimp trawl fishery would represent only a small percentage decrease.

While impacts to a major component of the local and state-wide economy would be realized under the No-action Alternative through fishery closures, no impacts would occur to other economic sectors within the Puget Sound region, such as manufacturing and technology, forestry and agriculture, and other, non-bottom fish-related tourism. Further, fishery closures would not result in measurable, or any, changes to population totals within the Puget Sound region (Subsection 3.6, Socioeconomics).

The most common activity among boaters—fishing—would still remain a key motivation for boating in preferred locations in Puget Sound under the No-action Alternative because other fisheries would remain open and because boating would still provide relaxation opportunities (Subsections 3.6, Socioeconomics).

Research activities would not occur under the No-action Alternative, and therefore, any future economic gains to fishing communities and industries in the action area related to information collected about overall abundance, species assemblages, distribution, and health would not be realized.

4.6.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Under the Proposed Action, closure by regulation of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries would have the same socioeconomic effects as described under the No-action Alternative for the 5-year term of the FCP. As compared to the No-action Alternative, however, the Proposed Action would have a moderate, positive effect with regard to socioeconomics in the action area, mostly because of the retention of the recreational bottom fish fishery with hook-and-line gear as well as the commercial shrimp trawl fishery (Subsection 1.2, Description of the Proposed Action; Subsection 2.2.2.1, Fishing Activities under the Proposed Action).

Recreational bottom fishing that is open for various periods of time within portions of Puget Sound would remain open under the Proposed Action, thereby continuing to support the fisheries economic sector and communities in the action area, including the three represented communities discussed in Subsection 3.6, Socioeconomics (Seattle, Anacortes, and Bellingham, Washington). For example, the lingcod fishery, which is the most popular bottom fish fishery in Puget Sound, occurs within a 45-day season in the spring, typically at times that most salmon fisheries are closed in Puget Sound. Thus, retention of this fishery would result in more opportunities for saltwater recreation in the action area.

As discussed in Subsection 3.6, Socioeconomics, the average economic value of this recreational fishery (bottom fish and other fish) is approximately $5.6 million annually, with approximately 100,000 fishing trips and a catch of more than 130,000 bottom fish reported in 2008 and 2009 (Table 3-2) (WDFW 2011c and TCW Economics 2008 as reported in the Application for an Individual Take Permit for ESA-listed rockfish and eulachon). Economic benefits to fishing communities would occur through the sales of fishing licenses and tackle, bottom fisheries-related tourism expenditures, and charter fishing businesses. While economic benefits would be realized under the Proposed Action, as discussed in Subsection 3.6, Socioeconomics, the approximate $5.6 million earned annually from bottom fish fisheries represents less than 1 percent of the total economic value of the recreational fishery in Washington State (WDFW 2011c and TCW Economics 2008 as reported in the Application for an Individual Take Permit for ESA-listed species).

Socioeconomic impacts in the action area with regard to the retention of the shrimp trawl fishery would be an average of $142,000 (catch value) annually (Subsection 3.6, Socioeconomics) (Table 3-2). Although this number amounts to a very small percentage of the overall Puget Sound commercial fishing economy (Subsection 3.6, Socioeconomics), it represents an economic benefit for local fish processors as compared to the No-action Alternative.

Impacts to other economic sectors and population totals within the Puget Sound region (Subsection 3.6, Socioeconomics) would be the same as those described under the No-action Alternative because open fisheries under the Proposed Action would not impact these sectors or totals. Common activities and motivations for boaters would also be the same as described under the No-action Alternative.

However, unlike the No-action Alternative, research activities would occur under the Proposed Action. Therefore, potential future economic gains to fishing communities and industries in Puget Sound related to information collected about overall abundance, species assemblages, distribution, and health

would be realized under the Proposed Action Such information could result in additional or continued fishing opportunities, which would enhance current economic revenues and benefits related to fishing.

4.6.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to socioeconomics within in the action area under Alternative 3 would be the same as those described under the Proposed Action with one exception. The 120-foot depth restriction would not be in effect under Alternative 3, which may result in increased fishing trips for deepwater bottom fish, lingcod, or other benthic or benthopelagic bottom fish as compared to the Proposed Action or the No-action Alternative. This increased number of fishing trips would provide a very small benefit to the fisheries economic sector in Puget Sound, including the three representative commercial and recreational fishing communities discussed in Subsection 3.6, Socioeconomics (Seattle, Anacortes, and Bellingham, Washington). Compared to the No-action Alternative, this economic benefit, although likely immeasurable, would occur over the 5-year term of the FCP.

4.7. Environmental Justice

4.7.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

The No-action Alternative would not affect tribal fishing seasons or tribal fisheries in any way. Tribal fisheries for bottom fish are regulated by the tribes themselves (Northwest Indian Fisheries Commission. 2010b).

Fishing opportunities for bottom fish under the No-action Alternative would be eliminated (except for the tribal fisheries). However, minority, Hispanic, and low income populations would not be disproportionately affected over other demographic groups for two reasons. First, CEQ guidelines suggest that potential environmental justice impacts could occur in an area if the percentage of minority, Hispanic, and low income populations are meaningfully greater than the percentage of these population groups in the general population. This is not the case within this action area. Second, all groups would be affected equally by fishery closures under the No-action Alternative. Opportunities for fishing in areas that are not closed under the No-action Alternative would remain available to all population groups and would not favor any one group over any other.

Under the No-action Alternative, the recreational bottom fish and commercial shrimp trawl fisheries would be closed, and affected groups would lose the economic and cultural benefits associated with the deep water bottom fish fishery. However, these closures would apply to all groups (except tribal fisheries) and would not disproportionately affect any one group over any other.

4.7.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

The Proposed Action would not affect tribal fishing seasons or target tribal fisheries in any way. Tribal fisheries for bottom fish are regulated by the tribes themselves (Northwest Indian Fisheries Commission 2010b).

As compared to the No-action Alternative, recreational bottom fishing opportunities and the commercial shrimp trawl fishery under the Proposed Action would increase (Subsection 1.2, Description of Proposed Action). Closure of fishing in waters deeper than 120 feet that targets bottom fish would not preclude the option of allowing such fisheries after the 5-year term of the FCP, but affected groups would have lost the economic and cultural benefits associated with the deep water fishery for the 5-year term of the Proposed Action. As compared to the No-action Alternative, the impact to any given population group from the closure of the deep water fishery would be smaller because the bottom fish fishery would remain open in waters shallower than 120 feet.

There are no data to suggest that any one population group has a disproportionately greater benefit from fishing opportunities in the action area than any other group. The closure of several other commercial fisheries (Subsection 1.2, Description of the Proposed Action) would limit the types of fish available for at least the 5-year term of the FCP. However, minority, Hispanic, and low income populations would not be disproportionately affected by this reduction because they are not disproportionately represented in the fishing community.

4.7.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts regarding environmental justice under Alternative 3 would be the same as those described under the Proposed Action with one exception. The 120-foot depth restriction would not be in effect

under Alternative 3, resulting in more fishing opportunities as compared to the Proposed Action. Additionally, as compared to the No-action Alternative, there would be an increase in fishing opportunities in the deep water fishery that targets bottom fish because the fishery would remain open without restriction. However, this increase in bottom fish fishing opportunities would be equally available to all population groups, and would not represent a benefit to minority, Hispanic, or low income groups. There would be no change in impacts regarding environmental justice from the commercial shrimp trawl fishery because the fishery would be the same as described under the Proposed Action.

4.8. Tourism and Recreation

4.8.1. Action Area Overview

No effects to any historical attribute, natural beauty, or scenic quality would occur within the action area under any alternative (Subsection 3.8, Tourism and Recreation), therefore, there would be no negative or positive effects to tourism and recreation opportunities associated with these elements of the action area. Furthermore, tourism to urban centers and within Puget Sound would continue, including visits to major urban centers and day-cruise opportunities under all alternatives. Recreational fishing opportunities, primarily salmon fishing opportunities, and scuba diving opportunities would also be unaffected by any alternative (Subsection 3.8, Tourism and Recreation).

4.8.2. Recreational Rockfish Fisheries

4.8.2.1. No-action Alternative

NMFS Issues No ITP or Research Permits; WDFW Authorizes No Bottom Fish Fishery or Shrimp Trawl Fishery; WDFW Conducts No Research that Might Take Rockfish

Under the No-action Alternative, there would be no set net, set line, bottom fish trawl, bottom fish pot, or scallop trawl fisheries because these fisheries would remain closed under the regulation (Subsection 1.1, Introduction and Background). Although several recreational fisheries have targeted rockfish within the past several decades, Puget Sound is currently closed to rockfish fishing. Therefore, there would be no change in the current lack of recreational rockfish fishing opportunities under the No-action Alternative. Consequently, tourism and recreational opportunities associated with the rockfish fishery would remain unavailable.

No specific data for historic or recent rockfish fisheries are available; however, it is anticipated that the continued recreational fishery closure would have some negative, but small, impact on recreational

opportunities for anglers in Puget Sound under the No-action Alternative (refer to Subsection 4.6, Socioeconomics, for economic impact information). Most tourist-based recreational fishing in Puget Sound is associated with salmon fishing because opportunities to fish for other species such as cod and rockfish have diminished in the past few decades (Subsection 3.8, Tourism and Recreation). Salmon fishing opportunities would not be affected by the No-action Alternative, and would remain available to anglers in Puget Sound.

4.8.2.2. Alternative 2: Proposed Action

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing in Waters Less than 120 Feet and the Shrimp Trawl Fishery with a Requirement for Observers; WDFW Conducts Rockfish Research

Under the Proposed Action, recreational bottom fishing opportunities in waters less than 120 feet deep would be retained for at least the 5-year term of the FCP. Compared to the No-action Alternative, this would provide more recreational fishing opportunities (and associated tourism) for anglers in Puget Sound, but bottom fishing opportunities would not represent a large proportion of overall recreational fishing.

Approximately 100,000 annual boat-based angler trips targeting bottom fish have occurred per year in recent times, compared to approximately 350,000 annual trips by anglers targeting salmon (Subsection 2.2.2.1, Fishing Activities under the Proposed Action). Prior to the rockfish fishing closure, an unknown but smaller subset of the 100,000 annual boat-based angler trips targeting bottom fish specifically targeted rockfish. Thus, the number of fishing trips targeting bottom fish under the Proposed Action would be less than 30 percent of the salmon fishery.

Currently, Puget Sound is closed to rockfish fishing; therefore, impacts to recreational fishing opportunities and tourism would be the same as under the No-action Alternative. Additionally, the Proposed Action would prohibit fishing, including rockfish fishing, at depths greater than 120 feet, which would also result in impacts similar to those anticipated under the No-action Alternative.

4.8.2.3. Alternative 3: Similar to Proposed Action Alternative but with Fewer Restrictions

NMFS Issues an ITP and Research Permits; WDFW Authorizes Bottom Fishing without Depth Restrictions and Does Not Require Observers in the Shrimp Trawl Fishery; WDFW Conducts Rockfish Research

Impacts to tourism and recreation under Alternative 3 would be the same as those described under the Proposed Action. Although there would be no 120-foot depth restriction on recreational fishing under

Alternative 3, Puget Sound is currently closed to rockfish fishing. Therefore, even with the increased opportunity to fish at greater depths compared to the No-action Alternative or the Proposed Action, there would be no change in the current lack of recreational rockfish fishing opportunities when compared to either alternative. Consequently, tourism and recreational opportunities associated with the rockfish fishery would remain unavailable.

5. CUMULATIVE IMPACTS

5.1. Context for Analysis

NEPA defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Section 3.0, Affected Environment, describes the current status of each resource, which reflects the effects of past and current actions. The preceding subsections in Section 4.0, Environmental Consequences, evaluated the effects of No-action and two action alternatives on the current status of each resource. This section now considers the cumulative effects of the alternatives, where such effects might occur, in the context of the effects of past actions, current conditions, and reasonably foreseeable future actions and conditions.

5.2. Other Actions Affecting the Same Environment

Past and current actions affecting the same environment as the alternative actions include:

- Puget Sound Chinook Harvest Agreement
- Halibut Management Plan
- Puget Sound Groundfish Management Plan
- Northwest Straits Marine Conservation Initiative, Derelict Gear Program
- WDFW Sportfishing Rules (2010/2011 and 2011/2012)
- WDFW Puget Sound Rockfish Conservation Plan
- Puget Sound Chinook Recovery Plan Actions [11]
- Southern Resident Killer Whale Recovery Plan Actions[10]

Subsection 1.5, Relationship to Other Plans and Policies, describes the above actions in detail. These actions collectively address habitat and fishing mortality for ESA-listed rockfish, and some improve these conditions compared to the recent past. In conjunction with the action alternatives, these actions would further serve to protect the ESA-listed rockfish species and address some habitat limiting factors over time. However, limiting factors such as contaminants, nearshore degradation, and derelict fishing gear would continue to limit recovery of ESA-listed rockfish. Cumulative effects under Alternative 2:

[11] Recovery plans themselves have no effect on the environment. Implementation of recovery plan actions (such as habitat restoration, research) can affect the environment.

Proposed Action would be slightly less protective than under the No-action Alternative, and slightly more protective than under Alternative 3: Similar to Proposed Action Alternative.

For ESA-listed rockfish, the cumulative annual mortality from the fisheries associated with the Puget Sound Chinook Harvest Agreement and the Halibut Management Plan have been added with the mortalities expected with each alternative (Table 5-1).

Table 5-1. Total authorized annual takes of ESA-listed rockfish.

	Yelloweye	Canary	Bocaccio*
No-action Alternative (plus Salmon and Halibut Fishery)	98	314	26
Alt 2: Proposed Action (plus Salmon and Halibut Fishery)	260	476	77
Alt 3: Similar to Proposed Action with Fewer Restrictions (plus Salmon and Halibut Fishery)	327	532	<77

*No bocaccio have been documented to be caught in the halibut fishery from 2003 - 2009 (WDFW 2011c).

The annual mortality estimates are conservative because we consider each caught fish as a mortality even though there would be some instances where yelloweye rockfish, canary rockfish, and bocaccio survive after their release (WDFW 2011d). However, even if this level of mortality would occur annually, it would not impact the viability of the species.

The actions described in Subsection 1.5, Relationships to Other Plans and Policies also collectively address habitat and fishing mortality for ESA-listed Chinook salmon, Hood Canal chum salmon, Puget Sound steelhead, and bull trout. Similar to ESA-listed rockfish, freshwater and Puget Sound limiting habitat conditions for ESA-listed salmonids would persist through the 5-year term of the Fishery Conservation Plan. Cumulative effects under the Proposed Action would be slightly less protective than under the No-action Alternative, and slightly more protective than under Alternative 3.

Similarly, the small numbers of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, and Puget Sound steelhead killed as a result of the Proposed Action would be a small fraction of their total numbers and would not affect the species' viability.

The actions described in Subsection 1.5, Relationships to Other Plans and Policies also influence cumulative effects to marine mammals and turtles, described in Subsection 3.4, Marine Mammals and Turtles. These plans and policies influence the number and types of prey available to various marine mammals. Cumulative effects under the Proposed Action would be slightly less protective than under

the No-action Alternative, and slightly more protective than under Alternative 3. Alternative 3 would result in more ESA-listed rockfish killed, though these fish would remain available as prey to marine mammals.

5.3. Climate Change and Ocean Acidification

Climate change is another factor that may affect the Puget Sound/Georgia Basin and ESA-listed and non-listed rockfish, salmonids, groundfish, and marine mammals. Important climate changes have occurred in the Puget Sound region in the past century and the next several decades will likely see even greater changes (Mote et al. 2005 as reported in Drake et al. 2010). Since the late 1800s, Pacific Northwest temperatures rose faster than the global average, and Puget Sound waters have warmed substantially since the early 1970s (Ruckelshaus and McClure 2007 as reported in Drake et al. 2010). As a consequence of regional warming in the 20th century, springtime snow pack has decreased markedly at many sites in Puget Sound, and the timing of river and stream flow has shifted with significant reductions in snowmelt runoff in May-July, reduced summer stream flows, and increased runoff in late winter and early spring (Ruckelshaus and McClure 2007 as reported in Drake et al. 2010). The effects to the habitats of Puget Sound from runoff, and precipitation changes of the watersheds that drain into it, are unknown. Projections for the consequences of future global warming in the Puget Sound region include continued rise of air and marine water temperatures, altered river and stream flows, increased winter runoff with decreased water stored as snow pack, increased river flooding, and continued sea level rise (Ruckelshaus and McClure 2007 as reported in Drake et al. 2010). Related consequences to Puget Sound will likely consist of changes to water quality, circulation patterns, biological productivity, habitat distributions, populations of sensitive species, rates of harmful algal blooms, surface wind patterns, and coastal upwelling regimes (Drake et al. 2010).

Given the general importance of climate to rockfish recruitment, it is likely that climate strongly influences the dynamics of the ESA-listed rockfish population productivity and therefore their overall population viability (Drake et al. 2010). Drake et al. (2010) contains a detailed discussion of the various threats to the viability of ESA-listed rockfish species and the individual and cumulative effects of these threats on rockfish conservation and recovery. In summary, recent declines in marine fish populations in greater Puget Sound may reflect recent climatic shifts; however, it is not known whether these climatic shifts represent long-term changes or short-term fluctuations that may reverse in the near future (Drake et al. 2010). Potential long-term threats to ESA-listed rockfish species as a result of climate change, coupled with other threats such as bycatch by other fisheries, habitat loss, pollutants,

and low dissolved oxygen (Drake et al. 2010) could further affect the survival and reproductive success of rockfish and their prey sources in the Puget Sound/Georgia Basin DPSs.

Long-term effects to climate change as a result of either the No-action or the action alternatives evaluated in this EA are likely to be minor. Impacts to climate change resulting from the Proposed Action or Alternative 3 would be similar. Outboard motors used by recreational anglers as well as engines used by commercial fishers and WDFW research boats would initially emit carbon dioxide at current levels, and emissions could be reduced over the 5-year period of the action alternatives as new engines become more efficient in response to better technology and improved standards, which are administered by the Environmental Protection Agency (75 Fed. Reg. 179, September 16, 2010). Because Alternative 3 does not include the 120-foot depth restriction, more recreational anglers targeting rockfish could be expected, resulting in slightly more carbon dioxide emissions than under the Proposed Action. A small reduction of carbon dioxide emissions would be expected under the No-action Alternative because there would be fewer recreational and commercial fishing trips, and fewer WDFW research trips in the marine environment.

Ocean acidification may also affect ESA-listed rockfish and other fish species in the Puget Sound/Georgia Basin. Ocean acidification is a global phenomenon resulting from increased carbon dioxide concentrations in the Earth's atmosphere. Carbonic acid is formed when carbon dioxide dissolves in sea water, and this chemical reaction leads to acidification. Ocean acidification can disrupt the process of shell-producing organisms that are an important part of the marine food web, including krill, oysters, sea urchins, and corals. For marine animals, including some fish, accumulation of CO_2 in the body may result in changes in the organism's morphology, metabolic state, physical activity, and reproduction (Symposium on the Ocean in a High CO_2 World 2008). Ocean acidification could negatively affect the ESA-listed rockfish species, listed and unlisted salmonids, and all species discussed in this EA because of impacts to important components of the food web, including invertebrates such as krill. When combined with the potential negative effects from climate change as discussed above, these effects could hinder conservation efforts as described in Subsection 1.5, Relationship to Other Plans and Policies. Long-term effects to ocean acidification as a result of either the No-action or the action alternatives evaluated in this EA are expected to be minor and would be the same or similar to the effects described above for climate change with regard to emissions from motors and engines used by recreational anglers and commercial fishers.

Climate change is unlikely to have tangible impacts on ESA-listed species that are considered under the Proposed Action over the next 5 years. The research and adaptive management scheme described in WDFW's conservation plan would assist in a better understanding of the marine environment and the effect of long-term climate change upon species of the Puget Sound/Georgia Basin, and the fisheries restrictions associated with the Proposed Action would not threaten covered species' viability.

6. AGENCIES CONSULTED

Washington State Department of Fish and Wildlife

United States Fish and Wildlife Service

Tribal coordination is important to NMFS for all NEPA review. On June 1, 2010, NMFS sent a letter to the Northwest Indian Fisheries Commission that notified them of our preparation of a draft EA and proposed Incidental Take Permit under section 10(a)(1)(B) of the ESA to WDFW.

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8. LIST OF PREPARERS

Dan Tonnes, National Marine Fisheries Service, Marine Biologist – Project and document management, preparation of all EA sections and analyses.

Tina Loucks-Jaret, Contractor, Technical Editor – Edited all document material and prepared document format.

9. FINDING OF NO SIGNIFICANT IMPACT FOR SECTION 10 PERMIT APPLICATIONS BY THE WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE FOR INCIDENTAL TAKE OF ESA-LISTED ROCKFISH AND OTHER LISTED FISH WITHIN THE PUGET SOUND/GEORGIA BASIN AND TAKE DUE TO SCIENTIFIC RESEARCH

National Marine Fisheries Service

National Oceanic and Atmospheric Administration Administrative Order 216-6 (NAO 216-6) (May 20, 1999) contains criteria for determining the significance of the impacts of a Proposed Action. In addition, the Council on Environmental Quality regulations at 40 C.F.R. 1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant in making a finding of no significant impact and has been considered individually, as well as in combination with the others. The Proposed Action, which NMFS has determined is the agency's preferred alternative, is for NMFS to issue the requested permits[12] and for WDFW to implement the proposed Fishery Conservation Plan and Puget Sound fish research program. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1) Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?

Response: The recreational bottom fish fishery and WDFW research activities would result in the death of some non-Endangered Species Act (ESA) listed bottomfish. The recreational groundfish fishery and WDFW research activities permitted under the Proposed Action would not jeopardize the sustainability of targeted groundfish in Puget Sound because the number of fish caught as a result of each of these activities would be small relative to the overall estimated biomass of 220 million tons of ground fish in the action area (Subsection 4.3.2, Proposed Action, 4.3.1 Groundfish Species). The shrimp trawl fishery harvests several tons of shrimp within the Puget Sound. This fishery takes a small fraction of the total biomass of shrimp in the action area, and removing a small amount of shrimp would not jeopardize the sustainability of these target species.

[12] An incidental take permit under section 10(a)(1)(B) of the ESA that would cover the incidental take of ESA-listed rockfish, Chinook salmon, and eulachon in two state-authorized fisheries in Puget Sound and scientific research permits under section 10(a)(1)(A) of the ESA that would cover the direct take of ESA-listed rockfish, Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer chum salmon, green sturgeon, and eulachon resulting from WDFW scientific research activities on fish.

2) Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?

Response: The Proposed Action would not jeopardize the sustainability of non-target species for the following reasons (refer to Subsection 4.2, ESA-listed Fish; 4.3, Non-listed Fish; 4.4, Marine Mammals and Turtles; and 4.5, Marbled Murrelet for a more detailed rationale):

Rockfish: Under the Proposed Action, the combined effects to yelloweye rockfish, canary rockfish, and bocaccio from fishing, research activities, and other continued risk factors unrelated to the Proposed Action would likely result in a small reduction in abundance and productivity, spatial structure, and diversity. This small reduction is unlikely to exceed levels that would hinder population sustainability and would not jeopardize species sustainability. Further, the Proposed Action would result in additional information about stock status, abundance, and distribution of ESA-listed rockfish that would inform management and development of measures supporting recovery actions. This information would come from two sources: (1) the Puget Sound fish research program; and (2) monitoring and reporting data from the bottom fish fishery and shrimp trawl fishery.

Salmonids: The mortality from the fisheries and research activities under the Proposed Action would not impact the sustainability of 22 ESA-listed populations of Puget Sound Chinook salmon, 9 populations of Hood Canal summer chum salmon, and 50 stocks of Puget Sound steelhead because of the extremely small numbers of fish that would be killed relative to the overall estimated population sizes. Additionally, there would be no change in life history, or injury to or mortality of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, or bull trout because the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries would be closed for the 5-year term under the Proposed Action. Fisheries and research authorized under the Proposed Action would result in small and transitory adverse affects to nearshore critical habitat of Puget Sound Chinook salmon and Hood Canal summer chum salmon because of benthic habitat disturbance and sediment mobilization (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat).

Under the Proposed Action, additional information about stock status, abundance, and distribution of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, and Puget Sound steelhead would result from the Puget Sound fish research program. This additional data would provide information about ESA-listed salmonid distribution, abundance, and trends which would assist with

developing measures supporting recovery and management of sustainable populations of these non-target species.

Eulachon: The mortality from bycatch of eulachon in the WDFW research trawls and the shrimp trawl fishery in the North Sound would not impact species sustainability because of the extremely small number of fish that would be killed relative to the overall estimated population size. In addition, the life-history expression (ability to feed, avoid predation, migrate and reproduce) of those eulachon not taken in trawls would not be altered.

The fisheries and research authorized under the Proposed Action would not alter eulachon critical habitat because critical habitat is not designated in marine waters. Further, additional information regarding eulachon distribution, habitat use, and the abundance of eulachon in Puget Sound would be gained by WDFW's research activities under the Proposed Action. Also, use of observers in the shrimp trawl fishery would provide data regarding the distribution and abundance of ESA-listed eulachon, which would assist with development of measures supporting recovery and management of sustainable populations of this non-target species.

Green sturgeon: The overall effects of the Proposed Action on green sturgeon would be negligible; a few green sturgeon could be captured in research and shrimp trawls, but should survive. If one green sturgeon is killed, the overall effects to the species, in combination with pre-existing freshwater limiting factors, would not impact species sustainability because it would be an extremely small number compared to the overall estimated population size.

Additionally, the Proposed Action would result in additional information about green sturgeon distribution from the Puget Sound fish research program, which would assist with development of measures supporting recovery and management of sustainable populations. There would be no change in life history, or injury to or mortality of green sturgeon in the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Non-listed groundfish: The research and recreational fisheries activities permitted under the Proposed Action should not have a substantial effect on groundfish in Puget Sound because the number of fish caught as a result of each of these activities would be small relative to the overall estimated biomass of 220 million tons of groundfish in the action area.

The research and commercial shrimp trawls under the Proposed Action would occur in areas designated as EFH for 44 species of groundfish in the action area. The general effects of bottom trawling on EFH and benthic habitats include sediment disruption, smoothing of sand waves, and bottom roughness. However, these likely adverse effects to EFH for these non-target groundfish species are would occur over small spatial and temporal scales, and habitat conditions would return to functional condition soon after trawling activities cease (Subsection 4.3.1.2, Proposed Action, Non-listed Fish). In addition, the catch of some prey species may affect EFH. However, the catch of prey species of groundfish, such as Pacific herring, would not adversely affect EFH because of the small amount of bycatch relative to the overall biomass of prey species in Puget Sound. Further, under the Proposed Action, information regarding stock status, abundance, and distribution of non-listed benthic and benthopelagic groundfish would be available as a result of WDFW research activities, and the additional information would be available to inform adaptive management of bottom fish fisheries to further minimize effects on groundfish.

Non-listed, non-groundfish species: Under the Proposed Action, no change in life history, or injury to or mortality of non-listed, non-groundfish species, such as Pacific herring and other forage fish, should occur from the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed 5-year term. The fisheries and research activities under this alternative should not alter the abundance of smaller food for non-groundfish species, such as zooplankton, because these organisms are not caught on hooks or within commercial nets. The research and commercial shrimp trawls under the Proposed Action is would result in the death of non-groundfish species, such as small numbers of Pacific herring. However, the impact from these deaths and subsequent loss of food for other species is should to be small.

The research and commercial shrimp trawls under the Proposed Action would occur in areas designated as EFH for several species of non-groundfish in the action area, including coastal pelagic species. Effects to EFH of coastal pelagic species are should be minimal because trawl gear does not alter the pelagic environment. Further, information regarding stock status, abundance, and distribution of non-groundfish would be available as a result of WDFW research activities.

Marine mammals and turtles: Under the Proposed Action, there would be no set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries; thus, there would be no impact from these fisheries on Southern Resident killer whale critical habitat, marine mammal life history, abundance, or fish and invertebrate prey that could be eaten by marine mammals including minke whales, grey

whales, killer whales, Steller sea lions, northern fur seals, elephant seals, and harbor seals. There would also be no interaction between fishing gear or vessels and marine mammals from these closed fisheries for a period of 5 years.

The authorized recreational bottom fish fishery, authorized commercial shrimp trawl fishery, and WDFW research activities would occur in portions of Southern Resident killer whale critical habitat. These activities would result in a small decrease in the amount of some prey available for marine mammals, compared to the other alternatives evaluated. The decrease of groundfish available to marine mammals because of the shrimp trawl fishery (approximately 15,759 pounds annually) and the recreational bottom fish fishery (approximately 113,000 fish annually) would be very small relative to the estimated amount of groundfish available to marine mammals in Puget Sound (220 million pounds). Similarly, fisheries and research activities associated with the Proposed Action would kill a small number of ESA-listed salmonids that would otherwise be available as prey. The number of Puget Sound Chinook salmon and chum salmon killed under the Proposed Action would be an extremely small fraction of the overall populations and, therefore, the reduction would not appreciably reduce prey for Southern Resident killer whales or alter their critical habitat.

Because the decrease of prey represents a small fraction of that available in the action area, the prey decrease would be unlikely to meaningfully affect any marine mammal species. Similarly, the fisheries and research activities should not catch appreciable numbers of small fish, benthic invertebrates, or crustaceans that some marine mammals eat. Finally, the few additional vessels from fisheries and research activities under the Proposed Action should not tangibly increase the risk to marine mammals from harassment, vessel strikes, or noise because they would operate in compliance with all laws and regulations.

Marbled murrelet: Under the Proposed Action, there would be no impact on marbled murrelet critical habitat, life history (including foraging and nesting), abundance, or reduction of fish and invertebrate prey from the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries because these fisheries would be closed. There would also be no interaction between fishing gear or vessels and marbled murrelets from these closed fisheries for a period of 5 years. Fisheries and research activities authorized under the Proposed Action would not occur in areas designated as critical habitat for marbled murrelet and, therefore, would not affect these areas.

Decreased prey abundance is a limiting factor of marbled murrelets; however, the catch of just over 1,000 Pacific herring would remove a small fraction of their 12,000 to 15,000 tons of annual spawning

biomass and should not have a noticeable effect on the total amount of prey available. Similarly, the decrease of prey as a result of bycatch in the authorized fisheries and research activities represents a small fraction of prey available in the action area, and would be unlikely to affect marbled murrelets. Further, the fisheries and research activities should not catch appreciable numbers of small fish, benthic invertebrates, or crustaceans that are food sources for marbled murrelets. Marbled murrelets should not be incidentally captured during fisheries and research activities under the Proposed Action, and the listing status of the marbled murrelet would not be affected by the Proposed Action.

3) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coast habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?

Response: NMFS expects a small physical impact or damage to ocean or coastal habitats or essential fish habitats over small spatial and temporal scales from some bottom trawls associated with the Proposed Action (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat), for the following reasons:

Closed fisheries: There would be no change to the ocean or coastal habitats and EFH related to the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for a period of 5 years, as these fisheries would remain closed for the agreed term under the Proposed Action.

Research: Research mid-water trawls would not come into contact with benthic habitats and, therefore, would not cause any ocean or coastal habitat and EFH alterations (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat). Research bottom trawls come into contact with benthic habitats and could alter ocean habitats used by green sturgeon and salmonids and EFH for several salmonids and groundfish. Research bottom trawls can alter habitat by suspending sediment and changing habitat complexity, smoothing of sand waves, and changing bottom roughness in localized areas. Some WDFW research trawls would occur in the photic zone (such as the nearshore of Puget Sound); thus, temporary sediment suspension could reduce light levels on a short-term basis, but would be unlikely to alter benthic habitats because habitat conditions and sediment levels in the nearshore are naturally dynamic. The probability of the future loss of a trawl net from research activities should be discountable.

Authorized fisheries: Effects to coastal pelagic EFH would be minimal because trawl gear does not alter the pelagic environment (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat). Jigs, weights, and hooks used by anglers have the potential to alter benthic ocean habitats by snagging

structure, and some gear can be lost; however, adverse effects to the seafloor and bottom fish EFH from lost recreational fishing gear have not been observed in WDFW habitat surveys and are thus should not occur under the Proposed Action (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat).

Under the Proposed Action, there would be increased activity in the marine ecosystem as a result of the authorized bottom fish fishery, and shrimp trawl fishery compared to the other alternatives evaluated. These activities could result in small and temporary changes to habitats, and would not cause substantial damage. Bottom trawls used in the shrimp trawl fishery come into contact with benthic habitats and could alter critical habitat for green sturgeon and salmonids, and EFH for several salmonids and groundfish. Shrimp trawl gear would be used in sandy, muddy/cobble habitats and would alter portions of the sea floor of the North Puget Sound by suspending sediment and changing habitat complexity, smoothing of sand waves, and changing bottom roughness in localized areas. Trawls in less structurally complex habitats, such as areas fished by the commercial shrimp trawlers, are less affected than areas of more complex habitat (Roberts 2008). The effect of suspended sediment would be small and temporary as sediment would re-settle to local habitats. Temporary sediment suspension would not alter light levels (and thus, would not interrupt photosynthesis or affect species such as eelgrass or kelp) because this suspended sediment is limited to waters deeper than the photic zone. The shrimp trawls use beam trawl gear (no rockhopper gear would be allowed) and thus, would not alter areas of rocky bottoms. The probability of the future loss of a trawl net from the commercial shrimp trawl fishery is discountable.

The overall status of the marine ecosystem under the Proposed Action would remain the same. The research activities and fisheries occurring under the Proposed Action would not degrade the overall condition of the marine ecosystem of Puget Sound and its habitats because changes to habitat structure and function would be short term and transitory. Additional information available from WDFW-conducted research about stock status, abundance, and distribution of Puget Sound fishes under the Proposed Action would be available to inform development of adaptive management measures for fisheries and other rockfish recovery efforts. These management efforts could subsequently positively influence the overall condition of the Puget Sound marine ecosystem and its habitats.

4) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: The inland waters of Washington, including Puget Sound, are heavily impacted by

human activities, which impact ecosystem function. The purpose of the proposed fisheries closures, restrictions, and requirements; and the proposed fish research program is to protect and enhance the recovery of the ESA-listed populations of yelloweye rockfish, canary rockfish, and bocaccio in Puget Sound (WDFW 2011d). As explained above in response to Question 3 (Can the proposed action reasonably be expected to cause substantial damage to the ocean and coast habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?), the overall status of the ocean and coastal habitats under the Proposed Action would remain the same.

Further, the Proposed Action would not have a substantial impact on biodiversity. The small numbers of ESA-listed and non-listed fish species killed as a result of the Proposed Action would be a small fraction of their total numbers and would not affect the species' viability, species composition, or interrelationship with other species and ecosystem elements that would affect biodiversity within the action area.

5) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: The Proposed Action would not have a substantial adverse impact on public health or safety because the recreational bottom fish fishery, commercial shrimp trawl fishery, and WDFW research activities would all continue to operate under current laws and regulations specific to each activity that include protections for public health and safety.

6) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: The Proposed Action would not adversely affect endangered, threatened, and non-listed fish species in Puget Sound, but would be a benefit to them for the following reasons. WDFW's research activities, as well as information provided by observers in the shrimp trawl fishery, would provide data regarding the distribution, habitat use, and abundance of listed and non-listed fish species in Puget Sound. This data would be used to develop management measures that would support recovery of listed fish and marine mammals. The fisheries and research activities under the Proposed Action would not adversely affect marine mammals or other non-target species such as marbled murrelets, some of which are listed as endangered or threatened (see responses to Question 2 – Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?).

7) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: The effects of the Proposed Action on the social and economic environment, interrelated with natural or physical environmental effects, are very limited. Possible employment of a few seasonal personnel needed to carry out the action (e.g., observers on shrimp trawls) is too small to have any measurable effect on the local economy, nor would environmental effects of the Proposed Action meaningfully alter natural and physical habitats of the action area. The Proposed Action would have a moderate, positive effect with regard to socioeconomics in the action area, mostly because of the retention of the recreational bottom fish fishery as well as the commercial shrimp trawl fishery (Subsection 4.6.2, Proposed Action, Socioeconomics).

Fishery closures under the Proposed Action would result in a small decrease of economic benefits to the Puget Sound economy for the 5-year term of the action. However, each of these fisheries has experienced a decline in ex-vessel values between 2005 and 2009, and closures under the Proposed Action would result in continued economic reduction trends (Subsection 4.6.2, Proposed Action, Socioeconomics). Potential future economic gains to fishing communities and industries in Puget Sound related to information collected about overall abundance, species assemblages, distribution, and health could be realized under the Proposed Action because such information could result in additional or continued fishing opportunities, which would enhance current economic revenues and benefits related to fishing.

8) Are the effects on the quality of the human environment likely to be highly controversial?

Response: The Proposed Action would have insignificant effects on the quality of the human environment and is not likely to be highly controversial. Rockfish fishing and retention of rockfish caught as bycatch are already prohibited in most of Puget Sound, while fishing for rockfish in waters deeper than 120 feet is prohibited throughout the geographic range of the U.S. waters of the Puget Sound/Georgia Basin rockfish DPSs. Additionally, fishery closures under the Proposed Action are currently in effect and, at this time, there is no plan to lift these closures (Subsection 4.7, Proposed Action, Environmental Justice).

The Proposed Action continues the State-authorized recreational bottom fish fishery and commercial shrimp trawl fishery. Retaining the recreational bottom fish fishery provides another opportunity for recreational anglers, and both fisheries provide some economic benefit to fishing communities in the Puget Sound region. The Puget Sound fish research program would include continuation of a bottom

fish trawl census that has occurred on an annual basis since the late 1980s, a mid-water trawl survey, an acoustic trawl survey of Pacific herring, and hook-and-line and tagging studies of non-listed rockfish. Because these activities are representative of the existing research program that occurs in the action area, these research activities are not expected to be controversial.

9) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?

Response: The Proposed Action would not result in substantial impacts to unique areas because there would be no activities associated with the Proposed Action in or near historic or cultural resources, park land, prime farmlands, wetlands, or wild and scenic rivers for the following reason.

As described above in response to Question 3 (Can the proposed action reasonably be expected to cause substantial damage to the ocean and coast habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?), small and temporary disturbances to ecologically important areas like critical habitat or EFH from commercial shrimp and research trawls is likely, but activities under the Proposed Action are not expected to result in substantial impacts to critical habitat or EFH. Other unique areas such as those in the question are not present in or near enough to the proposed action to be affected by it.

10) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: There are no unique or unknown risks to the human environment that would result from the Proposed Action. The small numbers of fish taken under the incidental take permit and the scientific research permit (Subsection 1.2, Description of the Proposed Action) is conservatively estimated (Appendix A). Other fishery closures, restrictions, and requirements under the Proposed Action are well-defined, and in many cases currently in effect. Thus, effects on the human environment as a result of the Proposed Action are not likely to be highly uncertain or involve unique or unknown risks.

11) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Response: The proposed action will not cause significant cumulative effects, for the following reasons. Past and current actions affecting the same environment as the Proposed Action are described in detail in Subsection 1.5, Relationship to Other Plans and Policies. These actions collectively address habitat and fishing mortality for ESA-listed rockfish, and some actions improve these

conditions compared to the recent past. In conjunction with the Proposed Action, these other actions would further serve to protect the ESA-listed rockfish species and address some habitat limiting factors over time. However, limiting factors such as contaminants, nearshore degradation, and derelict fishing gear would continue to limit recovery of ESA-listed rockfish (Subsection 5.2, Other Actions Affecting the Same Environment).

Mortalities to ESA-listed rockfish resulting from the Puget Sound Chinook Harvest Agreement (F/NWR/2010/06051) , even when combined with the expected take under the Proposed Action, would not be expected to impact the viability of the species (Subsection 5.2, Other Actions Affecting the Same Environment).

The actions described in Subsection 1.5, Relationships to Other Plans and Policies, also collectively address habitat and fishing mortality for ESA-listed Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead, and bull trout. Similar to ESA-listed rockfish, freshwater and Puget Sound limiting habitat conditions for ESA-listed salmonids would persist through the 5-year term of the Fishery Conservation Plan. The small numbers of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, eulachon, and Puget Sound steelhead killed as a result of the Proposed Action would be a small fraction of their total numbers and are not expected to affect the species' viability even in combination with other, ongoing activities in the action area or its vicinity.

The actions described in Subsection 1.5, Relationships to Other Plans and Policies, also influence cumulative effects to marine mammals and turtles, described in Subsection 3.4, Marine Mammals and Turtles. These plans and policies influence the number and types of prey available to various marine mammals. Because the decrease of prey, described in Subsection 4.4.2, Proposed Action, Marine Mammals and Turtles, represents a small fraction of that available in the action area, the prey decrease would be unlikely to meaningfully affect any marine mammal species, when combined with other, ongoing activities in the action area or its vicinity..

12) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?

Response: The Proposed Action would have no adverse effects on districts, sites, highways, structures, or objects listed or eligible for listing in the National Register of Historic Places or cause loss or destruction of significant scientific, cultural, or historical resources because the majority of activities under the Proposed Action would not impact or alter the physical environment, including these

structures and resources. Research and commercial shrimp trawls would intermittently and temporarily affect benthic habitats by suspending sediment and changing habitat complexity, smoothing of sand waves, and changing bottom roughness in localized areas. The effect of suspended sediments would be expected to be small and temporary as sediment would re-settle to local habitats (Subsection 4.1.2, Proposed Action, Marine Ecosystem and Habitat). This very minor effect on benthic habitat and suspended sediment will not happen by, and is unrelated to historic or potentially historic places or scientific, cultural and historical resources.

13) Can the proposed action reasonably be expected to result in the introduction or spread of non-indigenous species?

Response: The Proposed Action would not import, introduce, or contribute to the spread of non-indigenous species because vessels and equipment used for the fish research program and commercial shrimp trawls are already in use locally by the WDFW or commercial fishers, respectively, or would be fabricated or purchased for the action. Vessels used by recreational fishers could potentially result in the introduction or spread of non-indigenous species. However, recreational fishing vessels are currently present in the action area already must follow WDFW guidelines for boaters to follow to prevent the transfer of non-native organisms to waters of the state. Any small increase in numbers of vessels because of the recreational rockfish fishery would not result in a meaningful change in the likelihood of introduction or spread of non-indigenous species. In addition, Washington State regulates the importation of potentially invasive species under RCW 77.12.020. Numerous aquatic species may not be possessed, imported, purchased, sold, propagated, transported, or released into state waters. The overall number of vessels operating in the action area is not likely to measurably change, and any associated risk of introduction or spread of non-indigenous species would not be affected by the Proposed Action.

14) Is the proposed action likely to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

Response: The Proposed Action does not establish a precedent for future actions or represent a decision in principle because the Proposed Action is similar to previous actions to protect other ESA-listed species.

15) Can the proposed action reasonably be expected to threaten a violation of Federal, state, or local law or requirements imposed for the protection of the environment?

Response: The Proposed Action would not threaten a violation of Federal, state, tribal, and local law or

requirements to protect the environment because it will be conducted in a manner complementary to plans that support ESA-listed rockfish and other ESA-listed species' recovery. The Proposed Action would be limited to those activities necessary to fulfill WDFW's research needs and other fisheries regulations and restrictions designed to protect the populations of ESA-listed rockfish and other listed fish species as described in Subsection 1.2, Description of the Proposed Action, and would be conducted in a manner consistent with all laws.

16) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response: The Proposed Action would not result in cumulative adverse effects because it will benefit the target species (ESA-listed rockfish), as well as other ESA-listed fish species and non-target fish species. As described above in response to Question 11 (Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?), the closure of the set net, set line, bottom fish trawl, bottom fish pot, and scallop trawl fisheries for the 5-year term of the Proposed Action would prevent direct and incidental capture of any fish species in these fisheries. Additionally, information about stock status, abundance, and distribution of ESA-listed and non-listed fish species from the Puget Sound fish research program and on-board observers in the commercial shrimp trawl industry would provide information about ESA-listed salmonid distribution, abundance, and trends that would be used to inform fisheries management decisions.

Subsection 1.5, Relationship to Other Plans and Policies, describes in detail past and current actions affecting the same environment as the Proposed Action. These actions collectively address habitat and fishing mortality for ESA-listed rockfish and other listed fish, and some actions improve these conditions compared to conditions from the recent past. In conjunction with the Proposed Action, these actions would further serve to protect the ESA-listed rockfish species and other listed fish and address some habitat limiting factors over time. However, limiting factors such as contaminants, nearshore degradation, and derelict fishing gear would continue to limit recovery of ESA-listed rockfish.

The actions described in Subsection 1.5, Relationships to Other Plans and Policies, also collectively address habitat and fishing mortality for ESA-listed Chinook salmon, Hood Canal chum salmon, Puget Sound steelhead, and bull trout. Similar to ESA-listed rockfish, freshwater and Puget Sound limiting habitat conditions for ESA-listed salmonids would persist through the 5-year term of the Fishery

Conservation Plan. Similarly, the small numbers of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, Puget Sound steelhead killed and eulachon as a result of the Proposed Action would be a small fraction of their total numbers and would not affect the species' viability.

Climate change is another factor that may affect the Puget Sound/Georgia Basin and ESA-listed and non-listed rockfish, salmonids, groundfish, and marine mammals. Important climate changes have occurred in the Puget Sound region in the past century and the next several decades will likely see even greater changes (Mote et al. 2005 as reported in Drake et al. 2010). Given the general importance of climate to rockfish juvenile recruitment, it is likely that climate strongly influences the dynamics of the ESA-listed rockfish population productivity and therefore their overall population viability (Drake et al. 2010). Recent declines in marine fish populations in greater Puget Sound may reflect recent climatic shifts; however, it is not known whether these climatic shifts represent long-term changes or short-term fluctuations that may reverse in the near future (Drake et al. 2010). Potential long-term threats to ESA-listed rockfish species as a result of climate change, coupled with other threats such as bycatch by other fisheries, habitat loss, pollutants, and low dissolved oxygen (Drake et al. 2010) could further affect the survival and reproductive success of rockfish and their prey sources in the Puget Sound/Georgia Basin DPSs. Long-term effects to climate change as a result of the Proposed Action are likely to be negligible. Outboard motors used by recreational anglers as well as engines used by commercial fishers and WDFW research boats would initially emit carbon dioxide at current levels, and emissions could be reduced over the 5-year period of the Proposed Action as new engines become more efficient in response to better technology and improved standards, which are administered by the Environmental Protection Agency (75 Fed. Reg. 179, September 16, 2010).

Ocean acidification may also affect ESA-listed rockfish and other fish species in the Puget Sound/Georgia Basin. Ocean acidification can disrupt the process of shell-producing organisms that are an important part of the marine food web, including krill, oysters, sea urchins, and corals. For marine animals, including some fish, accumulation of CO_2 in the body may result in changes in the organism's morphology, metabolic state, physical activity, and reproduction (Symposium on the Ocean in a High CO_2 World 2008). Ocean acidification could negatively affect the ESA-listed rockfish species, listed and unlisted salmonids, and all species discussed in this EA because of impacts to important components of the food web, including invertebrates such as krill. When combined with the potential negative effects from climate change as discussed above, these effects could hinder conservation efforts as described in Subsection 1.5, Relationship to Other Plans and Policies. Long-term effects to ocean acidification as a result of the Proposed Action would be negligible and would be the same or similar to

the effects described above for climate change with regard to emissions from motors and engines used by recreational anglers and commercial fishers.

9.1. List of Reviewers

☐ Kate Hawe, NWR NEPA Coordinator

☐ Donna Darm, NWR Protected Resources ARA

☐ Barry Thom, NWR Deputy Administrator

☐ Jane Hannuksela, General Counsel Northwest

☐ Lynne Barre, NWR Protected Resources

9.2. Determination

In view of the information presented in the EA and analysis (Section 4, Environmental Consequences) prepared for the action titled "Section 10 Permit Applications by the Washington State Department of Fish and Wildlife for Incidental Take of ESA-Listed Rockfish and Other Listed Fish within the Puget Sound/Georgia Basin and Take Due to Scientific Research," I have determined that issuance of permits by NMFS will not significantly impact the quality of the human environment as described above and in the EA. In addition, all beneficial and adverse impacts of the Proposed Action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an Environmental Impact Statement is not necessary.

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William W. Stelle Jr., Regional Administrator Date
NMFS Northwest Region
Seattle, Washington

Appendix A

Estimated Numbers of ESA-listed Fish Species to be Incidentally Taken under the Various Alternatives

	Recreational			Shrimp Trawls			Research			Annual Takes*		
	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3
Bocaccio	0	38	<38	0	5	5	0	8	8	0	51	<51
Canary Rockfish	0	128	194	0	10	10	0	24	24	0	162	228
Yelloweye Rockfish	0	142	219	0	10	10	0	10	10	0	162	239
Eulachon, adult	0	0	0	0	3,240	3,240	0	~~540~~62<u>0</u>	~~540~~62<u>0</u>	0	3,~~780~~<u>860</u>	3,~~780~~<u>860</u>
PS Chinook Salmon	0	42	42	0	50	50	0	108	108	0	200	200
PS Steelhead	0	0	0	0	0	0	0	~~28~~24	~~28~~24	0	~~28~~24	~~28~~24
Hood Canal Summer Chum Salmon	0	0	0	0	0	0	0	~~13~~11	~~13~~11	0	~~13~~11	~~13~~11
Green Sturgeon	0	0	0	0	1	1	0	~~3~~2	~~3~~2	0	~~4~~3	~~4~~3

*Includes lethal and non-lethal take. No bull trout are expected to be taken.

Appendix B

Species of Fishes with Designated EFH in the Action Area

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EFH Groundfish Species		
English sole	Pacific ocean perch	flathead sole
Parophrys vetulus	*S. alutus*	*Hippoglossoides elassodon*
soupfin shark	redbanded rockfish	Pacific sanddab
Galeorhinus galeus	*S. babcocki*	*Citharichthys sordidus*
spiny dogfish	rosethorn rockfish	petrale sole
Squalus acanthias	*S. helvomaculatus*	*Eopsetta jordani*
big skate	rougheye rockfish	rex sole
Raja binoculata	*S. aleutianus*	*Glyptocephalus zachirus*
California skate	sharpchin rockfish	rock sole
R. inornata	*S. zacentrus*	*Lepidopsetta bilineata*
Longnose Skate	shortbelly rockfish	sand sole
R. rhina	*S. jordani*	*Psettichthys melanostictus*
ratfish	shortraker rockfish	starry flounder
Hydrolagus colliei	*S. borealis*	*Platichthys stellatus*
Pacific rattail	silverygray rockfish	chilipepper
Coryphaenoides acrolepis	*S. brevispinis*	*S. goodei*
lingcod	splitnose rockfish	shortspine thornyhead
Ophiodon elongatus	*S. diploproa*	*Sebastolobus alascanus*
Pacific cod	stripetail rockfish	arrowtooth flounder
Gadus macrocephalus	*S. saxicola*	*Atheresthes stomias*
sablefish	vermilion rockfish	darkblotched rockfish
Anoplopoma fimbria	*S. miniatus*	*S. crameri*
aurora rockfish	widow rockfish	butter sole
Sebastes aurora	*S. entomelas*	*Isopsetta isolepis*
black rockfish	yellowtail rockfish	curlfin sole
S. melanops	*S. flavidus*	*Pleuronichthys decurrens*
blue rockfish	Dover sole *Microstomus pacificus*	greenspotted rockfish
S. mystinus		*S. chlorostictus*
bocaccio		greenstriped rockfish
S. paucispinis		*S. elongatus*
EFH Coastal Pelagic Species		
anchovy *Engraulis mordax*	Pacific sardine *Sardinops sagax*	Pacific mackerel *Scomber japonicus*
jack mackeral *Trachurus symmetricus*	market squid *Loligo opalescens*	
EFH Pacific Salmon Species		
Chinook salmon *Oncorhynchus tshawytscha*	coho salmon *O. kisutch*	Puget Sound pink salmon *O. gorbuscha*

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