# Western Distinct Population Segment Steller sea lion
## *Eumetopias jubatus*

## 5-Year Review:
## Summary and Evaluation


**National Marine Fisheries Service**
**Protected Resources Division**
**Juneau, Alaska**

**February 2020**

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# 5-YEAR REVIEW

**Western Distinct Population Segment Steller sea lion**
**(*Eumetopias jubatus*)**

## 1.0 GENERAL INFORMATION

### 1.1 Reviewers

**Lead Regional Office:** Alaska Region (AKR) – Kim Raum-Suryan, 907-586-7424 and Dr. Lisa Rotterman.
**Cooperating Science Center:** Alaska Fisheries Science Center (AFSC) – Dr. Tom Gelatt, 206-526-4040.

### 1.2 Methodology used to complete review

This review was authored by Kim Raum-Suryan and Dr. Lisa Rotterman of the Alaska Regional Office in consultation with Dr. Tom Gelatt, Dr. Brian Fadely, Dr. Michelle Lander, Kathryn Sweeney, Beth Sinclair, and other AFSC staff. The primary sources of information relied on for the review are the many published papers, reports, and technical memoranda that have become available since the listing of the western distinct population segment (WDPS) Steller sea lion in 1997, augmented with recently-collected and analyzed Steller sea lion count data from AFSC and the lead Russian research coordinator Dr. Vladimir Burkanov. We also considered information submitted through public comments, and this document was reviewed by five external peer reviewers.

### 1.3 Background

Section 4(c)(2) of the Endangered Species Act (ESA) requires, at least once every five years, a review of all threatened and endangered species to determine if they should be removed from the list of threatened or endangered species or if their listing status should be changed (16 U.S.C. § 1533(c)(2)). The five-year review is also used to help track the recovery of a species.

#### 1.3.1 Federal Register notice citation announcing initiation of this review

82 FR 57955, December 8, 2017
83 FR 5248, February 6, 2018 (extension of comment period and correction)

#### 1.3.2 Listing History

<u>Emergency Listing</u>
**FR notice:** 55 FR 12645, April 5, 1990
**Date listed:** April 5, 1990
**Entity listed:** Steller sea lion throughout its range
**Classification:** Threatened

<u>Original Listing</u>
**FR notice:** 55 FR 49204, November 26, 1990
**Date listed:** December 4, 1990
**Entity listed:** Steller sea lion throughout its range
**Classification:** Threatened

Revised Listing
**FR notice:** 62 FR 24345, May 5, 1997
**Date listed:** June 4, 1997
**Entity listed:** Steller sea lion western DPS
**Classification:** Endangered[1]

#### 1.3.3 Associated rulemakings
**Critical Habitat Designation:** 58 FR 45269, August 27, 1993

#### 1.3.4 Review History
This is the first formal 5-year review for the WDPS of Steller sea lions following its listing as a separate DPS.

#### 1.3.5 Species' Recovery Priority Number at start of 5-year review
At the start of this review, the WDPS of Steller sea lion had a Recovery Priority Number of 7, based on the Recovery Priority Guidelines (55 FR 24296, June 15, 1990). This priority reflects that: the threat to the species is currently moderate; its recovery potential is moderate because not all threats to the species are well understood, nor are the full extent of management actions needed to affect recovery entirely clear; and the species has a relatively high level of conflict with economic activity, specifically commercial fisheries. The criteria for recovery priorities have recently been updated (84 FR 18243, April 30, 2019), and the new priority number can be found in Section 3.2 below.

#### 1.3.6 Recovery Plan or Outline
**Name of plan or outline:** Recovery Plan for the Steller sea lion, Eastern and Western Distinct Population Segments (*Eumetopias jubatus*)
**Date issued:** March 2008
**Dates of previous revisions, if applicable:** Final Recovery Plan for Steller sea lions (*Eumetopias jubatus*)
**Date issued:** December 1992

## 2.0 REVIEW ANALYSIS

### 2.1 Application of the 1996 Distinct Population Segment (DPS) policy

#### 2.1.1 Is the species under review a vertebrate?
__X__ **Yes**, *go to section 2.1.2*
_____ **No**, *go to section 2.2*

#### 2.1.2 Is the species under review listed as a DPS?
__X__ **Yes**, *give date and go to section 2.1.3*
_____ **No**, *go to section 2.1.4*

[1] The 1997 revised listing also recognized the eastern DPS as threatened (62 FR 24345). The eastern DPS was subsequently delisted in 2013 (78 FR 66140, November 4, 2013).

The Western DPS was recognized and listed as endangered in 1997 (62 FR 24345, May 5, 1997), with an effective date of June 4, 1997.

### 2.1.3 Was the DPS listed prior to 1996?

____**Yes**, *go to section 2.1.3.1*
__**X**_ **No**, *go to section 2.1.4*

### 2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

__**X**__Yes, *provide citation(s) and a brief summary of the new information; explain how this new information affects our understanding of the species and/or the need to list as DPSs. This may be reflected in section 4.0, Recommendations for Future Actions. If the DPS listing remains valid, go to section 2.2, Recovery Criteria. If the new information indicates the DPS listing is no longer valid, consider the 5-year review completed, and go to section 2.4, Synthesis.*
_____**No**, *go to section 2.2., Recovery Criteria*

In 1997, the ESA listing of the Steller sea lion was divided into two distinct population segments, the Western Distinct Population Segment (WDPS) and the Eastern Distinct Population Segment (EDPS) (62 FR 24345, May 5, 1997, Figure 1 below) with a dividing line at 144°W longitude. Loughlin (1997) based stock structure classification on the phylogeographic method used by Dizon et al. (1992) considering genetic (Bickham et al. 1996), morphological (Merrick et al. 1995, Loughlin 1997), population dynamics, and distributional Steller sea lion data.

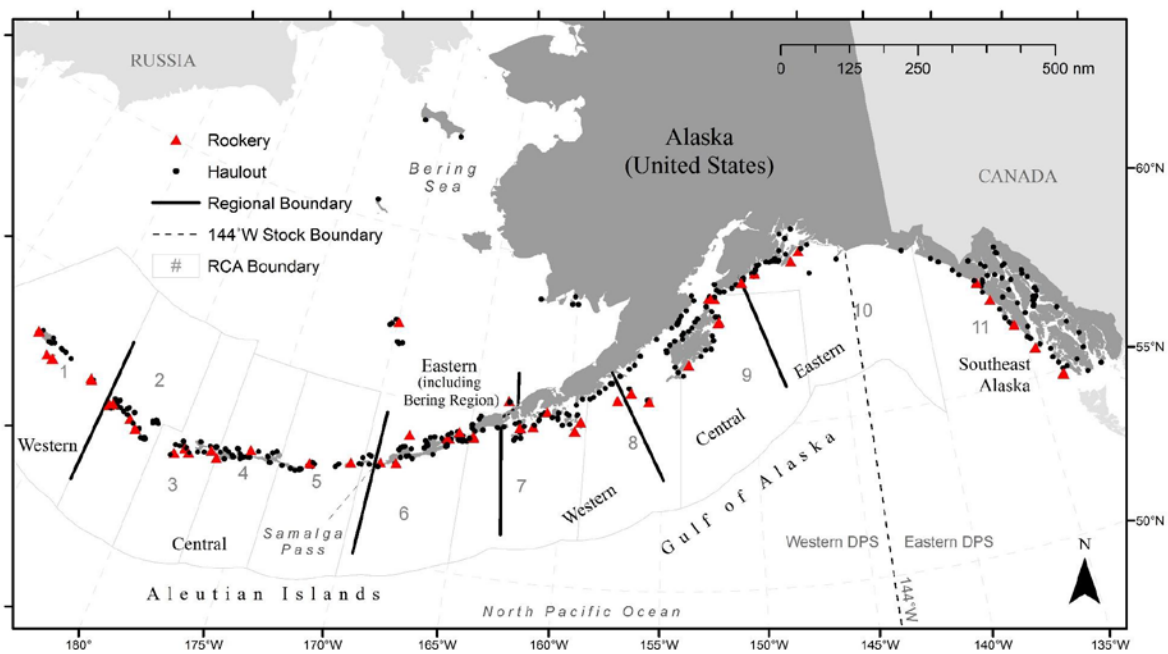


**Figure 1. Map of Alaska showing the NMFS Steller sea lion survey regions, rookery cluster areas (RCAs), and rookery and haulout locations. The line (144°W) separating the eastern and western DPSs is also shown. Reproduced from Fritz et al. (2016c).**

Research following the 1997 DPS listing provides new information and additional support for recognition of Steller sea lion DPSs (NMFS 2008, Muto et al. 2019). NMFS (2013) reviewed the genetic and movement data relevant to DPS discreteness and reported that there is an overwhelming collection of morphological, ecological, behavioral, and genetic evidence indicating the eastern and western DPSs remain discrete entities (AFSC 2011). The most recent Marine Mammal Stock Assessment for the WDPS (Muto et al. 2019) concludes that the WDPS and EDPS warrant distinction based on genetic analyses (Baker et al. 2005, Harlin-Cognato et al. 2006, Hoffman et al. 2006, O'Corry-Crowe et al. 2006, Phillips et al. 2009, Phillips et al. 2011) and there may be sufficient morphological differentiation to support two subspecies (Phillips et al. 2009). The Society of Marine Mammalogy's Committee on Taxonomy also has incorporated the two subspecies into the Society's List of Marine Mammal Species and Subspecies (https://www.marinemammalscience.org/species-information/list-marine-mammal-species-subspecies/). However, a review by Berta and Churchill (2012) characterized the status of these subspecies assignments as "tentative" and further research is required to determine if a change in taxonomic classification is warranted.

The two Steller sea lion DPSs meet the requirements of the 1996 policy (61 FR 4722, February 7, 1996) for discreteness and significance. The level of differentiation indicates long-term reproductive isolation resulting from four glacial refugia events 60,000 to 180,000 years before present (BP) (Harlin-Cognato et al. 2006). Evidence of glacial refugia support the genetic structure of female lineages and are an objective approach to defining populations without the need for a priori assumptions of the number or geographic boundaries of populations (Harlin-Cognato et al. 2006). The loss of any one DPS would result in a significant gap in the range of the species and loss of adaptive characteristics unique to the DPS.

Until the 1970s, the closest rookeries (Forrester Island in the east and Seal Rocks in the west) between the EDPS and WDPS were separated by a distance of about 1000 km (Pitcher et al. 2007). As the EDPS recovered, haul-outs in northern Southeast Alaska slowly transitioned into new rookeries (Hazy Islands rookery established ~ 1979, to White Sisters ~1990, and to Graves Rocks in the late 1990s, Pitcher et al. 2007). Although recent data indicate that a relatively low level of genetic interchange occurs between the EPDS and WDPS, concentrated in northern Southeast Alaska, evidence does not indicate that the rate of exchange has been sufficient to diminish the genetic distinctiveness between the two distinct population segments (Jemison et al. 2013, O'Corry-Crowe et al. 2014, Jemison et al. 2018, Rehberg et al. 2018). Hybridization among subspecies and species along a contact zone is not unexpected (AFSC 2011). The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a DPS (see 61 FR 4722, 4724, February 7, 1996), and the best available scientific information continues to support a conclusion that the WDPS satisfies the requirements for a DPS under the Services' DPS policy.

The best location for the demarcation line between the WDPS and EDPS could be debated in light of recent evidence that significant numbers of WDPS females produce pups east of 144°W longitude at the Graves Rocks and White Sisters rookeries (Jemison et al. 2013, O'Corry-Crowe et al. 2014, Jemison et al. 2018). The majority of pups produced at Graves Rocks (~60%), and significant numbers of pups at White Sisters (~30%) descend from WDPS females (O'Corry-Crowe et al. 2014, ADF&G, unpublished data). Also, 7-11% of animals near these rookeries and in Glacier Bay National Park were born in the WDPS, and a minimum of 37-38% of animals using these areas carry genetic information unique to the WDPS (ADF&G unpublished data). Animals from both DPSs commonly occur from northern Southeast Alaska to the eastern portion of Prince William Sound, and thus management actions need to account for the possible presence of EDPS and WDPS animals throughout this mixing zone.

## 2.2 Recovery Criteria

### 2.2.1 Does the species have a final, approved recovery plan[2] containing objective, measurable criteria?

**Yes**

### 2.2.2 Adequacy of recovery criteria.

#### 2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

__X__**Yes**, *go to section 2.2.2.2*
_____**No**, *go to section 2.2.3, and note why these criteria do not reflect the best available information. Consider developing recommendations for revising recovery criteria in section 4.0.*

#### 2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

__X__**Yes**, *go to section 2.2.3*
_____**No**, *go to section 2.2.3, and note which factors do not have corresponding criteria. Consider developing recommendations for revising recovery criteria in section 4.0.*

### 2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

#### 2.2.3.1 Downlisting Criteria

Per the Recovery Plan, the WDPS of Steller sea lion will be considered for reclassification to threatened when all of the following conditions are met (NMFS 2008):

1. The population for the U.S. region has increased (statistically significant) for 15 years on average, based on counts of non-pups (i.e., juveniles and adults). Based on an estimated U.S. population size of roughly 42,500 animals in 2000 and assuming a consistent, but slow (e.g. 1.5%) increasing trend, this would represent approximately 53,100 animals in 2015.

2. The trends in non-pups in at least five of the seven subregions are consistent with the trend observed under criterion #1.

[2] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion.

The population trends in any two adjacent subregions cannot be declining significantly. Subregions are based on a metapopulation modeled cluster analyses derived from Steller sea lion rookery locations and similarities in rates of decline over different periods of time (York et al. 1996). Because the decline began in one area and spread to other areas, a substantial decline of any two adjacent sub-areas would indicate an active threat that was not predicted (NMFS 2008). The seven subregions are:

a. Eastern Gulf of Alaska (US)
b. Central Gulf of Alaska (US)
c. Western Gulf of Alaska (US)
d. Eastern Aleutian Islands (including the eastern Bering Sea) (US)
e. Central Aleutian Islands (US)
f. Western Aleutian Islands (US)
g. Russia/Asia

***Have the Biological Criteria for Downlisting been met?***

**No, not all of the biological downlisting criteria have been met.**

Recent agTrend analyses indicate that the WDPS non-pup count in Alaska has increased 2.14%$y^{-1}$ (95% credible interval[3] of 1.49 – 2.78%$y^{-1}$) from 2002 to 2017 (Table 1, Figure 2) with notable population increases in the eastern, central, and western Gulf of Alaska (GOA) regions (Table 1, Figure 3) (Sweeney et al. 2017). AgTrend is a Bayesian approach for analyzing regional trends of abundance from sites with uneven sample schedules over space and time. This method uses a hierarchical model to augment missing abundance measurements, while accounting for survey methodology changes and variability due to survey replication. A zero-inflated log-normal distribution is used to model abundance and a log-normal distribution to model the observed abundance conditional on the true normalized abundance (Johnson and Fritz 2014). Abundance rates for the eastern, central, and western Gulf of Alaska regions were calculated for the 15-year period from 2002 to 2017 because a majority of the sites in each of these regions were last surveyed in 2017. The Aleutian Island regions were last surveyed most completely in 2016, therefore, trends for the eastern, central, and western Aleutian Islands were calculated for the 15-year period from 2001 to 2016. Based on an increasing population trend of 2.14%$y^{-1}$ (95% credible interval of 1.49 – 2.78%$y^{-1}$) over the past 15 years (for non-pups in Alaska), Recovery Plan criterion #1 for downlisting has been met. The 2017 Alaska WDPS agTrend model-predicted estimates of approximately 42,315 (38,039-47,377) non-pups and 11,953 (10,879-13,195) pups (Sweeney et al. 2017).

However, criterion #2 has not been satisfied for downlisting as trends in non-pup populations in three of the seven subregions are not consistent with the trend observed under criterion #1. The 2008 Steller sea lion recovery plan refers to sub-regions within which population trends should

[3] A credible interval is the interval in which an (unobserved) parameter has a given probability. It is the Bayesian equivalent of the confidence interval. However, unlike a confidence interval, it is dependent on the prior distribution.

be observed to determine whether biological recovery criteria have been met. These sub-regions were based on the documented variation in the rate of population decline across decades and among regions within the WDPS, demonstrating a need to employ a recovery strategy that accounts for spatial and temporal differences. Four population viability analyses (PVAs) (NMFS 2008) indicated the WDPS Steller sea lions have a high probability of declining to a low level if they are considered as a single homogeneous population (by combining all rookery counts and assuming an overarching population trend) (NMFS 2008). NMFS (2008) considered the results of the PVAs and determined that recovery should also involve maintenance of multiple widespread metapopulations that are independently viable because it is less likely that future singular threats will endanger widely separated multiple metapopulations than a single population with the same abundance.

Implicit in the ESA definitions of threatened and endangered and in the principles of conservation biology is the need to consider genetics, demographics, population redundancy, and threats (NMFS 2008). The ESA seeks to recover species to the point that they are not likely to be in danger of extinction within the foreseeable future throughout all or a significant portion of their range. Viable populations have sufficient numbers of individuals to counter the effects of deleterious gene mutations because of inbreeding, and to counter the effects of deaths exceeding births and recruitment failure. WDPS Steller sea lions occupy all of their historic range, and the Recovery Plan stated that maintaining those regional metapopulations as viable entities, with some fluctuations in population numbers, was important to recovery. In addition, because the previous decline in the WDPS started in one area and spread to other areas, the Recovery Plan stated that a substantial decline of any two adjacent sub-areas would indicate an active threat that was not predicted.

The distribution of Steller sea lions extends into Russia and Japan, and results of branding studies indicate interchange of Steller sea lions between Russian and the U.S. (NMFS 2008, Jemison et al. 2018). Therefore, any investigation of Steller sea lion population trends in the U.S., especially the western Aleutian Islands, should incorporate information on what is known of the population trends of sea lions in Russia.

The population trend in the two westernmost U.S. subregions (western and central Aleutian Islands) and the Russia/Asia subregion (Figure 4) have been in statistically significant decline in a 15-year period. In Alaska, the WDPS Steller sea lion non-pup counts declined significantly in the central (-0.67%y-1, -1.71, -0.30%y-1) and western (-6.92%y-1, -8.41, -5.41%y-1) Aleutian Islands from 2001 to 2016 (Johnson and Fritz 2014, AFSC 2016, Sweeney et al. 2017, Sweeney pers. comm., 5 April 2018) (Table 1, Figure 3). The results from the Russia/Asia subregion analysis indicate that non-pup counts for the Russia/Asia subregion declined significantly from 2002-2017, at approximately -1.3%y-1 (-2.6%y-1, -0.1%y-1) resulting in an estimated -21% (-38%, -1%) decrease in non-pup counts over the 15 year span. In Russia, the decline appears to be primarily driven by the decline in the Kuril Islands (Table 2), particularly in 2015 (Figure 5, Figure 6), which traditionally represents the highest non-pup counts (Johnson 2018). Johnson (2018) analyzed count data from Russia (Burkanov 2018) using a model similar to the agTrend analysis used by Johnson and Fritz (2014). In order to fully account for the uncertainty of missing survey counts when aggregating over sites into regions and stock totals, each site was separately modeled from 2002 to 2017 to predict counts at sites in years in which no survey occurred. The sparseness of the survey effort in the Asian stock relative to the WDPS required some changes for better model imputation of missing counts. Therefore, the Russian count data

(Burkanov 2018) were modeled on the natural scale of the observed counts instead of log-scale as is done on agTrend to prevent exponentiated model predictions from unrealistic inflation if sampling is especially sparse for a site or region (Johnson 2018).

In addition to the statistically significant declines in three subregions, there was a recent sharp drop in pup production in the eastern and central GOA subregions between 2015-2017 (Sweeney et al. 2017). Maniscalco (pers. comm.) also reported that the total number of pups born at Chiswell Island in 2018 declined more than 40% below the 2015 high. Analyses spanning the years of 2011-2017 at the Chiswell Island rookery in the eastern GOA indicated estimates of adult female annual apparent survival dropped sharply from 90% to 81% in 2016 and further to 62% in 2017 (Maniscalco 2018). The adult female estimates are of apparent survival and if many of the tracked females departed the Chiswell study area within the past few years, it would give the appearance of low survival because these animals would be effectively removed from the study population, at least temporarily (Maniscalco 2018). It is possible that some of these females from Chiswell Island departed the study area as Sweeney et al. (2017) reported a 17% decrease in non-pup abundance in the eastern GOA and a 14% increase in the central GOA. However, this drop in survival instead may have been a result of recent ecosystem changes in the GOA (Zador and Yasumiishi 2018) and continued monitoring is essential to answer this question and to determine if ecosystem changes detrimental to sea lions persist into the future.

Therefore, although there are overall positive trends in the WDPS population in the GOA, the statistically significant declines in three adjacent subregions (western and central Aleutian Islands, Russia/Asia) of the WDPS Steller sea lion population do not support the biological criterion for downlisting the WDPS to threatened.

**Table 1. Annual rates of change (% $y^{-1}$ with ± 95% credible intervals) in counts of Steller sea lion non-pups and pups in the U.S. portion of the WDPS modeled using agTrend (with data from 1978 to 2017) from 2002 to 2017. Regional rates were calculated in the Gulf of Alaska regions for 2002-2017 and 2001-2016 for the Aleutian Island regions (The 2017 survey did not cover this area, which is why the reported trend is for a 15 year period to 2016). (Table reproduced with permission from table provided by K. Sweeney, MML.)**

| Area | Year Interval | Annual Rate of Change: Non-Pups | -95% CI | +95% CI | Annual Rate of Change: Pups | -95% CI | +95% CI |
|---|---|---|---|---|---|---|---|
| **Total U.S. Western DPS** | **2002-2017** | **2.14** | **1.49** | **2.78** | **1.78** | **1.19** | **2.34** |
| Eastern Gulf | 2002-2017 | 4.21 | 2.04 | 6.26 | 2.65 | 0.99 | 4.63 |
| Central Gulf | 2002-2017 | 3.90 | 2.88 | 4.98 | 3.28 | 1.73 | 4.84 |
| Western Gulf | 2002-2017 | 3.01 | 1.50 | 4.56 | 3.65 | 2.31 | 5.12 |
| Eastern Aleutians | 2001-2016 | 1.75 | 0.37 | 3.13 | 3.10 | 2.13 | 4.00 |
| Central Aleutians | 2001-2016 | **-0.67** | **-1.71** | **0.30** | **-1.29** | **-2.23** | **-0.16** |
| Western Aleutians | 2001-2016 | **-6.92** | **-8.41** | **-5.41** | **-7.52** | **-8.68** | **-6.59** |

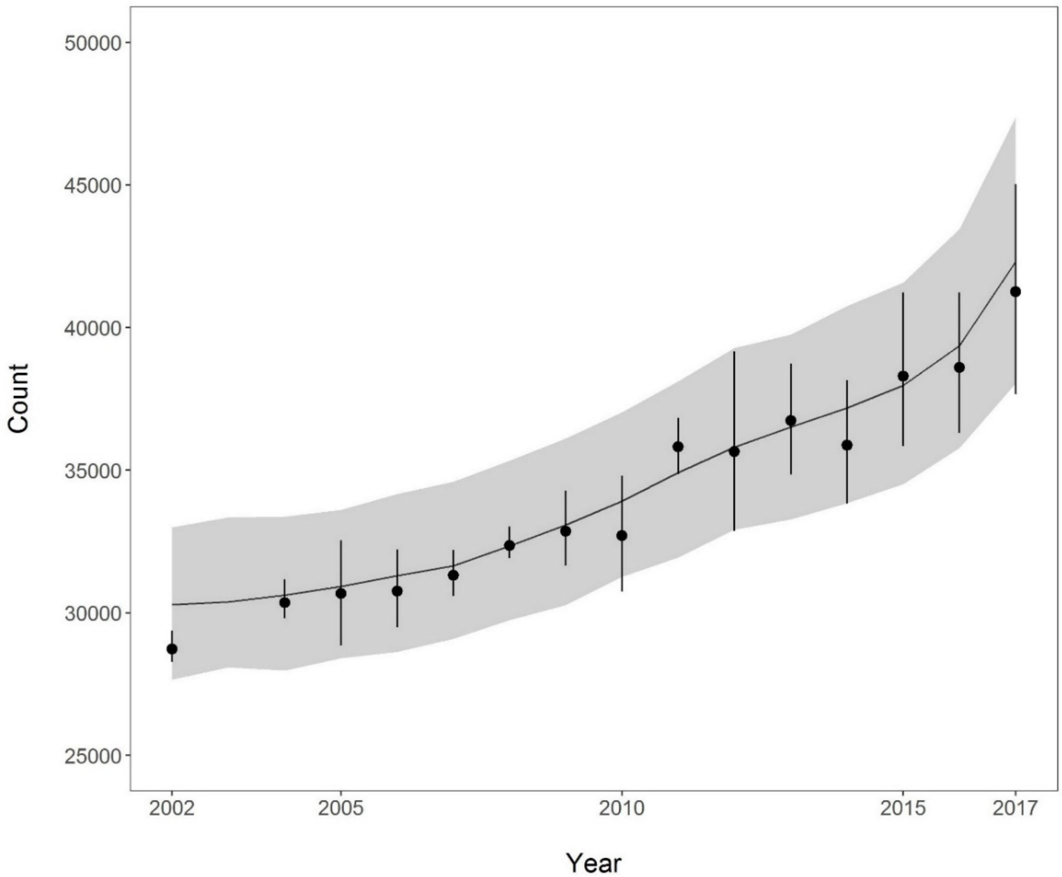


**Figure 2. Realized and predicted counts of WDPS Steller sea lion non-pups in Alaska, 2002-2017. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the black line surrounded by the gray 95% credible interval. (Figure reproduced with permission from K. Sweeney, MML).**

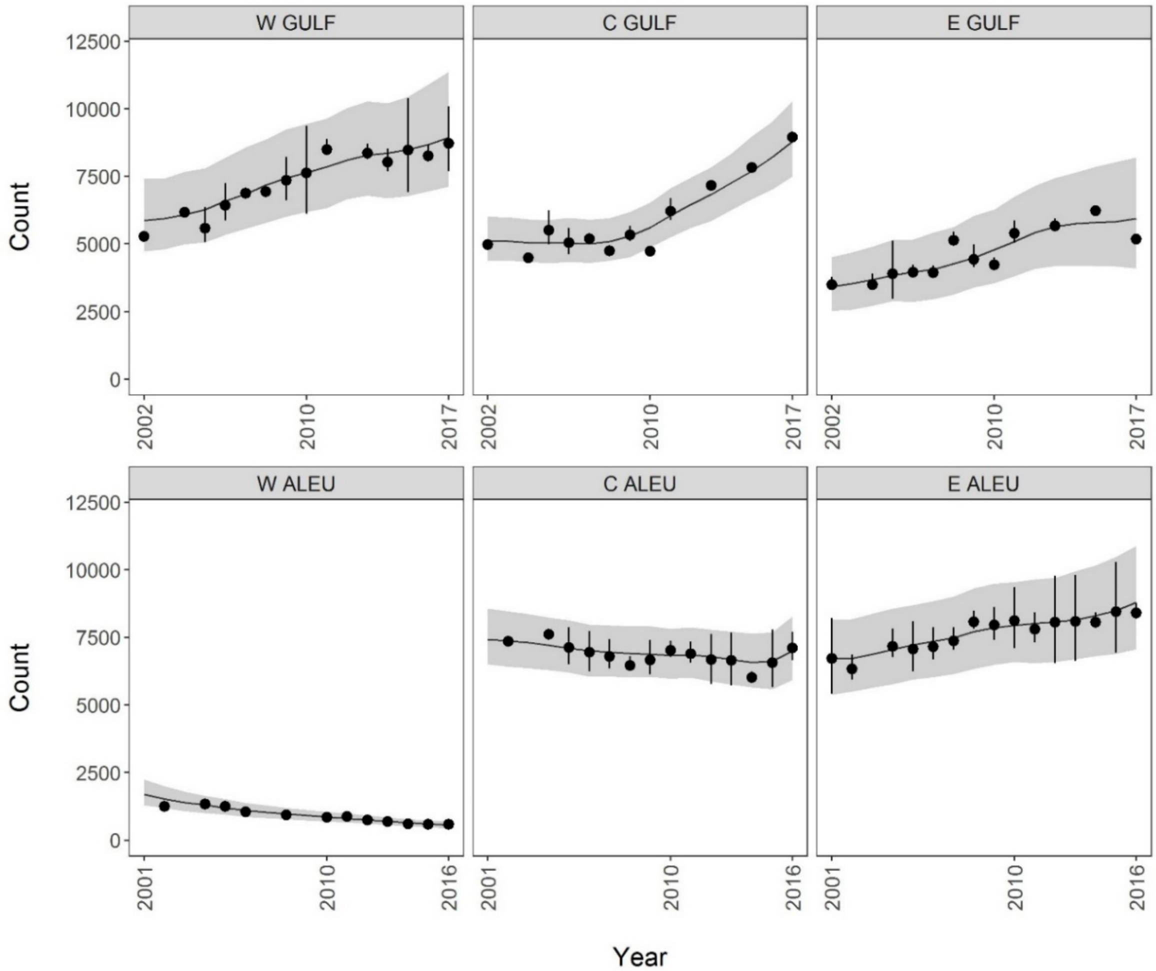


**Figure 3. Realized and predicted counts of WDPS Steller sea lion non-pups by subregions. Eastern (E-), central (C-), and western (W-) Gulf of Alaska (GULF) regions for the 15-year period from 2002-2017. Eastern, central, and western Aleutian Island (ALEU) subregions are shown for the 15-year period from 2001-2016. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the black line surrounded by the gray 95% credible interval. Figure reproduced with permission from K. Sweeney, MML.**

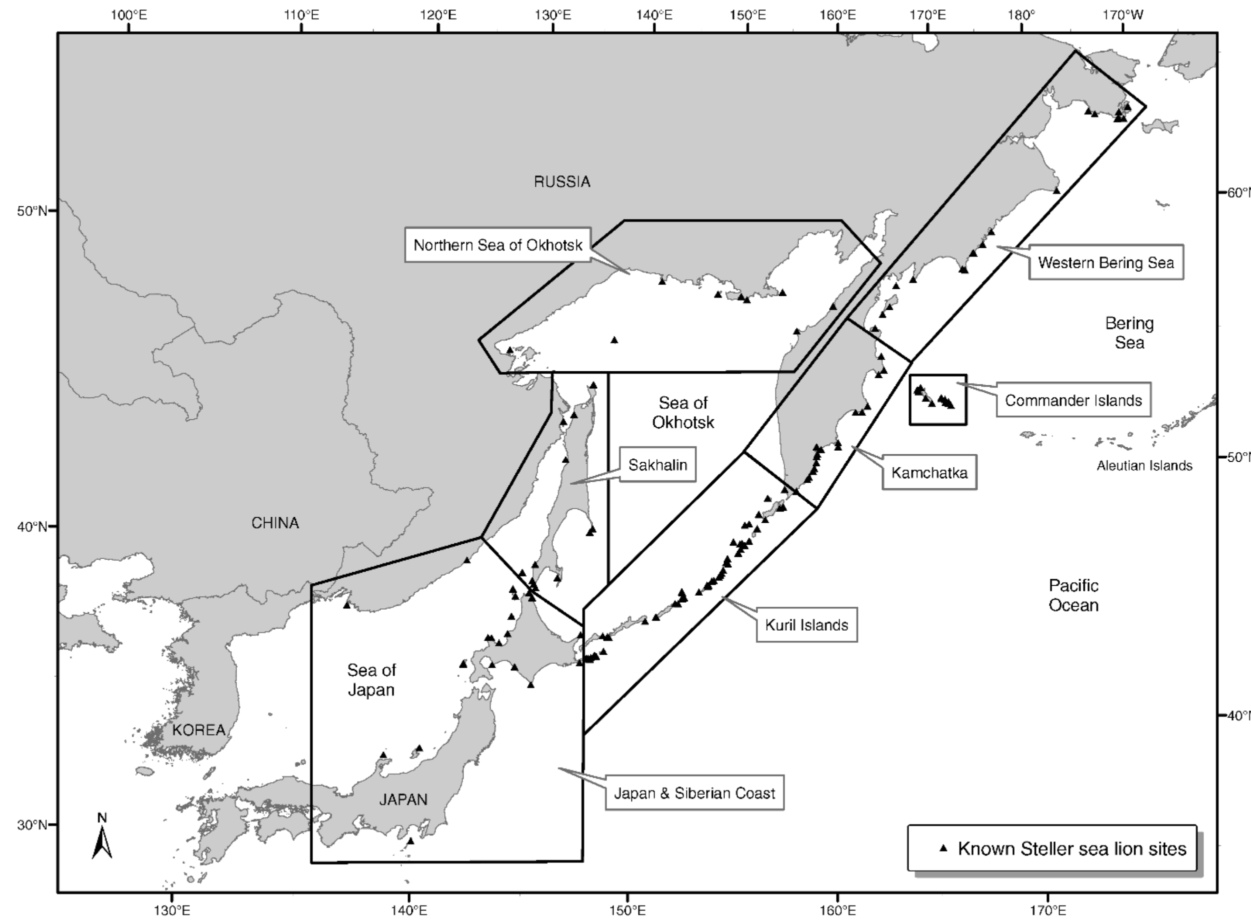


**Figure 4. Steller sea lion sections along the Russia/Asia coast comprise the Russia/Asia subregion. Reproduced from Burkanov and Loughlin (2005).**

**Table 2. Estimated trends for each of the Russia/Asia subregions of Steller sea lions. Estimates are presented in % growth form. Table reproduced with permission from Johnson (2018), which analyzed data from Burkanov (2018) .**

| Region | Annual Trend | 95% CI |
|---|---|---|
| Commander | -0.6 | [-2.6, 1.2] |
| Kamchatka | -0.8 | [-3.0, 1.5] |
| Kuril | -4.1 | [-5.4, -2.8] |
| Northern part of the Sea of Okhotsk | 0.9 | [-2.0, 4.0] |
| Sakhalin | 0.9 | [-2.3, 5.4] |
| Western Bering Sea | -1.1 | [-16.1, 10.2] |

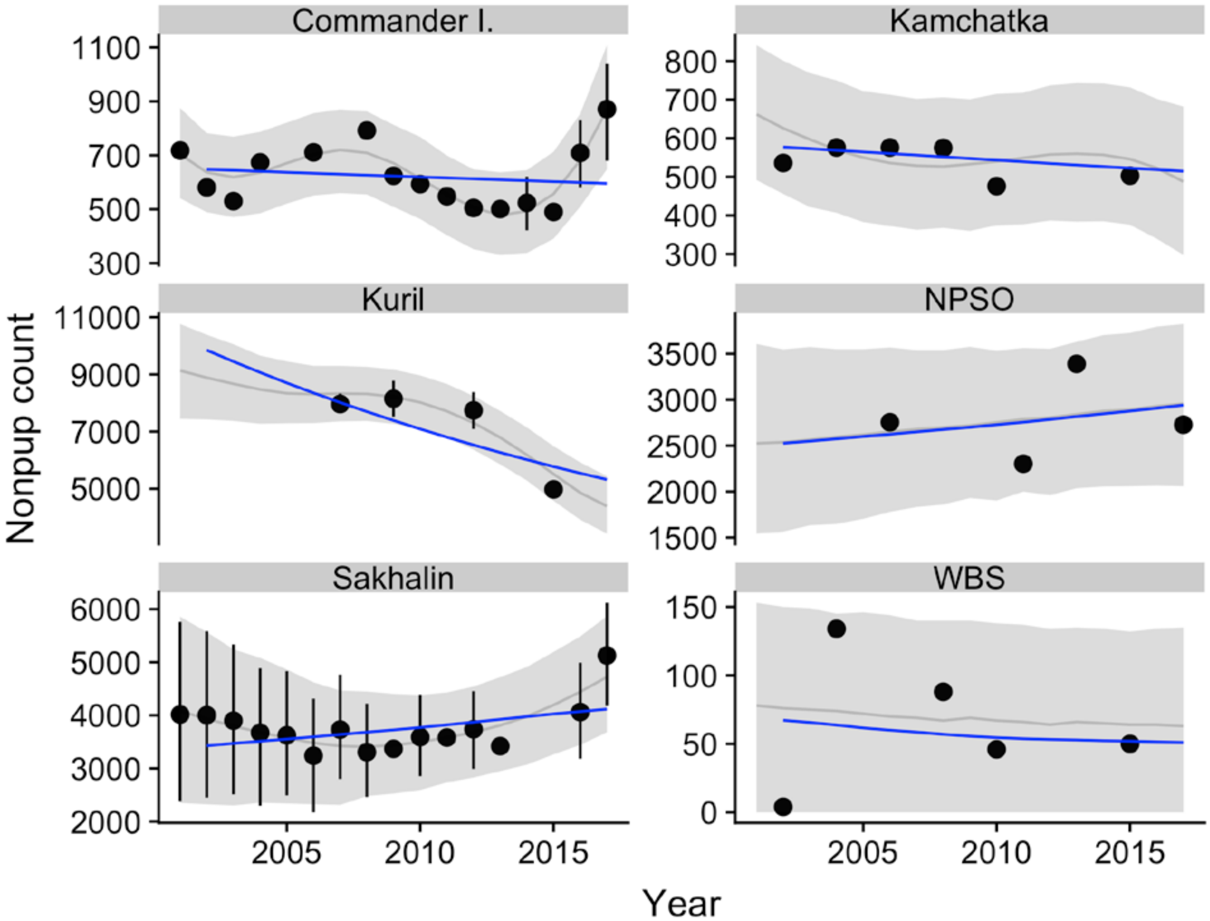


**Figure 5. Regional trend estimates for Russia/Asia Steller sea lions in the Commander, Kuril, Sakhalin Islands, Kamchatka, Northern part of the Sea of Okhotsk (NPSO), and the western Bering Sea (WBS). The black points represent the estimated count for each region and year; if a survey was made, it was used in the aggregation, otherwise an imputed value was used. The vertical black lines represent uncertainty in the realized counts due to missing sites in each year's survey effort. The gray ribbon represents the 95% credible interval for the process generating missing counts. The blue line represents the trend based on constant average growth. Figure reproduced with permission from Johnson (2018), which analyzed data from Burkanov (2018).**

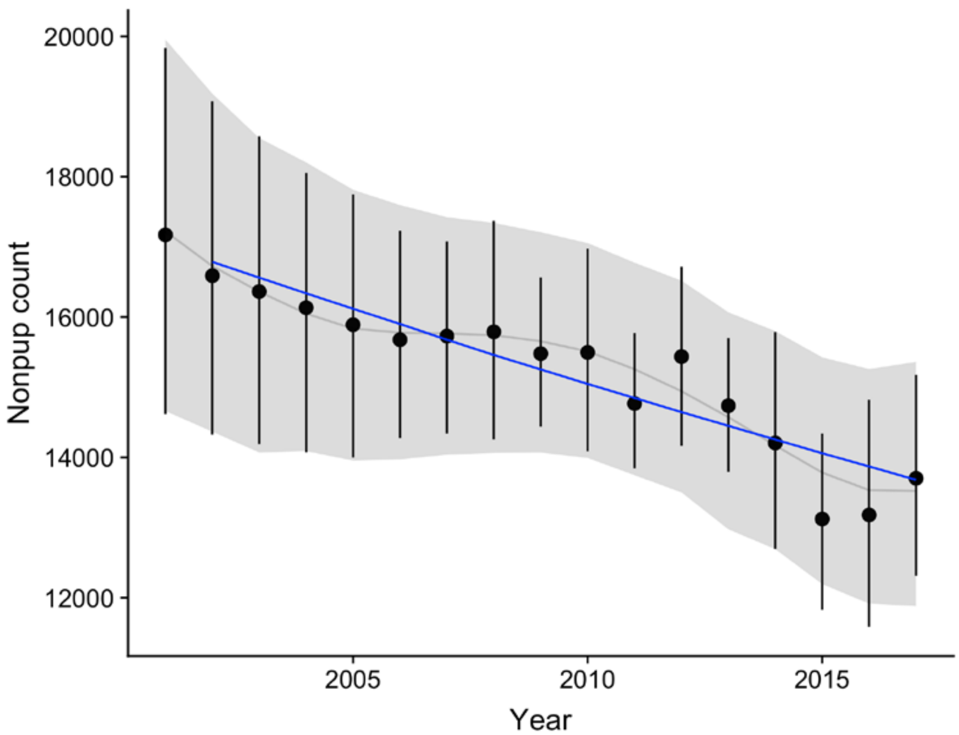


**Figure 6. Trend and aggregation estimates for the Russia/Asia stock of Steller sea lion. The black points represent the estimated count for each region of the Russia/Asia stock (see Figure 4) and year, i.e., if a survey was made, it was used for the aggregation; otherwise an imputed value was used. The vertical black lines represent uncertainty in the realized counts due to missing sites in each year's survey effort. The gray ribbon represents the 95% credible interval for the process generating missing counts. The blue line represents the trend based on constant average growth for the entire Russia/Asia stock as a whole. Figure reproduced with permission from Johnson (2018) which analyzed data from Burkanov (2018).**

#### 2.2.3.2 Listing Factor (Threats) Criteria

The threats criteria in the Recovery Plan for downlisting from endangered to threatened evaluate the ESA section 4(a)(1) factors as relevant to the WDPS (16 U.S.C. § 1533(a)(1)).

**Factor A: The present or threatened destruction, modification, or curtailment of a species' habitat or range.**

While there has been significant progress in assessing the habitat needs of the WDPS, there are still gaps in our understanding of foraging habitats used by Steller sea lions. It is especially important to determine the foraging habitat used by females in different subregions during the non-breeding season, the potential impacts of large scale fisheries on the temporal and spatial patterns of abundance and nutritional value of their prey (including impacts on ecosystem function that affect their prey), and potential impacts of other factors that could affect Steller sea lion habitat.

A distinct change in the ocean circulation of the GOA after the 1976-77 climate shift caused strong changes in the mean velocity of the Alaskan Stream and in its associated mesoscale eddy field while the Alaska Current and the eddy flows in the eastern Gulf remain relatively unchanged (Miller et al. 2005, Trites et al. 2007). Since mesoscale eddies provide a possible mechanism for transporting nutrient- rich open-ocean waters to the productive shelf region, the flow of energy through the food web may have been altered by this physical oceanographic change and may potentially help to explain changes in forage fish quality in diet diversity of Steller sea lions (Miller et al. 2005, Trites et al. 2007).

**A1. Knowledge of the foraging ecology of Steller sea lions and the impacts of fisheries on sea lion prey is sufficient to determine whether fisheries are likely to limit recovery**.

***This criterion for downlisting has been partially met.***

NMFS has made considerable progress in understanding the foraging ecology and prey of Steller sea lions that will assist in understanding the impacts of fisheries on Steller sea lion prey and whether fisheries are likely to limit recovery. However, due to the inherent complexity of the marine systems in which the species exists and the myriad of factors that can impact Steller sea lion foraging needs and behaviors, as well as the many factors that can impact the spatial and temporal patterns of Steller sea lion prey species (e.g., recent warm water events caused redistribution of certain fish species northward), knowledge of foraging ecology and the impact of fisheries on sea lion prey still is not sufficient to determine conclusively whether fisheries are likely to limit recovery.

At-sea behavior of Steller sea lions varies greatly within and among individuals and is influenced by age, gender, time-of-day, weaning status (for juveniles), region, season, and lunar phase (e.g., (Merrick and Loughlin 1997, Raum-Suryan et al. 2004, Fadely et al. 2005, Pitcher et al. 2005, Rehberg and Burns 2008, Thomton et al. 2008, Lander et al. 2010, Lander et al. 2011) as well as the distribution and abundance (including the aggregation and predictability) of primary prey (e.g., Sigler et al. 2004, Logerwell and Schaufler 2005, Womble et al. 2005, Womble and Sigler 2006, Sigler et al. 2009, Womble et al. 2009, Lander et al. 2013b, Sigler et al. 2017). The amount of prey consumed and required by a Steller sea lion to maintain health and reproduce varies depending on sex, age, season, reproductive status, nutritional stress, and digestive efficiency (Rosen and Trites 1999, 2000, Winship and Trites 2003, Rosen 2009). Diet varies regionally and seasonally (Sinclair and Zeppelin 2002, Sinclair et al. 2013), and as a result of dive ability, sex, and age (Raum-Suryan et al. 2004, Fadely et al. 2005, Rehberg and Burns 2008, Goundie et al. 2015). Steller sea lions generally target fish and cephalopod species, including those that are densely schooled in spawning or migratory aggregations on the continental shelf or along oceanographic boundary zones (Sinclair and Zeppelin 2002, Sinclair et al. 2013).

Steller sea lion diet has been largely described using occurrence methods (Sinclair and Zeppelin 2002, McKenzie and Wynne 2008, Sinclair et al. 2013), a technique considered most useful for geographic and temporal comparisons. Using a mixed assemblage of hard and cartilaginous structures from prey including skeletal bones, otoliths, and beaks found in scat samples, Sinclair et al. (2013) found coincident patterns in the relationship between WDPS Steller sea lion diet, regional population patterns, climate, and fisheries. In a comparison of diet between 1990-1998 and 1999-2009, Sinclair et al. (2013) reported that primary prey species (≥ 5% frequency of occurrence; FO) were analogous; however 7 of 13 increased in overall FO while two of the 13 decreased in specific regions. Sinclair et al. (2013) found that the areas having greatest increases in the FO and diversity of prey beginning in 1999 overlapped with the areas having strongest WDPS population growth during that time. These changes coincided with increased restrictions on groundfish trawling within Steller sea lion Critical Habitat. The area of lowest prey diversity overlapped with those areas having continuing population declines, the most restricted foraging habitat (narrow continental shelf), and the lowest seasonal and temporal variability in sea surface temperature in all years of study.

The use of morphological hard parts identification alone can fail to detect or underestimate important prey contributions to the diet. Instead, employing multiple techniques to identify prey limits the potential bias inherent in any single technique (Sinclair and Zeppelin 2002, Tollit et al. 2009, Sinclair et al. 2013). Independent scientific reviews of Steller sea lion diet studies in Alaskan waters have recommended increased utilization of biomass reconstruction techniques (Bowen 2000). These techniques include 1) the use of multiple diagnostic prey structures such as prey soft parts rather than limiting analysis to fish otoliths and cephalopod beaks (Olesiuk et al. 1990, Cottrell and Trites 2002), 2) the application of numerical correction factors to account for interspecific differences in the proportion of prey remains surviving digestion (Tollit et al. 2003, Grellier and Hammond 2006, Tollit et al. 2007, Phillips and Harvey 2009, Tollit et al. 2015), and 3) the application of digestion correction factors to account for size reduction of hard remains due to acidic erosion (Tollit et al. 1997, Phillips and Harvey 2009, Tollit et al. 2015). DNA analysis also can improve species level resolution for important prey taxa and improve prey species detection (Tollit et al. 2009, Tollit et al. 2017).

Considerable progress in mass-target DNA prey detection systems and DNA-based diet quantification techniques has been made and these likely represent the future direction of diet assessments for pinnipeds (Tollit et al. 2017). Using multiple techniques of prey hard part identification and DNA analysis from scats collected in 2008 and 2012, Tollit et al. (2017) found no evidence that hard part identification missed any major dietary components. Tollit et al. (2017) found hard parts and DNA identified an identical suite of the top 10 most prevalent species types, but ranking varied significantly and three prey types were underestimated using hard parts alone. Retention or regurgitation of large cephalopod beaks, the removal of large Pacific cod (*Gadus macrocephalus*) heads, and skeletal fragility of smooth lumpsuckers (*Aptocyclus ventricosus*) may explain these differences (Tollit et al. 2017). Atka mackerel (*Pleurogrammus monopterygius*) was the top-ranked nonbreeding season prey in the western and central Aleutians (Rookery Cluster Areas, RCAs 1–5; Figure 1) based on both hard parts occurrence alone (20%) and DNA composite (using DNA and prey hard part identification) methods (18%). Pacific cod, smooth lumpsucker, and rockfish spp. (*Sebastes spp.*) all contributed >10% to the composite diet, with *Cephalopod* spp., walleye pollock (*Gadus chalcogramma*), and Irish lord (*Hemilepidotus spp.*) contributing >5%. The importance of cephalopods and to a lesser degree Pacific cod and smooth lumpsucker were underestimated. For example, across the nonbreeding season, *Cephalopod* spp. was ranked tenth based on hard parts (2% split-sample frequency of occurrence), ranked third by DNA (14%), and ranked fifth in the resulting composite diet estimate. This >3-fold increase reflected the large proportion of unique cephalopod DNA-based identifications found. Pacific cod was ranked sixth by hard parts (8%), second by DNA (22%), and second in the composite diet (13%). Smooth lumpsucker was ranked third by hard parts (9%), was the top ranked by DNA (24%), and also ranked third in the composite diet. Atka mackerel and rockfish spp. were ranked first and second by hard parts, fourth and fifth by DNA, and first and fourth by composite methods, respectively (Tollit et al. 2017).

A recent inter-decadal study of Steller sea lion diets off Hokkaido Island, Japan compared the contents of 408 stomachs during the period 1994-1998 and 2005-2012. The most important prey species in the 1990s were walleye pollock, Pacific cod, and saffron cod (*Eleginus gracillis*) (Goto et al. 2017). Although the FO and gravimetric contribution of gadids decreased in the late 2000s in some areas and were replaced by Okhotsk Atka mackerel (*Pluerogrammus azonus*) and smooth lumpsucker, the dietary diversity of prey showed only a slight inter-decadal difference (Goto et al. 2017). Steller sea lion prey off Hokkaido were diverse and the dominant prey species differed in different areas. Steller sea lions appeared to switch between main prey species depending on availability but the Steller sea lions collected in the northern region of the Sea of Japan were younger than those collected in the central region, which may help explain the observed regional differences in diet (Goto et al. 2017).

Current understanding of Steller sea lion diet based on the combined findings of Sinclair et al. (2013) and Tollit et al. (2017) is that Atka mackerel, Pacific cod, and cephalopods (primarily giant Pacific octopus *Enteroctopus dofleini*) dominated the nonbreeding season diet of Steller sea lions in the Aleutian Islands in the 2000s with smooth lumpsucker and Irish lord of secondary importance. Rockfish, salmon (*Salmonidae spp*.), greenling (*greenling spp*.), sculpin, and walleye pollock contributed lesser amounts. Overall, this diverse nonbreeding season diet also reflects spatial variability, with smooth lumpsucker being a primary prey in the western and central-western Aleutians (RCAs 1-3), Pacific cod dominating in the central Aleutians (RCA 4), and Atka mackerel being very dominant in the east-central Aleutians (RCA 5) west of Samalga Pass (Sinclair et al. 2005) (Figure 1). Compared with the 1990s, the same range of species comprise the diet of Steller sea lions, but diversity of prey species was higher in the 2000s, with less Atka mackerel and salmon and larger contributions from Pacific cod, smooth lumpsucker, Irish lord, rockfish, and potentially (assuming size estimates are reasonable) giant Pacific octopus (Sinclair and Zeppelin 2002, Tollit et al. 2017).

Additional support for geographic variation in the diet of Steller sea lions was determined from stable carbon and nitrogen isotope values of vibrissae from Steller sea lion pups as an indirect indicator of maternal diets during gestation (Scherer et al. 2015). From 1998 to 2011, vibrissae were collected from 266 pups throughout the Alaska portion of the species’ range. Growth of sea lion vibrissae occurs at the root, which means that the area nearest the tip represents the oldest growth (Hirons et al. 2001). Each pup vibrissa, therefore, contains a record of diet from early growth in utero (near the tip; a reflection of the maternal female’s diet during the pup’s gestation) through nursing, and potentially independent feeding by the pup (near the root) (Scherer et al. 2015). As reported with scat-based analyses (Merrick and Loughlin 1997, Sinclair and Zeppelin 2002), Scherer et al. (2015) found that females in the western and central Aleutians relied heavily on Atka mackerel and squid, whereas females inhabiting the Gulf of Alaska region had a fairly mixed diet, and females in Southeast Alaska indicated a diet comprised primarily of forage fish.

Many studies aimed at understanding the impacts of fisheries on Steller sea lion recovery do not have the statistical power[4] to detect effects of fisheries, even when the effect is there (Conn et al. 2014). McDermott et al. (2016) indicated that trawl exclusion zones can be effective for preserving prey fields of Atka mackerel for Steller sea lions, but each study area must be carefully evaluated to understand area-specific variations in abundance and movement patterns of Atka mackerel. Conn et al. (2014) suggested that experimental manipulation of fishing effort might be necessary to directly assess prey removal effects on Steller sea lion vital rates.

**A2. Federal and state fishery management measures, or their equivalent, especially for pollock, Pacific cod, and Atka mackerel fisheries, are maintained in order to allow for the recovery of Steller sea lions. Modification of the conservation measures is based on the foraging requirements of Steller sea lions.**

***This listing factor recovery criterion for downlisting has been met.***

The Steller sea lion Recovery Plan (NMFS 2008) ranked competition with fisheries for prey as a potentially high threat to the recovery of the WDPS. Substantial scientific debate continues to surround the impact of potential competition between fisheries and Steller sea lions (NMFS 2010, 2014a). Commercial fisheries target several important Steller sea lion prey species (NRC 2003) including salmon species, Pacific cod, Atka mackerel, walleye pollock, and others. These fisheries could be reducing sea lion prey biomass and quality at regional and/or local spatial and temporal scales such that sea lion survival and reproduction are reduced. NMFS has completed ESA Biological Opinions to assess the effects of commercial fisheries on WDPS Steller sea lions, most recently in 2010 and 2014. NMFS (2010) found that jeopardy and adverse modification of critical habitat were likely, and subsequently the pollock and mackerel fisheries were altered in the Aleutian Islands. NMFS (2014a) subsequently reviewed a modified set of management measures for the Bering Sea and Aleutian Islands proposed by the North Pacific Fishery Management Council and concluded that those measures were not likely to jeopardize the continued existence of the WDPS. NMFS (2014a) discussed a Risk Analysis, which evaluated whether the proposed groundfish fisheries were likely to result in local depletions of prey temporally and spatially important to WDPS Steller sea lions, with an emphasis on adult females in winter and spring. The available data indicated that if nutritional stress was acting on the WDPS it was likely due to localized limitation of important prey resources, low-diet diversity, or a combination of the two. The evidence also indicated that the mechanism would be chronic nutritional stress where reduced food resources result in increased maternal investment into juveniles at the expense of high reproduction (i.e., forgoing annual pupping in favor of continuing to support the previous year's pup for a second year). However, there are extensive gaps in the available information that prevent understanding the causal relationships affecting Steller sea lions in the western and central Aleutian Islands. Therefore, a cautionary approach to fishing for prey species in Steller sea lion critical habitat is warranted, especially in winter when the least information is available about groundfish biomass. NMFS also recommended that catch

[4] Statistical power is the likelihood that a study will detect an effect when an effect is present. If statistical power is high, the probability of concluding there is no effect when, in fact, there is one, goes down. Statistical power is affected chiefly by the size of the effect and the size of the sample used to detect it. Larger effects are easier to detect than smaller effects, while large sample sizes offer greater test sensitivity than small sample sizes.

be dispersed in time and space to prevent localized depletion, at least until there are better local biomass and exploitation rate estimates.

NMFS (2014a) recommended: 1) dispersing the commercial Atka mackerel, Pacific cod, and walleye pollock catch temporally and spatially and limiting harvest inside critical habitat in winter until there is a better understanding of WDPS Steller sea lion foraging distribution and local biomass and exploitation rates; 2) assessing nutritional stress in the WDPS; 3) continuing to conduct NMFS Fishery Interaction Team (FIT) research to understand areas of high potential for localized depletion of Steller sea lion prey by fisheries; 4) collecting pollock, Pacific cod, and Atka mackerel biomass information inside and outside of critical habitat and in winter in addition to summer; and 5) to the extent possible, standardizing telemetry methods and establishing clear objectives for WDPS Steller sea lion telemetry work. Any substantive modification to fishery management measures that causes an effect not considered in a previous section 7 consultation would be subject to further consultation under section 7 of the ESA, including consideration of Steller sea lion foraging requirements. Nevertheless, the extent to which fisheries may compete with sea lions for prey and may hinder recovery remains controversial and closer evaluation of this recovery criterion would be appropriate if and when NMFS considers downlisting the WDPS.

**A3. State of Alaska fishery management is reviewed, and those state fisheries that adversely affect Steller sea lions or their critical habitat should be authorized under the MMPA and ESA; habitat conservation plan under section 10 of the ESA or through section 7 consultations.**

***This listing factor recovery criterion for downlisting has not been fully met.***

NMFS has not comprehensively evaluated State of Alaska (State) fishery management west of 144° W. longitude. State fisheries that could adversely impact WDPS Steller sea lions or their critical habitat have not been authorized under the ESA and no habitat conservation plans (HCPs) have been developed for state fisheries. For most federal groundfish fisheries, the Alaska Department of Fish and Game (ADF&G) issues emergency orders for state waters that duplicate NMFS management actions, although gear or other restrictions may vary. These emergency orders establish parallel fishing seasons (termed “parallel fisheries”) allowing vessels to fish for groundfish (primarily Pacific cod, walleye pollock, and Atka mackerel) in state waters within the same seasons as the federal fisheries. In other instances, the State establishes state-managed fisheries with separate guideline harvest levels (GHLs), and fishing seasons under state groundfish regulations (Kruse 2000). Where there is a federal and parallel State fishery for a species, the State fishery usually opens after the parallel federal fishery closes. NMFS evaluates federal actions that include state parallel fisheries, and only considers other state fisheries via cumulative effects.

While there is uncertainty and controversy regarding the joint impacts of such federal and State groundfish fisheries in Alaska, NMFS reviews the potential impacts of parallel State fisheries in Biological Opinions on the federal fisheries, and some of the same (but not necessary all) federal restrictions are placed on State fisheries. State fisheries for Pacific cod, pollock, rockfish, and other species occur within 3 nm of some WDPS Steller sea lion rookeries and major haulouts, including near certain rookeries that currently are not covered by the protective regulations specified in 50 CFR 224.103(d). Given the importance of nearshore habitats to WDPS Steller sea lions (Sinclair et al. 2013) and the nearshore State fisheries, this potential competition may have consequential effects for Steller sea lions. Specifically, these potential interactions may contribute to nutritional stress for Steller sea lions, and may reduce the value of the marine portions of Steller sea lion critical habitat. State managed fisheries will likely continue to reduce the availability of prey within these marine foraging areas and may alter the distribution of certain prey resources in ways that reduce the foraging effectiveness of Steller sea lions.

Additional research about the foraging habits of Steller sea lions in key geographic areas could aid our understanding in determining where and when the effects of State fisheries on Steller sea lion foraging are most significant or pronounced (NMFS 2014a). If the State of Alaska obtained authorization for take under section 10 of the ESA, the evaluation required for the section 10 permit/HCP would enable NMFS to determine the magnitude of interactions with state-managed fisheries and the feasibility of reducing those interactions to support recovery.

**A4. The designation of sea lion critical habitat is adequate to allow for recovery.**

***This criterion for downlisting has not been fully met.***

In the final rule to delist the EDPS (78 FR 66140, November 4, 2013), NMFS indicated that it would undertake a separate rulemaking to consider amendment to the existing critical habitat designation to take into account any new and pertinent sources of information since the 1993 designation, including amending the critical habitat designation as appropriate to reflect the delisting of the EDPS. NMFS convened a WDPS Critical Habitat Review Team (CHRT) to identify, consider, and synthesize the best available scientific information and to delineate areas that contain one or more physical or biological features essential to the conservation of the WDPS that may require special management considerations or protection. This CHRT produced a draft Biological Report that has not been finalized.

The CHRT considered recent Steller sea lion studies, including telemetry (Fadely et al. 2005, Lander et al. 2009, Lander et al. 2011, Fadely and Lander 2012, Lander et al. 2013a) and platform of opportunity (POP) data to generate a habitat-use model (Himes Boor and Small 2012) and habitat suitability model (Gregr and Trites 2008) for the WDPS. According to Gregr and Trites (2008), the current critical habitat designation does not identify some habitats that are likely to contain physical or biological features essential to the conservation of WDPS Steller sea lions (e.g., support health, reproduction, foraging, nutritional and energetic needs, growth and development, rest, refuge, molting, social system) and includes some habitat areas that do not. Gregr and Trites (2008) concluded that although the original conceptual model of Steller sea lion habitat was likely the best possible representation of critical habitat when it was designated in 1993, the intervening years have yielded a wealth of new knowledge to develop a more quantitative definition of critical habitat. Using deductive habitat models, Gregr and Trites (2008) quantitatively incorporated hypotheses about sea lion foraging and information about the potential processes (foraging behavior, terrestrial resting sites, bathymetry, seasonal ocean climate, etc.) that are responsible for suitable habitat. Moreover, based on their analysis of POP sighting data, Himes Boor and Small (2012) concluded that the range-wide generalizations about Steller sea lion use patterns with respect to water depth and distance to shore are not appropriate. They further state that results based on their Bayesian model that quantified Steller sea lion encounter rates can be used to gauge the suitability of current critical habitat designations and inform future critical habitat modifications.

**Factor B: Overutilization for commercial, recreational, or educational purposes.**

**B.1. Incidental takes are limited in commercial and recreational fisheries such that the effect of the take does not appreciably increase the time to recovery**.

***NMFS has inadequate information to fully evaluate the extent to which this listing factor recovery criterion has, or has not, been met.***

Although the Steller sea lion Recovery Plan (NMFS 2008) ranked interactions with fishing gear and marine debris as a low threat to the recovery of the WDPS, it is likely that many entangled sea lions may be unable to swim to shore once entangled, may die at sea, and may not be counted (Loughlin 1986, Raum-Suryan et al. 2009).

The best available information about known levels of incidental take in fisheries in the U.S. is updated annually in the marine mammal stock assessment for the WDPS Steller sea lion (Muto et al. 2019). Detailed information for each human-caused mortality, serious injury (any injury that will likely result in mortality (50 CFR 229.2)), and non-serious injury reported for NMFS-managed Alaska marine mammals in 2011-2015 is listed, by marine mammal stock, in Helker et al. (2017); however, only the mortality and serious injury data are included in the Stock Assessment Reports (Muto et al. 2019). The total estimated annual level of human-caused mortality and serious injury for Western U.S. Steller sea lions in 2011-2016 is 247 sea lions: 35 in U.S. commercial fisheries, 1.2 in unknown (commercial, recreational, or subsistence) fisheries, 2 in marine debris, 5.5 due to other causes (arrow strike, entangled in hatchery net, illegal shooting, Marine Mammal Protection Act (MMPA) authorized research-related), and 203 in the Alaska Native subsistence harvest (Muto et al. 2019). Observers have not been assigned to several fisheries that are known to interact with the WDPS Steller sea lion, and estimates of entanglement in fishing gear and marine debris based solely on stranding reports in areas west of 144°W longitude may underestimate the entanglement of WDPS animals in parts of Southeast Alaska (Muto et al. 2019). From 2011-2016, mortality and serious injury of WDPS Steller sea lions were observed in 10 of the 22 federally-regulated commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands Pacific cod longline, GOA Pacific cod trawl, GOA Pacific cod longline, GOA sablefish longline, GOA flatfish trawl, GOA rockfish trawl, and GOA pollock trawl fisheries, resulting in a mean annual mortality and serious injury rate of 16 sea lions (Breiwick 2013). The minimum average annual mortality and serious injury rate for all fisheries is 36 WDPS Steller sea lions, based on observer data and stranding data (35 sea lions) for U.S. commercial fisheries and stranding data (1.2 sea lions) for unknown (commercial, recreational, or subsistence) U.S. fisheries (Muto et al. 2019).

Steller sea lions that interact or become entangled in fishing gear may be injured (NMFS 2019) or die (Helker et al. 2017). From 2012 to 2016, there were four reports of Steller sea lions in poor body condition with flasher lures (troll gear) hanging from their mouths and, in each case, the animal was believed to have ingested the hook. Two additional animals were entangled in unidentified fishing gear. Additionally, since Steller sea lions from the WDPS occur regularly in parts of northern Southeast Alaska (Jemison et al. 2013, Jemison et al. 2018), and higher rates of entanglement of Steller sea lions have been observed in this area (Raum-Suryan et al. 2009), estimates based solely on stranding reports in areas west of 144°W longitude may underestimate the total entanglement of WDPS sea lions in fishery-related and other marine debris. Moreover, estimates of mortality and serious injury are derived from an actual count of verified human-caused deaths and serious injuries and should be considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or have the cause of death determined.

Hence, while NMFS has relatively good information upon which to estimate at least lethal interaction in certain federal fisheries, NMFS does not have recent data on which to accurately evaluate the level of interaction in State of Alaska fisheries. There is also inadequate information about take in Russian fisheries and Burkanov et al. (2017) suggested that there is reason for concern and further study into the impacts of commercial fisheries in Russian and Japanese waters is warranted. Between 2004-2013, Burkanov et al. (2017) found that approximately 41% of the total targeted catch was within 30 km of Steller sea lion terrestrial sites, and the percentage taken in such areas was tending to increase, raising the likelihood of interaction with Steller sea lions. Whether or not these fishing activities affected Steller sea lions is unclear, but there have been no commercial fisheries within 30 nm of the Commander Islands since the 1950s and the Steller sea lion population on the Commander Islands has been relatively stable and even increasing recently (Burkanov et al. 2017). This suggests that closure of commercial fisheries near Steller sea lion terrestrial sites, in areas in which they are likely to forage on primary prey, may facilitate recovery. Moreover, although any vessel owner, vessel operator, or fisherman (for non-vessel fisheries) working in a fishery identified in the annual MMPA List of Fisheries must report all incidental deaths or injuries of marine mammals during commercial fishing to NMFS (per 50 CFR 229.6) for such takes to be authorized under the MMPA, reporting often does not occur. For example, a Steller sea lion that ingests fishing gear or is released with fishing gear entangling, trailing, or perforating any part of its body is considered injured. However, there have been no reports by fishermen indicating these interactions occur even though several hundred Steller sea lions have been documented with ingested fishing gear from 2000-present (Raum-Suryan et al. 2009, ADF&G, unpublished data, Helker et al. 2017). NMFS recently hosted a Steller sea lion/Salmon Fisheries Interaction workshop in Southeast Alaska to discuss the impacts of these interactions to fishermen and sea lions. As a result, fishermen and agency personnel have formed a working group to find solutions to this issue. Building trust and relationships between NMFS and the fishing community is key to success.

**B2**. **The occurrence of illegal shooting of sea lions remains low through awareness of regulations and enforcement**.

***NMFS has inadequate information to fully evaluate the extent to which this listing factor recovery criterion has, or has not, been met.***

NMFS (2008) concluded that the threat to recovery from illegal shooting was likely low, but acknowledged a medium level of uncertainty about this conclusion.

The current level of illegal shooting of WDPS Steller sea lions is unknown. Pinnipeds with gunshot wounds reported to the NMFS Alaska Regional Marine Mammal Stranding Network were assumed to be struck and lost animals associated with the Alaska Native subsistence hunt and were not included in Helker et al. (2017) unless there was information which indicated the animals were unlawfully shot. NMFS has recently documented instances of the shooting of sea lions, including numerous sea lions killed in the Copper River Delta during commercial salmon fishing, resulting in two convictions to date for harassing and killing Steller sea lions with shotguns and obstructing the government's investigation into criminal activities (Wright 2016, DOJ 2018).

**B3. Methods are developed and utilized to minimize the impacts of the research program, and those impacts do not limit the time to recovery of the population**.

***This recovery criterion has been met.***

(NMFS 2009, 2014b) evaluated the potential effects of the Steller sea lion research program on Steller sea lions. NMFS (2009) developed a Policy and Guidance Document to promote consistent compliance for reviewing permit applications and reports, coordinating research, and monitoring the effects of and effectiveness of research. Any research on WDPS Steller sea lions requires compliance with the ESA and MMPA. NMFS processes permits and suspends permitted activities if a permit holder violates the ESA, MMPA, the permit, or the implementing regulations of either act. The guidance specifies a clearly articulated decision framework that NMFS uses in the application review process to promote conservation and recovery of the species. This document also specifies limitations to total estimated research-related mortality that will be permitted. It specifies that requirements will be placed on permits related to monitoring the effects of research. There is a requirement for prompt notification and review in the case of serious injury or death of a Steller sea lion during research activities. To the extent possible, measures have been put in place to minimize the adverse impact of permitted research and to address inadvertent impacts.

There are substantial potential benefits to WDPS Steller sea lion conservation from implementing a research program that can fully accommodate all recovery actions in the 2008 Recovery Plan. There is risk to the population if research needed to guide recovery is not undertaken. NMFS has in place an improved framework for ensuring positive net benefit of research to the species and considerable discretion to impose additional conditions on permits if necessary to minimize impacts to Steller sea lions. The expected net result of WDPS research, if implemented consistent with the Policy and Guidance Document and the issuance criteria under the ESA and the MMPA, is positive (NMFS 2009).

**Factor C: Disease or predation.**

**C.1. Methods have been developed and utilized to test sea lions for health related illness that may be limiting recovery and that information is adequate to conclude that disease is not limiting recovery.**

***This listing factor recovery criterion for downlisting has been partially met.***

The Steller sea lion Recovery Plan (NMFS 2008) ranked diseases and parasites as a low threat to the recovery of the WPDS. Steller sea lions are exposed to a variety of diseases and parasites and adult females and pups are likely the age-classes most vulnerable to disease and parasitism. Climate-change-related shifts in distribution of other species may expose WDPS Steller sea lions to novel disease vectors or parasites that could have large-scale impacts. Increasing temperatures in the Arctic and subarctic waters not only lead to an increased potential for harmful algal blooms that produce biotoxins such as domoic acid and Saxitoxin, but also increase *Brucella* infections in Steller sea lions, including fetuses (Lefebvre *et al.* 2016). Using blood samples collected from pups, Lander et al. (2013b) indicated pup condition in the WDPS was not compromised during the first month postpartum. However, studies to determine mercury concentrations in Steller sea lion pups in the western and central Aleutian Islands (Castellini et al. 2012, Rea et al. 2013, Rea and O'Hara 2018) found elevated mercury concentrations in some Steller sea lion pups and these concentrations have the potential to impact the central nervous system, immune system (Kennedy et al. 2019, Levin et al. *In Prep.*), endocrine system (Keogh et al. *In Prep.*), birth weights, and foraging success of lactating mothers (Crawford et al. 2017, Rea et al. *In Prep.*). Environmental contaminants may be a significant threat impeding recovery of Steller sea lions in parts of the WDPS (Rea and O'Hara 2018). Moreover, Steller sea lions rely on similar prey species and foraging areas as those targeted by commercial fisheries and subsistence users and are therefore valuable sentinels of marine ecosystem health (Castellini et al. 2012).

Environmental contaminants including organochlorine compounds (OCs) also have been hypothesized as a contributing factor to Steller sea lion population decline and slow recovery (Barron et al. 2003, Atkinson et al. 2008, NMFS 2008, Beckmen et al. 2016, Keogh et al. *In Prep.*). Keogh et al. (*In Prep.*) reported that the concentration of ∑PCBs (summation of PCBs) in Steller sea lion pups decreased from young (< 3 months old) to older pups (3 to 6 months old) followed by an increase in older age classes. They found that the concentration of ∑PCBs for a pup weighing 54 kg were highest in the Aleutian Islands followed by Southeast Alaska and lastly Gulf of Alaska pups. Moreover, the rate at which pups gained mass and lipids stores varied between the regions, and the faster mass and lipids were gained (e.g. Aleutian Islands) the greater the rate of dilution found in the concentration in ∑PCBs.

The widespread use of OCs has been associated with deleterious effects on the health of pinnipeds including reduced pup production, premature parturition, and altered immune function (DeLong et al. 1973, de Swart et al. 1996, Beckmen et al. 2003). Due to the complexity of the many factors that can affect WDPS Steller sea lions' vulnerability to disease and predation, there is still considerable uncertainty about impacts from both of these threat categories. Systematic monitoring for disease agents and their effects is needed to determine whether infectious diseases currently play a role in the decline and lack of recovery of Steller sea lions (Burek et al. 2005). Continued sampling of live and dead stranded WDPS Steller sea lions and increased sampling and reporting by Alaska Native co-management partners will benefit our understanding of the occurrence and effects of disease. It is unclear whether diseases are limiting recovery in certain areas, and therefore this factor has not yet been fully met.

**C.2. Knowledge of the impacts of killer whale predation on sea lions is sufficient to determine that predation is not limiting recovery.**

***This listing factor recovery criterion has not been met.***

The Steller sea lion Recovery Plan (NMFS 2008) ranked predation by killer whales (*Orcinus orca*) as a potentially high threat to the recovery of the WDPS. Studies have identified three divergent yet sympatric ecotypes of killer whales inhabiting northern North Pacific waters (Bigg 1982, Ford et al. 1998). The three ecotypes, commonly referred to as "residents," "offshores," and "transients" or "Bigg's", have different diets. Residents are fish-eating killer whales that in most areas specialize on salmon (Ford et al. 1998). Offshores are thought to primarily eat sharks or other high-trophic level fish (Krahn et al. 2007, Ford et al. 2011). Bigg's killer whales are known to primarily prey on marine mammals (Ford et al. 1998). Steller sea lions are preyed upon by Bigg's killer whales (Heise et al. 2003, Maniscalco et al. 2007, Dahlheim and White 2010, Horning and Mellish 2012). Studies of Bigg's killer whales have been conducted in the western GOA, Aleutian Islands, Prince William Sound, and Kenai Fjords (Heise et al. 2003, Maniscalco et al. 2007, Zerbini et al. 2007, Durban et al. 2010). Zerbini et al. (2007) found residents to be much more abundant than Bigg's in the western GOA and Aleutian Islands, but higher Bigg's killer whale densities were found south of the Alaska Peninsula. Durban et al. (2010) estimated 345 Bigg's between the central GOA and central Aleutian Islands and detected spatial population structure and seasonal movements away from near-shore (and near sea lion rookery) areas that suggest predation pressure likely varies spatially and temporally. Heise et al. (2003) summarized stomach contents of three Bigg's killer whales and found Steller sea lions represented 33% of the total individual prey found in all of the stomach contents. Based on other observations from GOA, Steller sea lions represented 5% (Matkin and Saulitis 1994, NMFS 2014b) of the remains found in a deceased killer whale stomach. Matkin (2012) estimated the abundance of Bigg's killer whales in the eastern GOA to be 18 whales.

The timing and spatial extent of prey switching among Bigg's killer whales has the potential to greatly impact Steller sea lions throughout Alaskan waters (Springer et al. 2003, Williams et al. 2004). Maniscalco et al. (2007) identified 19 Bigg's killer whales in Kenai Fjords from 2000 through 2005 and observed killer whale predation on six pup and three juvenile Steller sea lions. Moreover, Maniscalco et al. (2007) estimated that 11 percent of the Steller sea lion pups born at the Chiswell Island rookery (in the Kenai Fjords area) were preyed upon by killer whales from 2000 through 2005 and concluded that GOA Bigg's killer whales were having a minor impact on the recovery of the sea lions in the area. Maniscalco et al. (2008) further studied Steller sea lion pup mortality using remote video at Chiswell Island. Pup mortality up to 2.5 months postpartum averaged 15.4 percent, with percentages varying greatly across years (2001–2007). They noted that high surf conditions and killer whale predation accounted for over half the mortalities from 2001-2007. Maniscalco (2018) reported that during the period of Steller sea lion population expansion and increased survival (2005-2014) at the Chiswell Island rookery, there was little predatory killer whale activity around the rookery. However, killer whales have reestablished a significant presence around the rookery in more recent years (Figure 7) coinciding with a steadily decreasing pup abundance since the peak in 2015 (Maniscalco 2018).

Other studies in the Kenai Fjords/Prince William Sound region have also found evidence for high levels of juvenile Steller sea lion mortality, presumably from killer whales, but possibly also from salmon sharks (*Lamma ditropis*), or Pacific sleeper sharks (*Somniosus pacificus*) (Horning and Mellish 2012). Based on data collected post-mortem from juvenile Steller sea lions implanted with life history tags, 12 of 36 juvenile Steller sea lions were confirmed dead from November 2005 through November 2012, at least 11 of which were killed by predators (Horning and Mellish 2012). Horning and Mellish (2012) estimated that over half of juvenile Steller sea lions in this region are consumed by predators before age 4 yr. They suggested that low juvenile survival due to predation, rather than low natality, may be the primary impediment to increasing the WDPS of Steller sea lions in the eastern Gulf of Alaska region, however the study had a very low sample size and more research is needed to further study the impacts of predation on Steller sea lions in the WDPS. Killer whales occur in significant numbers and are known to prey on

Steller sea lions in Southeast Alaska (Dahlheim and White 2010) so it is unclear how predation pressure in the WDPS differs from the EDPS.

Fritz et al. (2014) found that natality of the WDPS Steller sea lion population east of Samalga Pass (~ 170° W) may not have been significantly different from rates estimate for the 1970s prior to the decline in WDPS abundance. Fritz et al. (2014) also stated that the slower rate of decline and stabilization of this area was due to increasing juvenile survival, indicating possible reduced predation in this area. Inadequate data exist to assess the threat of killer whale predation to the recovery of sea lions in the central and western Aleutian Islands (NMFS 2014b). Therefore, our current knowledge about the impacts of killer whale predation on sea lions is insufficient to determine that predation is not limiting recovery. Increasing the sample size of juvenile Steller sea lions implanted with life history tags and responses by the Alaska Marine Mammal Stranding Network to live and dead stranded WDPS Steller sea lions will benefit our understanding of the effects of predation.

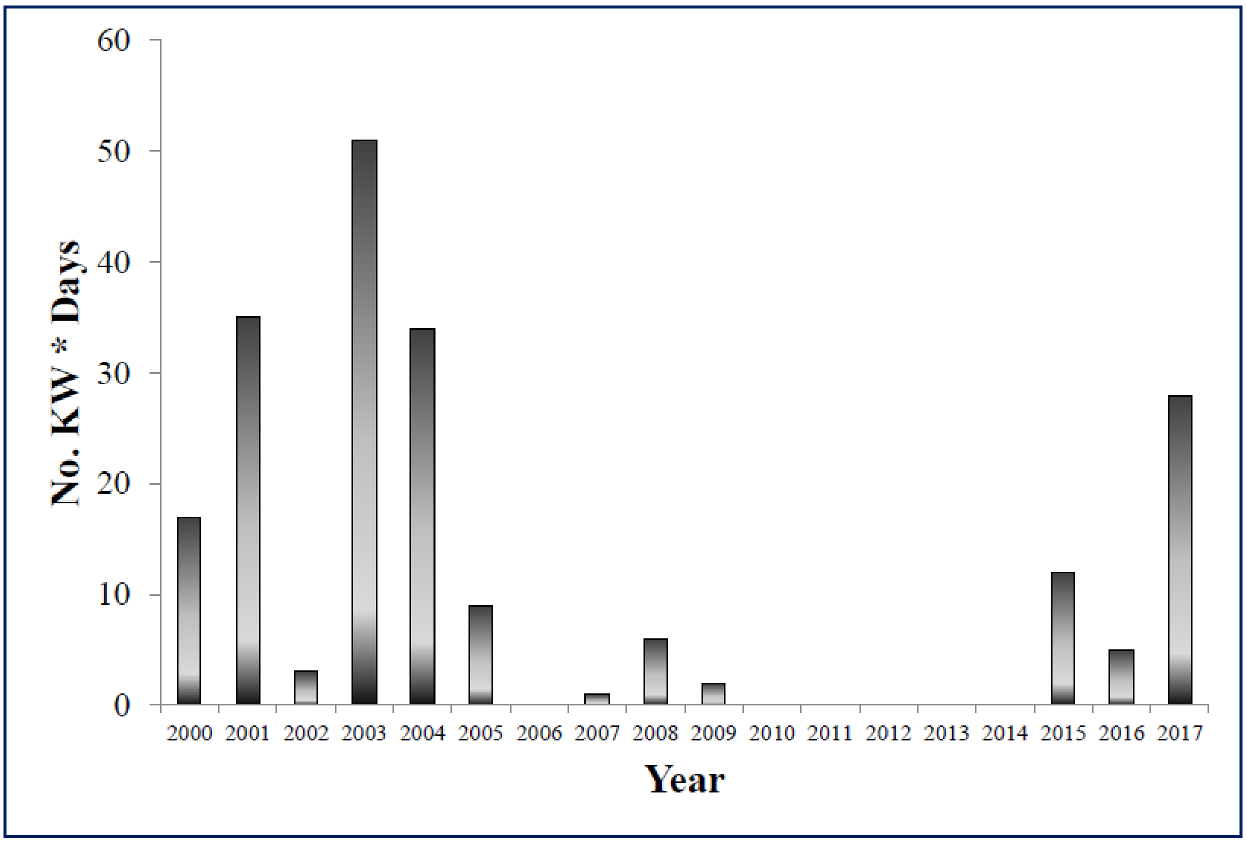


**Figure 7. Presence of transient killer whales (number of killer whales [KW] * days present) at the Chiswell Island Steller sea lion rookery between 2000 and 2017. Predatory activity against Steller sea lions was observed in most cases (Maniscalco 2018).**

**Factor D: The inadequacy of existing regulatory mechanisms.**

**D.1. Continue to implement fisheries regulations in 50 CFR part 679, following threats criterion A.1.**

***This criterion for downlisting has been met.***

NMFS continues to implement, and has recently reviewed, fisheries regulations relevant to potential effects on the WDPS and its critical habitat (NMFS 2010, 2014a). NMFS regulations implement Steller sea lion protection measures to ensure that groundfish fisheries in the Bering Sea and Aleutian Islands Management Area off Alaska are not likely to jeopardize the continued existence of WDPS Steller sea lions or destroy or adversely modify their designated critical habitat (NMFS 2014a). These management measures disperse fishing effort temporally and spatially to provide protection from potential competition for important Steller sea lion prey species. The management measures in NMFS regulations are intended to protect the endangered Steller sea lions, as required by the ESA, and to minimize, to the extent practicable, the economic impact of fishery management measures, as required by the Magnuson-Stevens Fishery Conservation and Management Act.

**D.2. Update critical habitat by correcting erroneous locations for major rookery and haulout sites listed in 50 CFR parts 223 and 226.**

***This listing factor recovery criterion for downlisting has not been met.***

As noted above, NMFS initiated but has not completed a review of critical habitat. NMFS has taken several steps necessary for greater accuracy of locations of haulout and rookery sites used by WDPS Steller sea lions. Lewis et al. (*In Prep.*) updated the old LORAN-based coordinates for 48 rookeries and 139 major haulouts used by WDPS Steller sea lions in Alaska based on detailed satellite imagery and satellite-based Global Positioning System (GPS) coordinates. Information provided by Lewis et al. (*In Prep.*) represents the first step needed to update geolocations of WDPS Steller sea lion terrestrial sites specified in current regulations at 50 CFR parts 224 and 226.

**D.3. Pursue international agreements and develop cooperative recovery programs with Russia and Japan.**

***This listing factor recovery criterion for downlisting has not been met.***

NMFS has not pursued formal international agreements with Russia or Japan for WDPS Steller sea lions. However, the U.S. and Russia have shared scientific information on Steller sea lions at annual Russia-U.S. Intergovernmental Consultative Committee (ICC) meetings. The U.S. and Russia have formed a U.S.-Russia Marine Mammal Working Group (https://www.fws.gov/international/wildlife-without-borders/russia/us-russia-marine-mammal-working-group.html) and the NMFS Marine Mammal Laboratory is a cooperator. The focus of the group has been on collaborative research, rather than management. The U.S. and Russia also have shared scientific information in focused Holarctic Marine Mammal Conferences.

NMFS has worked closely with and funded scientists conducting research aimed at assessing the status of, and threats to, Steller sea lions in Russia. This collaborative approach has provided substantive new information on Steller sea lions in Russia, including factors that may impact recovery of the WDPS (Permyakov and Burkanov 2009, Artukhin et al. 2010, Waite et al. 2012, Burkanov et al. 2017), vital rates (Burdin et al. 2009, Altukhov et al. 2012, Permyakov et al.

2014, Altukhov et al. 2015), and trends in pup and non-pup distribution and abundance in the Commander Islands, the Kamchatka Peninsula, the Sea of Okhotsk, and the Kuril Islands (e.g., (Burkanov et al. 2011, Burkanov 2018). To fulfill this criterion, NMFS should work toward implementation of formal international management cooperative agreements with both Russia and Japan for the conservation and recovery of WDPS Steller sea lions.

**Factor E: Other natural or anthropogenic factors affecting the species continued existence.**

**E1. Co-management agreements are in place with Alaska Native Organizations (ANOs) and a working relationship between the ANOs and NMFS results in an accurate accounting of the subsistence harvest, and the harvest levels do not likely limit sea lion recovery.**

***This recovery criterion has been partially met.***

NMFS has co-management agreements in place with three ANOs that represent one or more tribes that include Steller sea lion subsistence hunters: the Aleut Marine Mammal Commission; the Aleut Community of St. Paul Island, Tribal Government; and the Traditional Council of St. George Island, Tribal Government. NMFS also works collaboratively with two other ANOs that undertake activities to foster the conservation of Steller sea lions and the long-term availability of the species for use by subsistence hunters: The Alaska Sea Otter and Steller Sea Lion Commission and the Bristol Bay Marine Mammal Council. Activities undertaken by ANOs include outreach, facilitating cross-cultural communication of traditional knowledge and western science, monitoring of harvests and biosampling, harvest retrospective surveys (see next paragraph), habitat use monitoring, brand resights (identification of previously branded Steller sea lions), hunter knowledge sharing, etc.

Information on the subsistence harvest of Steller sea lions comes via three sources: ADF&G, the Ecosystem Conservation Office of the Aleut Community of St. Paul Island, and the Kayumixtax Eco-Office of the Aleut Community of St. George Island. The ADF&G conducted systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska (Wolfe et al. 2005, 2006, Wolfe et al. 2008, 2009a, 2009b). The interviews were conducted once per year in the winter (January to March) and covered hunter activities for the previous calendar year. As of 2009, annual statewide data on community subsistence harvests are no longer being consistently collected. Data are being collected periodically in subareas. Data were collected on the Alaska Native harvest of WDPS Steller sea lions for seven communities on Kodiak Island in 2011 and 15 communities in Southcentral Alaska in 2014. The Alaska Native Harbor Seal Commission (ANHSC) and ADF&G estimated a total of 20 adult sea lions were harvested on Kodiak Island in 2011, with a 95% confidence range between 15 and 28 animals (Wolfe et al. 2012), and 7.9 sea lions (CI = 6-15.3) were harvested in Southcentral Alaska in 2014, with adults comprising 84% of the harvest (ANHSC 2015). These estimates do not represent a comprehensive statewide estimate; therefore, the best available statewide subsistence harvest estimates for a 5-year period are those from 2004 to 2008. Harvest data are collected in near real-time on St. Paul Island (Lestenkof 2012) and St. George Island (Kashevarof 2015) and recorded within 36 hours of the harvest. The mean annual subsistence take from this stock for all areas except St. Paul and St. George in 2004-2008 (172) combined with the mean annual take for St. Paul (30) and St. George (1.4) in 2012-2016 is 203 western Steller sea lions (Muto et al. 2019).

Even in the absence of more recent and comprehensive harvest monitoring, based on our understanding of subsistence hunting, NMFS is reasonably confident that subsistence harvest levels are not currently limiting recovery of the WDPS Steller sea lion. However, as discussed in the previous paragraph, NMFS lacks a full accounting of the subsistence harvest and therefore this recovery criterion has not been fully met.

**E2. Sources of potential pollution, including offshore oil and gas development, are known and they are not likely to pose significant health risks to the sea lion population.**

***This recovery criterion has been partially met.***

The sources of potential pollution that pose a risk to the WDPS are not fully known. Marine pollution including oil spills could impact food web dynamics by removing top predators from the ecosystem, influencing food web dynamics, and harming wildlife and ecosystem functions (NMFS 2014b). NMFS is aware of the locations of current offshore oil and gas activity that pose potential risks to WDPS Steller sea lions. At present, the only active offshore oil and gas development that poses a risk to the WDPS is in Cook Inlet. A large oil spill in lower Cook Inlet would likely contaminate Steller sea lion foraging areas and terrestrial habitats including areas of designated critical habitat. As with federal oil and gas activity, future foreseeable pollution risk from state-regulated oil and gas activity is highest in sea lion habitat within and “downstream” (from an oil spill trajectory standpoint) of Cook Inlet. Risks due to oil and gas development may increase in the future if exploration and development increase.

In addition to oil and gas development, environmental contaminants including organochlorine compounds (OCs) have been hypothesized as a contributing factor to Steller sea lion population decline and slow recovery (Barron et al. 2003, Atkinson et al. 2008, NMFS 2008). However, the potential impact of OCs on sea lion health and survival have not been fully evaluated due, in part, to limited contaminant data currently available for this species (Lee et al. 1996, Myers et al. 2008, Alava et al. 2012, Zaleski et al. 2014). OCs, which include *polychlorinated biphenyls* (PCBs) and *dichlorodiphenyl- trichloroethane* (DDTs), bioaccumulate and biomagnify within top-level predators and have been detected in the tissues of marine mammals world-wide (Braune et al. 2005, Law 2014). The widespread use of these compounds has been associated with deleterious effects on the health and condition of pinnipeds including reduced pup production, premature parturition, altered immune function (DeLong et al. 1973, de Swart et al. 1996, Beckmen et al. 2003), and cancer (Gulland et al. 1996, Greig et al. 2005, Ylitalo et al. 2005, Randhawa et al. 2015, Deming et al. 2018).

The effects of organochlorine exposure and their association with cancer and infectious disease have been studied widely on California sea lions (*Zalophus californianus*) (Gulland et al. 1996, Greig et al. 2005, Ylitalo et al. 2005, Randhawa et al. 2015, Deming et al. 2018) and could help us better understand the impacts to WDPS Steller sea lions. The persistence of organochlorine contamination in the environment and the associated serious health risks warrant continued monitoring.

**E3. The influence of global climate change and oceanographic variability is examined, including in combination with other human influenced factors, and is determined unlikely to limit recovery**.

***This recovery criterion for downlisting has not been met.***

Climate change and ocean acidification effects to the WDPS of Steller sea lions were discussed in NMFS (2010) and more fully in NMFS (2014a). In recent years, the climate regime in Alaska has brought shifts in the distribution of prey species. In the northern Bering Sea, there has been a significant shift in latitudinal displacement as well as variable recruitment success in many fish species, including walleye Pollock, Pacific cod, and flatfishes between surveys conducted in 2010 (when the majority of the continental shelf was covered by a pool of cold , < 2° C water) and 2017 (water temperatures above the long-term survey mean) (Stevenson and Lauth 2019). The GOA in 2017 remained characterized by warm conditions, which moderated since the extreme heatwave of 2014-2016 (Zador and Yasumiishi 2018). Fish apex predator biomass during 2017 bottom trawl surveys was at its lowest level in the 30 year time series, and the recent 5-year mean is below the long-term average (Zador and Yasumiishi 2018). The trend is driven primarily by Pacific cod and arrowtooth flounder, which were both at the lowest abundance in the survey time series. Pacific halibut and arrowtooth flounder have shown a general decline since their peak survey biomasses in 2003. Pacific cod has continued to decline from a peak survey biomass in 2009 (Zador and Yasumiishi 2018). In addition to changes in prey distribution and availability associated with changing ecosystems, sea level rise caused by climate change will directly affect terrestrial rookery and haulout sites currently used by Steller sea lions as well as those that may be used by a recovering population. This may result in more deaths among small pups, and traditional sites on some islands with low relief may be submerged. Ocean acidification effects on WDPS Steller sea lions are uncertain but are likely to include serious impacts on ecosystems and specific prey species.

NMFS (2014b) summarized that the distribution and abundance of at least some WDPS primary prey varies with environmental conditions (Hollowed et al. 2013, Sinclair et al. 2013) and is likely to be affected in the future by changing climate and oceanographic conditions (Dorn et al. 2017). Large scale shifts in oceanographic conditions, including ocean circulation, distribution of gyres, stratification, nutrient input, pH, and temperature shifts, could potentially disrupt such basic characteristics of affected ecosystems as trophic pathways (Doney et al. 2012, Salinger et al. 2013), with potentially large impacts on the ability of Steller sea lions to forage efficiently. Dorn et al. (2017) recommend additional research on the foraging habitat use of adult female Steller sea lions in the non-breeding season in the GOA because, based on the currently available information, we cannot predict the exact pathways or levels of effects on WDPS Steller sea lions. ADF&G is currently tracking four adult females in the GOA and is scheduled to capture eight more adult females during the 2019-2020 non-breeding season (M. Rehberg, ADF&G, pers. comm.). Sinclair et al. (2013) notes that identifying the links between climate, fishery activity, and prey availability to Steller sea lions is challenging because of our lack of understanding of the dimensionality of the marine system. Each influence likely has multiplicative effects regarding how removal of one prey type affects the abundance or availability of another. Given the overall complexity of climate change and its impacts on the ecosystem, we currently do not have enough information to determine how global climate change and oceanographic variability will affect Steller sea lion population health.

**E.4. An Alaska stranding network is in place and functional**.

***This recovery criterion for downlisting has been met.***

NMFS has an Alaska Region Marine Mammal Stranding Network in place, which has provided new information about rates of Steller sea lion strandings and, in some instances, can provide information about health and cause of death of WDPS sea lions. These data are summarized regularly (e.g., https://www.fisheries.noaa.gov/alaska/marine-life-distress/alaska-marine-mammal-stranding-network). The stranding network is not able to provide comprehensive data on strandings because of the geographic extent and remoteness of so many areas of the WDPS Steller sea lion range. With increased resources and improved partnerships with people in remote areas, the Alaska stranding network could improve data collection and better identify sources of injury and mortality to WDPS Steller sea lions.

**E.5. There is an outreach program to educate the public, commercial fishermen, and others to the continued need to conserve and protect Steller sea lions, including avoidance of rookery and haulout sites and the no-feeding rule around boats and harbors**.

***This recovery criterion has been met.***

NMFS has developed outreach products and programs on several issues related to this recovery criterion. For example, NMFS developed "Marine Mammal Viewing Guidelines" (https://www.fisheries.noaa.gov/resource/outreach-and-education/alaska-marine-mammal-viewing-guidelines-and-regulations-booklet) which include language on Steller sea lions and their terrestrial sites, as well as "Do Not Feed!" (https://www.fisheries.noaa.gov/resource/outreach-and-education/take-lead-do-not-feed) and "Steller sea lion entanglement" (https://www.fisheries.noaa.gov/resource/outreach-and-education/keep-sea-entanglement-free) outreach kiosk rack cards. NMFS created a "Do Not Feed" 10 second video public service announcement to play on an electronic display above the luggage area in the Juneau airport every three minutes from June 2019 through April 2020. NMFS also provides information on deterring Steller sea lions in Alaska on its website (https://www.fisheries.noaa.gov/alaska/endangered-species-conservation/deterring-steller-sea-lions-alaska) and NMFS created laminated wheelhouse fliers for commercial fishermen to provide information on what fishermen can do to reduce Steller sea lion interactions. NMFS has also presented to Alaska harbormasters to educate about the impacts of feeding sea lions. Although NMFS has made great strides in outreach, this message requires consistency and an ongoing outreach program to ensure the message continues to reach people who may encounter Steller sea lions.

**E.6. Catch and effort statistics of state and federal commercial fisheries for Steller sea lion prey species within designated critical habitat are collected and described annually**.

***This recovery criterion has been partially met.***

NMFS catch and effort statistics related to federal fisheries in Alaska waters and data on catch and effort for several primary sea lion prey species have been considered in recent biological opinions on the effects of the groundfish fisheries (NMFS 2010, 2014a) on Steller sea lions and their critical habitat. The State of Alaska keeps catch and effort records related to state-managed commercial fisheries but these have not been reported at a fine enough scale that helps inform evaluation of potential impacts from these fisheries. Because State fisheries operate in nearshore habitats that also are important to Steller sea lions, there is the potential for competition that may have consequential effects for sea lions. Specifically, these potential interactions may contribute to nutritional stress for Steller sea lions, and may reduce the value of the marine portions of designated Steller sea lion critical habitat. State managed fisheries will likely continue to reduce the availability of prey within these marine foraging areas and may alter the distribution of certain prey resources in ways that reduce the foraging effectiveness of Steller sea lions. More data on the foraging habits of Steller sea lions from research in key geographic areas could aid our understanding of where and when these effects might be most important (NMFS 2014a).

**Delisting Objectives and Criteria**

Because downlisting objectives and criteria have not been met for WDPS Steller sea lion, an analysis is not required for the delisting objectives and criteria, which, if met, would indicate the species is recovered and delisting is warranted (50 CFR 424.11).

## 2.3 Updated Information and Current Species Status

### 2.3.1 Biology and Habitat

#### 2.3.1.1 New information on the species' biology and life history:

The biology and life history of Steller sea lions has been well documented. Adult male Steller sea lions arrive on rookeries in early to mid-May to establish territories, adult females arrive shortly after the males, and pups are born from mid-May to mid-July (Gentry 1970). The average age of first ovulation is 4.6 years, and first pregnancy 4.9 years; incidence of pregnancy ranged from 20% for females three years of age to 87% for females 8-20 years of age (Pitcher and Calkins 1981). Females usually give birth for the first time at ages 5-7 years (Perlov 1971, Pitcher and Calkins 1981) and exhibit moderately high natal philopatry (first breeding occurs at the natal site) (Raum-Suryan et al. 2002, Hastings et al. 2017) in the WDPS and EDPS and for the EDPS in southeastern Alaska, very high breeding philopatry at all five rookeries in southeastern Alaska (Hastings et al. 2017). Male Steller sea lions are reproductively mature by 5-7 years of age (Thorsteinson and Lensink 1962, Perlov 1971) but generally are not socially mature nor of sufficient size to hold a territory until about 9 years of age (Thorsteinson and Lensink 1962, Pitcher and Calkins 1981, Hastings et al. 2018).

#### 2.3.1.2 Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

The WDPS of Steller sea lion decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000 (Loughlin et al. 1984, Loughlin and York 2000, Burkanov and Loughlin 2005). Data indicate that the decline began in the 1970s in the eastern Aleutian Islands, western Bering Sea/Kamchatka, and the Kuril Islands (Braham et al. 1980, Burkanov and Loughlin 2005), and then, in Alaska, spread both east and west of the eastern Aleutians in the 1980s. By 1990, trends indicated that populations in the eastern Aleutians and western GOA were relatively stable while those to the east and west continued to decline (Sease et al. 2001, Fritz et al. 2008).

Calkins and Pitcher (1982) originally estimated a factor of 4.5 to evaluate total abundance from pup production, but this factor was based on a life history table using age-specific fecundity and survival for a stable, mid-1970s population. The demographics of central Gulf of Alaska populations indicate that these rates have changed since the mid-1970s (Holmes and York 2003, Holmes et al. 2007). Recent analyses instead use a minimum population estimate count ($N_{MIN}$) to sum the total number of WDPS Steller sea lions by adding the non-pup and pup counts (Muto et al. 2019). The total *agTrend* model-predicted non-pup count in the WDPS in Alaska in 2017 is 42,315 (38,039-47,377), ~1,600 more than the 2016 estimate (Sweeney et al. 2017). The total estimated pup count for the WDPS in Alaska in 2017 is 11,953 (10,879-13,195), which is 678 fewer than the 2016 estimate (Sweeney et al. 2017). The current WDPS $N_{MIN}$ for Alaska is 54,268 (48,918-60,572). For the Russian segment of the population, only non-pup counts were modeled because robust pup count data are currently unavailable. Therefore, the total *agTrend* model-predicted Russian non-pup count for 2017 is 13,691 (12,225 - 15,133) (Johnson 2018, pers. comm., 9 October 2018). It is important to note that these are modeled counts for the U.S. and Russia and do not account for sea lions at sea, and therefore do not represent the total population size.

Johnson and Fritz (2014) estimated regional and overall trends in counts of pups and non-pups in Alaska using data collected at all sites with at least two non-zero counts, rather than relying solely on counts at "trend" sites (Fritz et al. 2013, Fritz et al. 2016a). Using data collected through 2016, there is strong evidence that pup and non-pup counts of WDPS Steller sea lions in Alaska were at their lowest levels in 2002 and 2003, respectively, and increased at 2.19% $y^{-1}$ and 2.24% $y^{-1}$, respectively, between 2003 and 2016 (Sweeney et al. 2016). However, there are strong regional differences across the range in Alaska, with positive trends in the GOA and eastern Bering Sea east of Samalga Pass (~170°W) and generally negative trends to the west in the Aleutian Islands. Trends in 2003-2016 in Alaska have a longitudinal gradient with highest rates of increase in the east (eastern GOA) and steadily decreasing rates to the west. Moreover, there was a recent sharp drop in pup production in the eastern and central GOA subregions between 2015-2017 (Sweeney et al. 2017), and a recent sharp drop in estimates of annual female survivorship at the Chiswell Islands in the eastern GOA subregion (Maniscalco 2018). Maniscalco (pers. comm.) also reported that the total number of pups born at Chiswell Island in 2018 declined more than 40% below the 2015 high.

As mentioned in Section 2.2.3.1, the WDPS Steller sea lion non-pup counts in Alaska declined significantly in the central (-0.67%$y^{-1}$, -1.71 – -0.30%$y^{-1}$) and western (-6.92%$y^{-1}$, -8.41 – -5.41%$y^{-1}$) Aleutian Islands from 2001 to 2016 (Johnson and Fritz 2014, AFSC 2016, Sweeney et al. 2017, Sweeney pers. comm., 5 April 2018) (Table 1, Figure 2). The results from the Russia/Asia subregion analysis indicate that non-pup counts declined significantly from 2002-2017, at approximately -1.3%y-1 (-2.6%$y^{-1}$, -0.1%$y^{-1}$) resulting in an estimated -21% (-38%, -1%) decrease in non-pup counts over the 15 year span. In Russia, the decline appears to be primarily driven by the decline in the Kuril Islands, particularly in 2015 (Figure 5, Figure 6), which traditionally represents the highest non-pup counts (Johnson 2018).

Since the listing of the WDPS, and the finalization of the Recovery Plan (NMFS 2008), WDPS sea lions have become increasingly less abundant in the Central and especially the Western Aleutian Islands. Information related to diet, genetics, and population changes over time supports hypotheses that foraging is dictated by proximity to natal rookeries, and that Steller sea lions may develop foraging skills specific to the regions of their birth (Sinclair and Zeppelin 2002, O'Corry-Crowe et al. 2006). Jemison et al. (2018) examine geographic population structure of Steller sea lions based on site use of branded Steller sea lions during the breeding and non-breeding seasons. Site use patterns of Steller sea lions using the eastern Aleutian Islands and Bering Sea were most distinct from other groups, and were even more distinct than all other western groups were from eastern groups (Jemison et al. 2018). In the eastern Aleutian Islands, some long term and traditional rookeries have become essentially extirpated (e.g., Buldir and St. George rookeries) or greatly diminished, as have important major haulouts, as the regional population has decreased (Fritz et al. 2016a).

The sharp drop in abundance of the WDPS observed in the 1980s was caused largely by a steep decline in juvenile survival and a smaller decline in adult survival (York 1994, Holmes and York 2003, Pendleton et al. 2006, Winship and Trites 2006, Holmes et al. 2007). Survival increased in the 1990s as the population decline slowed, possibly as a result of the listing of Steller sea lions as threatened under the ESA in 1990 and a drop in mortality associated with incidental take in fisheries and legal and illegal shooting (Atkinson et al. 2008). By the 2000s, survival of both juveniles and adults in areas containing long-term monitoring plans had rebounded to rates similar to those observed in the mid-1970s prior to the decline (Calkins and Pitcher 1982, Holmes et al. 2007, Horning and Mellish 2012, Fritz et al. 2014, Maniscalco 2014).

Fritz et al. (2014) indicated that natality of the increasing population east of Samalga Pass in 2000−2012 may not have been significantly different from rates estimated for the 1970s prior to the decline in overall western abundance. However, west of Samalga Pass, no survival data are currently available to help explain the continued abundance declines (Fritz et al. 2014). In 2011, 54 Steller sea lion pups were branded at Gillon Point rookery on Agattu Island (173° E) in the western Aleutians. Between June 2012 and July 2013, 27 (50 percent) of these branded animals were observed alive at least once (MML, unpublished). Sightings in subsequent years are expected to improve estimates of survival to age one year in the western Aleutians. While preliminary, these first year sightings of sea lions branded as pups on Agattu Island suggest that first year survival is currently not compromised in the western Aleutians, where Steller sea lion populations are declining.

New information submitted during the public comment period on this 5-year review indicates that the annual survivorship of adult female Steller sea lions may be highly sensitive to environmental variability that is causing large changes in primary prey. Using similar analyses as Maniscalco (2014), Maniscalco (2018) reported that for adult female annual survival and natality (female reproductive rate) spanning the years 2011–2017 at Chiswell Island, natality remained relatively stable at around 70%, but estimates of adult female annual survival dropped sharply from 90% to 81% in 2016 and further to 62% in 2017 (Figure 8). These results are extremely concerning, especially since adult survival has a much greater impact on population health than does natality or juvenile survival for this species (Maniscalco et al. 2015). The adult female estimates are of apparent survival and if many of the tracked females departed the Chiswell study area within the past few years, it would give the appearance of low survival because these animals would be effectively removed from the study population, at least temporarily (Maniscalco 2018). On the other hand, a drop in survival, reduced pup production in 2016 and 2017 (Sweeney et al. 2017), or movements of juveniles and adults (Sweeney et al. 2017) could have resulted from recent ecosystem changes in the GOA (Zador and Yasumiishi 2018). The GOA in 2017 remained characterized by warm conditions although conditions have moderated since the extreme heat wave of 2014-2016; copepod community size remained small for the fourth consecutive year indicating planktivorous predators may have had a more difficult time finding adequate nutrition; capelin declined during the warm water years of 2015-2016; fish apex predator biomass during 2017 bottom trawl surveys was at its lowest level in the 30 year time series, and the recent five year mean is below the long-term average; and the number of Steller sea lion pups declined from 2015 to 2017 in the western GOA (Zador and Yasumiishi 2018), and at Chiswell Island through 2018 (J. Maniscalco, pers. comm.).

If the preliminary estimates observed by Maniscalco (2018) reflect drops in female survivorship over a broader area, this may be another strong signal that WDPS Steller sea lions are not resilient to the environmental variability that results in large changes to prey distribution and abundance. This is especially important since the issue of whether Steller sea lions are resilient to such change underlies the rationale in the recovery criteria.

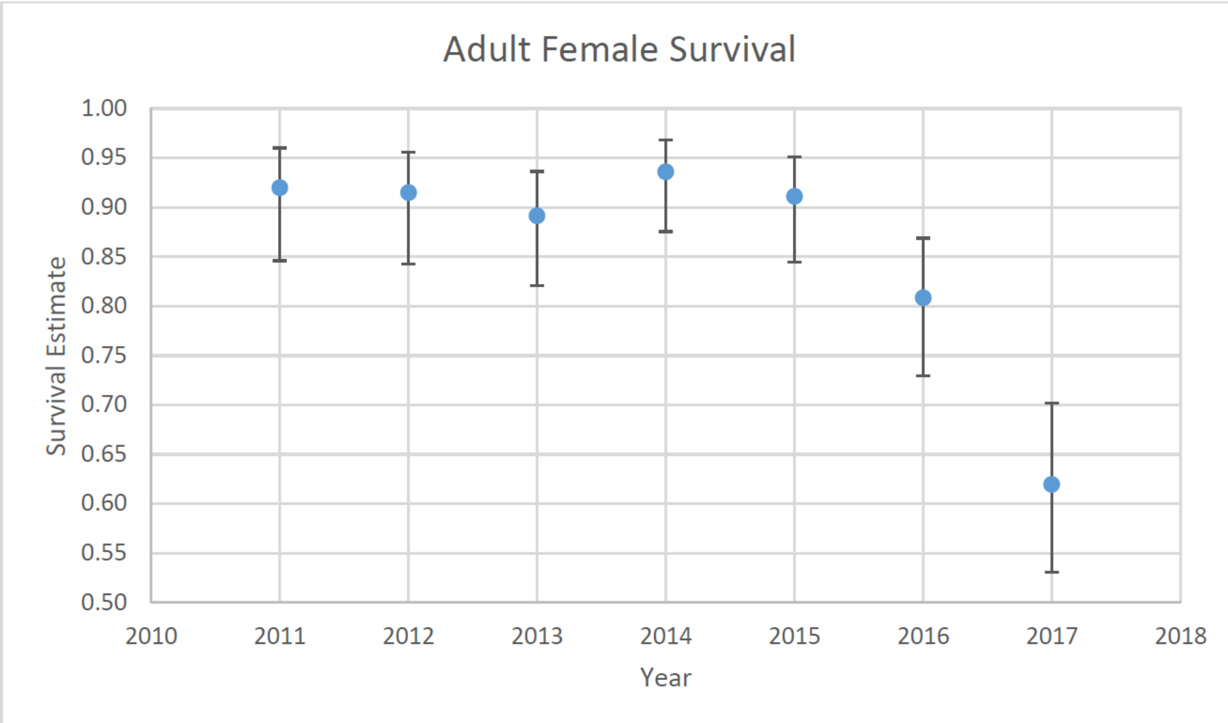


**Figure 8. Adult survival estimates at the Chiswell Island Steller sea lion rookery 2011 – 2017, ±95% C.I. (Maniscalco 2018).**

#### 2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

A considerable amount of new genetic information has become available since the 1997 designation of the two DPSs. Multiple studies have found evidence of genetic differentiation among three Steller sea lion populations: the EDPS, the WDPS in Alaska and the Commander Islands, and the WDPS in Asia (Bickham et al. 1996, Baker et al. 2005, Hoffman et al. 2006). There is sufficient genetic (Bickham et al. 1996, Baker et al. 2005, O'Corry-Crowe et al. 2006) and morphometric (Brunner 2002) differentiation between the EDPS and WDPS populations to consider them as separate sub-species (Phillips et al. 2009). Within the Asian and western Alaska populations, observed genetic structure based on separate female- and male-mediated markers is consistent with female philopatry and male dispersal (Bickham et al. 1998, Koyama et al. 2008), with higher dispersal rates for males than females (Trujillo et al. 2004, Hoffman et al. 2006). Genetic data from sea lions sampled at Commander Island rookeries in Russia statistically cluster with the Alaskan portion of the western stock and are differentiable from an Asian group comprised of the other Russian rookeries (Baker et al. 2005) (though for management purposes NMFS recognizes only one western stock that includes Alaska and Russia). Permanent emigration from the WDPS is known to have occurred at both ends of their range in Alaska (Jemison et al. 2013, Jemison et al. 2018), but there is no evidence to suggest significant movement beyond the border regions. The genetic composition of pups suggest that the growth of a Medny Island (Commander Islands) rookery during the 1970s–1980s (Burkanov and

Loughlin 2005) was a result of immigration from the WDPS, but not of animals from further west in Russian waters (Baker et al. 2005, Jemison et al. 2013).

A relatively low level of genetic interchange occurs in northern Southeast Alaska between the EDPS and WDPS (O'Corry-Crowe et al. 2014, Jemison et al. 2018, Rehberg et al. 2018). Although the eastern and western DPSs remain distinct entities, genetic analyses of Steller sea lion pups from recently colonized rookeries in northern Southeast Alaska (Graves Rocks and White Sisters) (O'Corry-Crowe et al. 2014) and movement data (Jemison et al. 2013, Jemison et al. 2018) revealed a mixing zone between these two evolutionarily distinct population segments. Pups at the recently established rookeries at the northernmost part of the EDPS range (northern Southeast Alaska, Graves Rocks, and White Sisters) are in part derived from females with western DPS stock haplotypes (Gelatt et al. 2007), and nine adult females that were born at WDPS rookeries in the central Gulf of Alaska (GOA) (Marmot, Sugarloaf, and Seal Rocks) have been observed giving birth at the Graves Rocks or White Sisters rookeries since 2008 (Jemison et al. 2013). Rehberg et al. (2018) studied genetic origins, foraging range, diving behavior, and dispersal of immature Steller sea lions (≤ 24 months of age) captured in Glacier Bay and their results corroborate previous studies (Hoffman et al. 2006, Jemison et al. 2013, O'Corry-Crowe et al. 2014) that indicate that some WPDS Steller sea lions are emigrating to this mixing zone. There appears, however, to be no reciprocal immigration of breeding animals from the EDPS to the west. Moreover, it appears that northern Southeast Alaska (including Graves Rocks and Glacier Bay) can provide the resources needed for Steller sea lions to reproduce and thrive (Rehberg et al. 2018). Pups born at Graves Rocks are twice as likely to survive through age seven than pups born at other Southeast Alaska rookeries (Hastings et al. 2011) and fitness benefits for females born west of 144°W that dispersed to Southeast Alaska had higher female survival and higher survival of their female offspring to breeding age compared to females that remained west of the boundary (Hastings et al. 2019). Northern Southeast Alaska is the area of greatest overlap between stocks, and is important to WDPS Steller sea lions, especially those born in Prince William Sound (Jemison et al. 2018). High survival and rapid population growth in northern Southeast Alaska indicates that conditions in this region have been optimal for Steller sea lions from both DPSs (Jemison et al. 2018).

The observed population decline in the WDPS and increase in the EDPS, however, are not explained by emigration from the WDPS to the EDPS as over the past three decades, the amount of growth observed in the eastern population is equivalent to only a fraction of the losses in the western population (Loughlin et al. 1984, Loughlin et al. 1992, Pitcher et al. 2007, Fritz et al. 2013).

#### 2.3.1.4 Taxonomic classification or changes in nomenclature:

Phillips et al. (2009) recommended that two subspecies (corresponding to the WDPS and EDPS) of Steller sea lions be recognized based on concordance of morphometric and genetic patterns of variability and differentiation. The Society for Marine Mammalogy Committee on Taxonomy (2017) also concluded that two subspecies of *Eumetopias*, *E. j. jubatus* (Schreber 1776) or "Western Steller sea lion" (WDPS) and *E. j. monteriensis* (Gray 1859) or "Loughlin's Steller sea lion" (EDPS) are supported largely on molecular genetic data. However, a review by Berta and Churchill (2012) characterized the status of these subspecies assignments as "tentative." Further research is required to determine if a change in taxonomic classification is warranted.

#### 2.3.1.5 Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The current overall range of the WDPS remains essentially the same as it was prior to the beginning of its decline in the U.S. in the 1980s and essentially the same as it was at the time of listing in 1997. The present range of the WDPS extends around the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, and along the coast of the GOA into northern parts of Southeast Alaska (Burkanov and Loughlin 2005, NMFS 2014b).

Genetic and marked animal sighting data collected since 2000 provide more specific information indicating that WDPS sea lions make seasonal, multi-year, and permanent movements across the currently recognized DPS boundary. Data indicate that most of the cross-boundary habitat use by WDPS animals occurs within northern Southeast Alaska (Gelatt et al. 2007, Jemison et al. 2013, O'Corry-Crowe et al. 2014). Data also indicated that WDPS females were at least partially responsible for the establishment of the newest eastern rookeries (White Sisters in the late 1980s and Graves Rocks ~2000) (Gelatt et al. 2007, O'Corry-Crowe et al. 2014) in northern Southeast Alaska. Jemison et al. (2018) analyzed >30,000 sightings collected from 2000-2014 of 2,385 Steller sea lions that were branded as pups at 10 Alaskan rookeries to examine mesoscale (mostly < 500 km) spatial distribution, geographic range, and geographic population structure. The authors found sea lions from larger rookeries, and rookeries with slower population growth and lower survival, had wider dispersion than animals from smaller rookeries, or rookeries with high growth and survival. Steller sea lions from larger rookeries where survival rates and population trends are lower have wider dispersion and greater dispersal, suggesting movement patterns could result from density dependence (e.g., competition for food). The opposite pattern appears to be true for smaller rookeries, with high survival rates and population trends associated with limited dispersion and dispersal (Jemison et al. 2018). The most recent genetic data suggest that growth of northern Southeast Alaska rookeries (i.e., Graves Rocks and White Sisters) is consistent with positive and negative density dependent emigration of eastern and western animals, respectively (O'Corry-Crowe et al. 2014, Jemison et al. 2018).

While the overall range is similar to that at the time of listing, the distribution of WDPS animals throughout that large range has changed significantly since the decline first began (e.g., NMFS 2008). Prior to the decline in the west, most large rookeries were in the GOA and Aleutian Islands (Kenyon 1962, Calkins and Pitcher 1982, Loughlin et al. 1984, Merrick et al. 1987, Loughlin et al. 1992). The number of sea lions using rookeries in the west became progressively smaller during the decline, and the number of sea lions using rookeries in the western and central Aleutian Islands continues to decline (Fritz et al. 2016b, Sweeney et al. 2017). In the central Bering Sea, of four rookeries that previously were used in the Pribilof Islands (two on St. George Island, one on St. Paul, and one on Walrus Island) (Kenyon 1962), today only Walrus Island (Fritz et al. 2016a) is still used for breeding, pupping, and related activities. If current multi-decadal declines continue in some parts of the range, large gaps in the breeding range, and increased fragmentation, could result.

Based on analyses of geographic population structure, Jemison et al. (2018) indicated that animals born in the eastern Aleutian Islands had the most distinct (clustered) movements and had little overlap (i.e., use of the same sites) with other WDPS Steller sea lions. Detailed knowledge of distribution and movements of WDPS sea lions is useful for defining recovery and population trends within certain regions that best reflect dispersion and population structure. Available data indicate there is not substantial directed east-west movement of adult females (in either direction) within the WDPS in Alaska, other than those western females from the central and eastern GOA that moved to northern Southeast Alaska (Gelatt et al. 2007, Jemison et al. 2013, O'Corry-Crowe et al. 2014, Jemison et al. 2018). Thus, even if Steller sea lions moved east and west, there is no evidence that the significant declines in the western and central Aleutian Islands are due to movement or emigration to locations east of the current regulatory boundary of 144° W longitude.

#### 2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Steller sea lions require both terrestrial and aquatic habitats for their essential life history functions. The terrestrial sites used historically are still physically available and space on the sites is not limiting. However, it is also possible that some functions of WDPS terrestrial sites are degraded, as sea lion abundance falls, due to “Allee effects.” In short, reduced density may lead to reduced fitness which is ultimately realized in decreased population growth rate. For example, huddling (Alberts 1978, Canals 1998, Gilbert et al. 2010) is a well-documented behavior of Steller sea lions and it is likely that WDPS Steller sea lions realize thermoregulatory and related energy-saving benefits of huddling on terrestrial sites that could, at some level of decline in abundance, be reduced. Gilbert et al. (2010) reports huddling allows individuals to maximize energy savings by decreasing their cold-exposed body surface area, reducing their heat loss through warming of ambient temperatures surrounding the group, and eventually lowering their body temperature through physiological processes.

Information related to genetics and population changes over time suggest that foraging is dictated by proximity to natal rookeries, and that Steller sea lions may develop foraging skills specific to the regions of their birth (Sinclair and Zeppelin 2002, O'Corry-Crowe et al. 2006). Additionally, the process of learning where prey resources may be found may be negatively affected in areas in which Steller sea lion abundance has declined. Steller sea lions sometimes depart their haulouts in large groups to begin foraging. These group departures are opportunities for sea lions to learn alternative foraging locations from the others foraging with them. Thus, reduced sea lion numbers at a haulout can reduce these possibilities for individuals to adapt to change in prey distribution and location (Schakner et al. 2017). Other functions of terrestrial sites that may be subject to degradation when abundance is severely reduced include 1) inability to cooperatively feed (Gende et al. 2001), 2) opportunities for pups and juveniles to learn social skills and/or to play fight, 3) the dilution of harassment of females by conspecific males because females in larger breeding groups receive less harassment by resident males that defend large groups compared to small groups (Cappozzo et al. 2008, Bowen et al. 2009), and 4) the ability of Steller sea lions to continue to dominate use of a site and to hold off competitors, such as northern fur seals (*Callorhinus ursinus*), for these terrestrial sites. Some or all of these types of the reduction in functionality of terrestrial sites may have occurred within parts of the range of the WDPS, especially in areas where abundance is now very low.

Another potential habitat change involves the availability of prey. Estimated total biomass (age 0+) and projected female biomass of GOA Pacific cod plunged sharply downward between 2016 and 2017: 428,885 t to 170,565 t and 98,479 to 36,209 t, respectively (Barbeaux et al. 2017).

Female spawning biomass is currently estimated to be at its lowest point in the 41-year time series after three years of poor recruitment from 2014 through 2016 and increased natural mortality during the 2014-2016 GOA marine heat wave (Barbeaux et al. 2018). Even before the recent abrupt decline, there was evidence (Barbeaux et al. 2017) of a gradual, but clear long term decline in the female spawning biomass of this primary prey species since Steller sea lions were listed range-wide in 1990. Barbeaux et al. (2018) currently rates the population dynamics of Pacific cod as one of extreme concern. Such changes in prey availability may be related to changes in ocean conditions, which could occur more frequently in the future with climate change.

A distinct change in the ocean circulation of the GOA after the 1976-77 climate shift caused strong changes in the mean velocity of the Alaskan Stream and in its associated mesoscale eddy field while the Alaska Current and the eddy flows in the eastern Gulf remain relatively unchanged (Miller et al. 2005, Trites et al. 2007). Since mesoscale eddies provide a possible mechanism for transporting nutrient- rich open-ocean waters to the productive shelf region, the flow of energy through the food web may have been altered by this physical oceanographic change and may potentially help to explain changes in forage fish quality in diet diversity of Steller sea lions (Miller et al. 2005, Trites et al. 2007).

Herring stocks in multiple locations within the foraging range of the WDPS have declined as well, leading to the loss of a high energy, highly aggregated seasonal food resource for Steller sea lions (Womble et al. 2005, Thorne and Thomas 2007).

##### 2.3.1.7 Other:

Other human activities have continued to increase in portions of the range of WDPS Steller sea lions, bringing increased potential for harassment, entanglement in marine debris, contamination, or other conflicts that could, to some unknown extent, affect the recovery of the WDPS.

### 2.3.2 Five-Factor Analysis (threats, conservation measures, regulatory mechanisms)

This section summarizes the status of WDPS Steller sea lions relative to the factors for listing specified in section 4(a)(1) of the ESA (16 U.S.C. § 1533(a)(1) & 50 CFR 424.11), considering the threats listed in Section 2.2.3 and the recovery criteria in the revised Steller sea lion Recovery Plan (NMFS 2008).

#### 2.3.2.1 Present or threatened destruction, modification, or curtailment of its habitat or range:

The principal threats to WDPS Steller sea lion habitat involve factors that may change the availability of sea lion prey. Steller sea lions’ diet varies regionally, seasonally (Sinclair and Zeppelin 2002), and as a result of dive ability, sex, and age (Raum-Suryan et al. 2004, Fadely et al. 2005, Rehberg and Burns 2008). NMFS and others (Hennen 2006, Trites et al. 2010, McDermott et al. 2016) have made considerable progress in understanding the foraging ecology and prey of Steller sea lions that will assist in understanding the impacts of fisheries on Steller sea lion prey and whether fisheries are likely to limit recovery, but much remains to be learned. Studies attempting to understand the effects of fisheries on Steller sea lion prey availability have conflicting results however, leading to disagreements among stakeholders regarding potential fisheries effects (Bowen and Plains 2012, Stewart 2012, Stokes 2012). Additional research about the foraging habits of Steller sea lions in key geographic areas could aid our understanding of where and when fisheries effects might be most pronounced (NMFS 2014a).

There is widespread consensus within the scientific community that atmospheric temperatures on earth are increasing, that this will continue for at least the next several decades (Watson and Albritton 2001, Oreskes 2004), and that the warming trend will alter current weather patterns and patterns associated with climatic phenomena. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Pachauri and Reisinger 2007). Climate change is likely to have its most pronounced effects on species whose populations are already in tenuous positions (Issac 2009). Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). The effects of these changes to the marine ecosystems of the Bering Sea, Aleutian Islands, and the GOA, and how they may affect WDPS Steller sea lions, are uncertain.

Global climate change and oceanographic variability may cause large changes in distribution of some of Steller sea lion prey, and potentially on the timing of key life history events. Since data indicate that prey aggregations that are predictable in space and time are important to Steller sea lions (Sigler et al. 2017), there is potential for such shifts to temporarily reduce their ability to forage efficiently, and, in so doing, could impact their recovery.

#### 2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Since listing Steller sea lions range-wide in 1990, NMFS has taken multiple actions to reduce incidental take in commercial fisheries, including the promulgation of regulations that prohibit transit within 3 nm of many rookeries (50 CFR 224.103(d)), fishery restrictions to prevent jeopardy and adverse modification of critical habitat (e.g., NMFS 2010, 2014b), and the annual evaluation of human-caused serious injury and mortality of NMFS-managed Alaska marine mammal stocks (Helker et al. 2017). However, most State of Alaska fisheries in the range of the WDPS that target WDPS prey (Sinclair et al. 2013, NMFS 2014a) are not monitored, including around some WDPS rookeries.

Burkanov et al. (2017) indicate that there is cause for concern about the take of Steller sea lions in commercial fisheries in Russian and Japanese waters. For both Russian and Alaskan waters, our assessment of the threat posed by incidental take, except for the well-monitored federal groundfish fisheries, is hampered by the lack of observer programs for many fisheries.

#### 2.3.2.3 Disease or predation:

Increasing temperatures in the Arctic and subarctic waters not only leads to an increased potential for harmful algal blooms that produce biotoxins such as domoic acid and saxitoxin but also increased *Brucella* infections in Steller sea lions, including fetuses (Lefebvre *et al.* 2016).

Maniscalco (2018) reported that killer whales have reestablished a significant presence around the Chiswell Island rookery in recent years. There is currently inadequate data to assess the threat of killer whale predation to the recovery of sea lions in the central and western Aleutian Islands (NMFS 2014b). Therefore, our knowledge about the impacts of predation on sea lions is insufficient to determine whether predation is limiting recovery.

#### 2.3.2.4 Inadequacy of existing regulatory mechanisms:

NMFS continues to implement, and has recently reviewed, federal fisheries regulations relevant to potential effects on the WDPS and its critical habitat (NMFS 2010, 2014a).

In 2016, NMFS initiated a preliminary review to consider whether to update the list of rookeries subject to buffer zones designed to reduce disturbance to WDPS Steller sea lions (i.e., the list in Table 1 of 50 CFR 224.103(d)). This review indicated that the existing list of rookeries is outdated, including four sites that likely never functioned as rookeries and excluding about 14 sites that meet specified criteria to be identified as rookeries, and yet do not have the same protections as other currently-listed rookeries. Moreover, Himes Boor and Small (2012) reported that the range-wide generalizations about Steller sea lion use patterns with respect to water depth and distance to shore were not appropriate and results based on their Bayesian model that quantified Steller sea lion encounter rates can be used to gauge the suitability of current critical habitat designations and inform future critical habitat modifications. Further development of platform of opportunity data can better inform our knowledge of Steller sea lion spatial use patterns, and provide information for better management in the future (Himes Boor and Small 2012). NMFS has not yet initiated a rulemaking to more fully consider updating the regulations.

NMFS has not pursued formal international agreements with Russia or Japan for WDPS Steller sea lions. We do not have sufficient information to assess the effectiveness of any domestic regulatory mechanisms in those countries to protect WDPS Steller sea lions.

#### 2.3.2.5 Other natural or manmade factors affecting its continued existence:

The sources of potential pollution that pose a risk to the WDPS are not fully known. Marine pollution including oil spills could impact food web dynamics by removing top predators from the ecosystem, influencing food web dynamics, and harming wildlife and ecosystem functions (NMFS 2014b). However, the potential impact of organochlorine compounds on the health and survival of Steller sea lions have not been fully evaluated due, in part, to limited contaminant data currently available for this species (Lee et al. 1996, Myers et al. 2008, Alava et al. 2012, Zaleski et al. 2014). Environmental contaminants may be a significant threat impeding recovery of Steller sea lions in parts of the WDPS (Rea and O'Hara 2018).

Other human activities have continued to increase in portions of the range of WDPS Steller sea lions, bringing increased potential for harassment, entanglement in marine debris, contamination, or other conflicts that could, to some unknown extent, affect the recovery of the WDPS.

### 2.4 Synthesis

Recent analyses indicate that the WDPS population trend for non-pups in Alaska increased 2.14%$y^{-1}$ (95% credible interval[5] of 1.49 – 2.78%$y^{-1}$) from 2002 to 2017 with notable population increases in the Eastern, Central, and Western Gulf regions, satisfying the first criterion for downlisting the WDPS Steller sea lion to threatened. However, the second criterion has not been satisfied for downlisting as trends in non-pups in three of the seven subregions are not consistent with the trend observed under criterion #1. The population trends in three adjacent subregions

[5] A credible interval is the interval in which an (unobserved) parameter has a given probability. It is the Bayesian equivalent of the confidence interval. However, unlike a confidence interval, it is dependent on the prior distribution.

(western and central Aleutian Islands and Russia/Asia) have been in statistically significant decline in a 15-year period.

Moreover, there is high uncertainty about the cumulative threats that continue to cause declines in the central and western Aleutian Islands and Russia/Asia. We have concerns about the potential for contaminants to impede recovery, following multiple studies that indicate that pups in the western Aleutian Islands have relatively high levels of mercury burdens, including levels of mercury that are known to cause serious health effects in other mammals. We also have uncertainty about levels of take in State fisheries, since there are no recent data about levels of take in such fisheries, including fisheries within 3 nm of rookeries and fisheries in which take has been documented in the past. Many of the recovery criteria for downlisting have not been fully met.

In this five-year review, NMFS considered the best scientific and commercial information and data available, which does not support downlisting or delisting the WDPS Steller sea lion. As outlined in this review, the WDPS is not recovered, nor is it extinct, and the WDPS continues to meet the statutory definition of a species (50 CFR 424.11(e)). Neither the demographic nor the listing factor (threats-based) criteria for downlisting have been satisfied fully, and the best available information indicates that threats to this DPS remain. Moreover, the five-factor analysis outlined in this review does not support downlisting or delisting the WDPS Steller sea lion at this time (16 U.S.C. § 1533(a)(1); 50 CFR 424.11(c) & (e)). Therefore, based on new information that has become available since the listing of this DPS, and existing conservation and management measures, we recommend that the WDPS of Steller sea lion retain its status as endangered under the ESA.

## 3.0 RESULTS

### 3.1 Recommended Classification

*Given your responses to previous sections, particularly section 2.4. Synthesis, make a recommendation with regard to the listing classification of the species*

_____**Downlist to Threatened**
_____**Uplist to Endangered**
_____**Delist** *(Indicate reason for delisting per 50 CFR 424.11):*
    _____*Extinction*
    _____*No longer threatened or endangered*
    _____*Does not meet statutory definition of species*
__**X**__**No change is needed**

### 3.2 New Recovery Priority Number

Based on the 2019 NMFS Listing and Recovery Priority Guidelines (84 FR 18243, April 30, 2019) available at https://www.federalregister.gov/documents/2019/04/30/2019-08656/endangered-and-threatened-species-listing-and-recovery-priority-guidelines, we recommend the recovery priority for WDPS Steller sea lions be a 5C, which is defined as a high demographic risk with low to moderate understanding of major threats; a high potential for U.S. jurisdiction, authority, or influence over management actions to address major threats; low to moderate certainty that management or protective actions will be effective; and expected conflict with development projects or other forms of economic activity.

**Brief Rationale:**

Recovery Priority Number 5C acknowledges that threats and uncertainties continue to influence the recovery potential of the WDPS Steller sea lion. While the overall WPDS population is increasing, three contiguous subregions (western and central Aleutians and Russia/Asia) have been in statistically significant decline in a 15-year period. The reasons for that decline are unknown, threats to the population are not well understood, and thus we are not reasonably confident that management or protective actions will reverse the decline in the western portion of the range, even though the U.S. has jurisdiction over many human activities affecting that region. We also anticipate some continued degree of conflict with economic activities, such as commercial fishing and vessel-related disturbance near unprotected rookeries.

As discussed above, although a significant amount of work has been conducted to further our understanding of factors limiting the recovery of WDPS Steller sea lions, and although significant regulatory and non-regulatory measures have been undertaken to control some of those factors, the species does not meet many of the downlisting or delisting criteria. Many of the criteria do not provide specific enough measures to determine what it would take to downlist or delist the species. When the Recovery Plan was last updated in 2008, it was not practicable to provide more objective or measurable criteria for downlisting or delisting. However, in light of more recent information, it may now be possible to provide more direction to researchers and managers as to what it would take to recover the species. This could provide more specific, objective, and measurable guidance regarding the actions to take or uncertainties to address to facilitate recovery.

## 4.0 RECOMMENDATONS FOR FUTURE ACTIONS

- Consider whether a strong rationale continues to exist for the demographic criteria in the Recovery Plan that the population trend in any two adjacent sub-regions cannot be declining significantly.
- Conduct further genetic analyses, including nuclear DNA, and convene a meeting of experts to consider whether the best available scientific information indicates that changes may be warranted to the existing DPS structure for Steller sea lions, including whether the regulatory boundary between the existing two DPSs should be adjusted to better identify geographic areas in which sea lions of WDPS origin are predominant.
- Synthesize all available information regarding the continued decline of WDPS Steller sea lions in the Western and Central Aleutian Islands and in Russia/Asia and develop specific hypotheses to address research gaps.
- Continue to obtain counts of Steller sea lions throughout the range of the WDPS during the breeding season to enable evaluation of trends in pups and non-pups. Continue the current practices and schedules for these surveys.
- Conduct additional research, and conduct a synthesis of existing research, aimed at further understanding indirect and direct effects of both federal and state fishing on the WDPS. Specifically, 1) conduct further research and/or monitoring to evaluate incidental and intentional take of Steller sea lions in State fisheries; 2) evaluate potential effects on Steller sea lion foraging efficiency in both the breeding and the non-breeding season by

evaluating the effects of fishing on the temporal and spatial distribution and abundance of their primary prey; 3) evaluate ecosystem effects of fishing on Steller sea lion primary prey abundance and distribution; and 4) increase electronic monitoring or observer coverage in fisheries to document the extent of interactions with Steller sea lions.

- Conduct additional research on the foraging habitat use of adult females in the non-breeding season, especially in the central and western Aleutians, to determine the most important habitat areas to sustain adult females and their dependent young during the non-breeding season.
- Continue long-term studies of vital rates throughout the range of the WDPS (including the mixing zone in northern Southeast Alaska), including the U.S., Russia, and other parts of Asia. This will be especially important to monitor in light of warming oceans, which could impact prey resources and increase diseases such as biotoxins.
- Continue to determine predation effects on different age classes of WDPS Steller sea lions to assess whether predation is limiting recovery, especially in the central and western Aleutian Islands.
- Conduct additional research on effects of environmental change, including climate change, on the WDPS and the spatial and temporal distribution and abundance of their primary prey.
- Expand the Alaska Marine Mammal Stranding Network and increase collaboration with ANO co-management partners to facilitate increased availability of biological samples from WDPS sea lions to improve understanding of their health and causes of death.
- Conduct additional research on the effects of environmental contaminants, especially mercury and organochlorine compounds, on Steller sea lions in the central and western Aleutian Islands and Russia/Asia.

## 5.0 REFERENCES


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**NATIONAL MARINE FISHERIES SERVICE**
**5-YEAR REVIEW**
***Eumetopias jubatus***

**Current Classification:** Endangered

**Recommendation resulting from the 5-Year Review**

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change is needed

**Review Conducted By:** Kim Raum-Suryan and Dr. Lisa Rotterman, Alaska Region,

**REGIONAL OFFICE APPROVAL:**

**Lead Regional Administrator, NOAA Fisheries**

Approve____________________ Date: February 18, 2020

**HEADQUARTERS APPROVAL:**

**Assistant Administrator, NOAA Fisheries**

✓ Concur ____ Do Not Concur

Signature____________________ Date 3/11/20