# National Marine Fisheries Service, Alaska Region

# Occurrence of Western and Eastern Distinct Population Segment Steller Sea Lions East of 144° W. Longitude

June 2020

## Purpose

This document updates a previous version from 2013 (NMFS 2013a) and provides information about the occurrence of endangered western distinct population segment (WDPS) Steller sea lions (*Eumetopias jubatus*) within areas east of 144° W. longitude (Cape Suckling; Figure 1), as well as the proportion of WDPS versus eastern distinct population segment (EDPS) Steller sea lions in those areas, based on the best available science. This brief summary has been developed to help federal agencies meet their obligations to consult with the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act (ESA), and to provide guidance for authorized or permitted take of WDPS Steller sea lions east of 144° W. longitude (i.e., in the range of the EDPS Steller sea lion) during NMFS authorized research, incidental take, and stranding response activities.

## Background

Beginning in the 1970s, the Steller sea lion population declined by over 80% (Loughlin et al. 1992, Trites and Larkin 1996, Sease et al. 2001) resulting in the species being listed as ‘‘threatened’’ under the ESA. In 1997, the ESA listing of the Steller sea lion was divided into two distinct population segments, the endangered WDPS and the threatened EDPS (62 FR 24345, May 5, 1997) with a dividing line for breeding areas at 144° W. longitude (Figure 1). Research following the 1997 DPS listing provided new information and additional support for recognition of Steller sea lion DPSs (NMFS 2008, Muto et al. 2019). NMFS (2013b) reviewed the genetic and movement data relevant to DPS discreteness and reported an overwhelming collection of morphological, ecological, behavioral, and genetic evidence indicating the eastern and western DPSs remain discrete entities. The most recent Marine Mammal Stock Assessment for the WDPS (Muto et al. 2019) concluded 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).

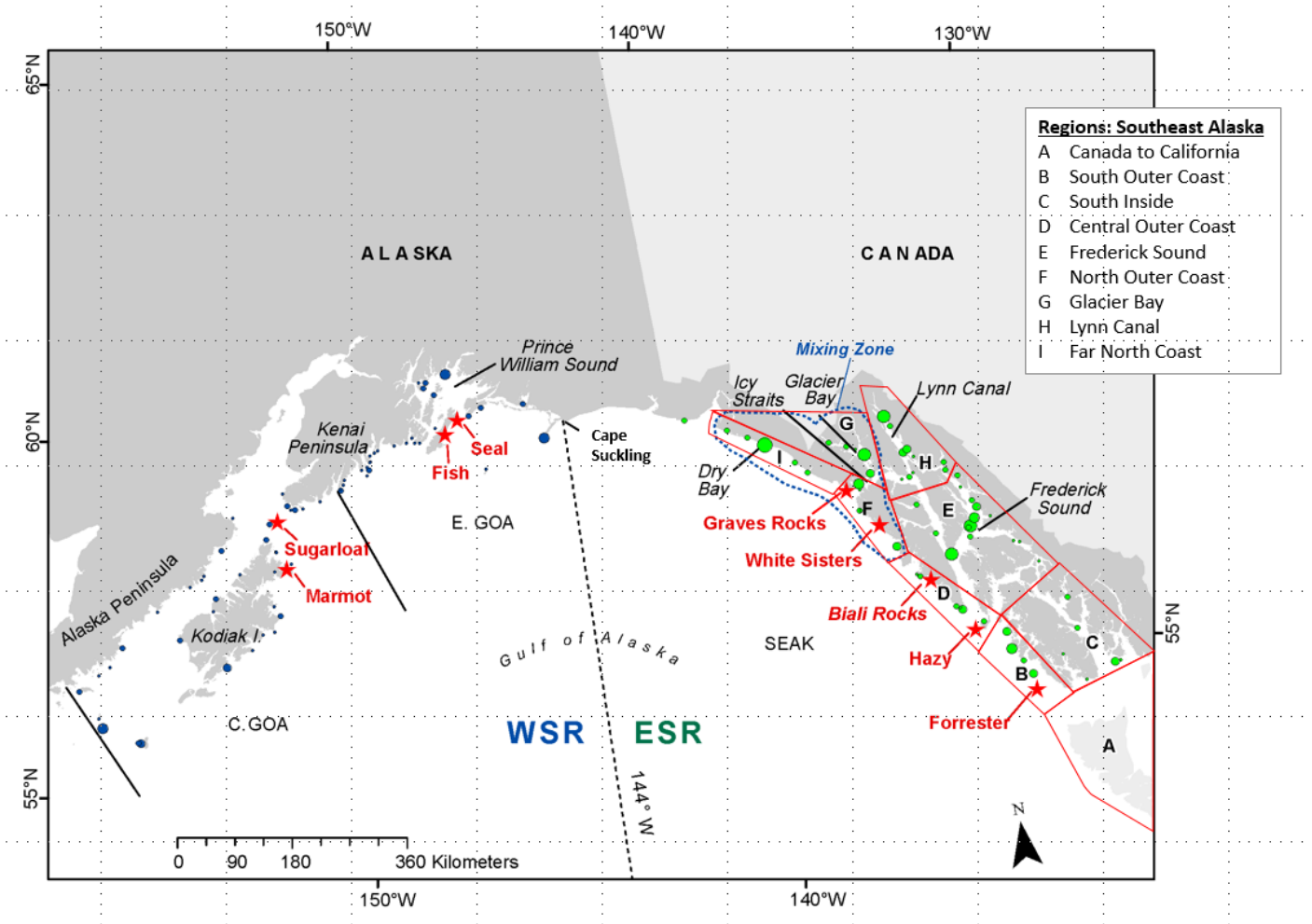


**Figure 1. Map of DPS boundaries, rookery locations, and occurrence regions for WDPS Steller sea lions.** The black dotted line shows the DPS boundary (144° W. longitude) between the EDPS (ESR) and WDPS (WSR). Red stars indicate eight rookeries where pups were marked (sea lions were resighted but not marked at Biali Rocks). Red lines define the nine study regions (see legend for codes). The core Mixing Zone in the EDPS region is delineated by the blue dashed line and is a zone with significant mixing of Steller sea lions born in both the Western and the Eastern Stock regions. Dots are other sites used by at least 20 nonpups (blue dots for the WDPS region and green dots for the EDPS region). The sizes of the dots indicate maximum numbers of nonpups counted during aerial or brand–resight surveys from 2000 to 2015 (ranges are: 20–200, 201–500, 501–1,000, 1,001–1,500, 1,501–2,500, 2,501–3,500, > 3,500). Adapted with permission from K. Hastings, (Hastings et al. 2020).

Steady population growth of the eastern population (Pitcher et al. 2007, Mathews et al. 2011) led to removal of the "threatened" listing for the EDPS in 2013 (78 FR 66140). Due to the delisting, federal agencies are no longer required to consult under Section 7 of the ESA when activities they authorize, fund, or carry out may affect the EDPS. However, because WDPS Steller sea lions occur in some locations east of 144° W. longitude, in this document we provide information to help action agencies and others determine where WDPS Steller sea lions may be present and thus could potentially be affected by coastal development, research, stranding response, or other actions.

The WDPS and EDPS are characterized by a formerly distinct break in mitochondrial DNA (*mt*DNA) lineage distributions (Bickham et al. 1996, O'Corry-Crowe et al. 2006) at 144° W. longitude. This population break is likely ancient and is consistent with a pattern of geographic isolation in one or more glacial refugia in the northern Pacific (Harlin-Cognato et al. 2006). Mixing of these genetic lineages is both very recent and unprecedented in the last 20,000+ years, and is likely a function of the gradual reduction in the size of the historical gap between the breeding distributions of the two populations, possibly poor foraging conditions in the WDPS region, as well as better foraging conditions and positive feedback from conspecific attraction in northern Southeast Alaska (O'Corry-Crowe et al. 2014). Until the 1970s, the closest rookeries (Forrester Island complex 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 number of Steller sea lions increased in the EDPS, especially in northern Southeast Alaska, haulouts slowly transitioned into new rookeries from south to north (Hazy Island rookery was established in approximately 1979, White Sisters in approximately 1990, and Graves Rocks in the late 1990s; Figure 1) (Pitcher et al. 2007). Moreover, it appears that northern Southeast Alaska (including Graves Rocks and Glacier Bay) provide the resources needed for Steller sea lions to reproduce and thrive (Hastings et al. 2011, Mathews et al. 2011). Pups born at Graves Rocks are twice as likely to survive through age seven compared to pups born at southern Southeast Alaska rookeries and females born west of 144° W. longitude that dispersed to Southeast Alaska had higher survival and higher survival of their female offspring to breeding age compared to females that remained west of the 144° W. longitude boundary (Hastings et al. 2011). High productivity (Hastings et al. 2011) likely resulted in part from exposure of new marine habitat following deglaciation, especially in Glacier Bay (see reviews by Mathews et al. 2011, Rehberg et al. 2018).

Based on movement data (Jemison et al. 2013, 2018) and genetic analyses (O'Corry-Crowe et al. 2014), a mixing zone exists in the northern region of the EDPS. Adult females that were born at WDPS rookeries in the central Gulf of Alaska (Figure 1) have been observed giving birth at the northernmost rookeries in the EDPS (Graves Rocks and White Sisters) since 2005 (Jemison et al. 2013). Pups born at these northern EDPS rookeries have WDPS haplotypes (Gelatt et al. 2007) indicating these rookeries were founded by females from both the EDPS and WDPS. 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 (Jemison et al. 2013, O'Corry-Crowe et al. 2014) that indicate that some WDPS Steller sea lions are emigrating to this mixing zone. There appears to be no reciprocal immigration of breeding Steller sea lions from the EDPS to the west.

This scientific information led us to re-evaluate the occurrence of WDPS Steller sea lions east of 144° W. longitude, using the most recent and best available information. Earlier information provided by NMFS (NMFS 2013a) relied on Jemison et al. (2013) who analyzed over 22,000 photo-confirmed sightings of 4,172 Steller sea lions that were branded as pups from 2000-2010 to estimate probabilities of a Steller sea lion born in one DPS being seen within the range of the

other DPS. NMFS (2013a) then defined where abundance was “common” (Cape Suckling to Sumner Strait) or “rare” (Sumner Strait or further south) (Figure 2) and noted that Steller sea lions also occur in offshore waters west of Southeast Alaska (Himes Boor and Small 2012). Lacking data to indicate otherwise, NMFS assumed that “WDPS Steller sea lions may occur in these offshore habitats in a frequency similar to their occurrence at terrestrial habitats in the same general region.”

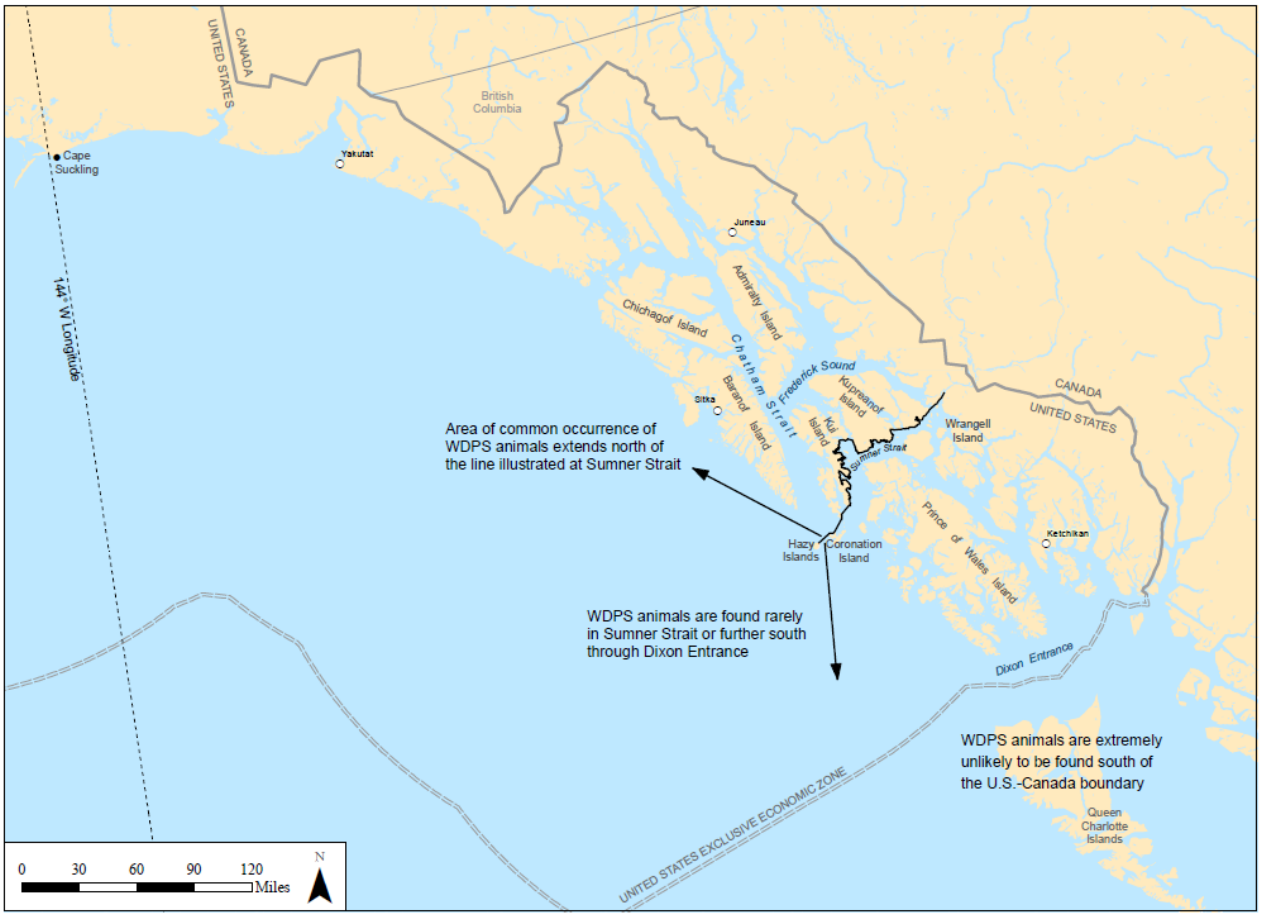


**Figure 2. The occurrence of WPDS Steller sea lions east of 144° W. longitude as depicted in NMFS (2013a).**

## New Information

Recent analyses by Hastings et al. (2020), using resighting data collected through 2018, provides estimates of WDPS Steller sea lion occurrence in the east at a finer geographic scale than Jemison et al. (2013). In a study on Steller sea lion geographic range, distribution, and movements, eight regions (Figure 1) were identified in Southeast Alaska (Jemison et al. 2018) and used also by Hastings et al. (2020). Using mark-recapture models, 18 years of resighting data from over 3500 branded Steller sea lions in the western and eastern regions, and mitochondrial DNA haplotypes from western and eastern populations, Hastings et al. (2020) estimated the minimum proportions of Steller sea lions with western genetic material in

regions of Southeast Alaska. Their analyses found evidence of mixed lineage as well as genetically distinct WDPS Steller sea lions east of 144° W. longitude. For five regions there was sufficient data to estimate the percentage of WDPS Steller sea lions (Table 1). Based on this analysis, the proportion of WDPS Steller sea lions in each region should henceforth be calculated using all nonpups (1+ years old) born in the "western stock region (WSR)".

**Table 1.** Proportions of Steller sea lion nonpups using regions in the population mixing zone (northern–central Southeast Alaska) by birth region, age-class, and maternal genetic lineage (*mt*W or *mt*E: western or eastern maternal haplotype). **The proportion of WDPS Steller sea lions in each region should be calculated using the numbers highlighted in the second row from the bottom of the table.** Birth regions were WSR (born in the Western Stock region, all with *mt*W), MZ (born in the new rookeries in the Mixing Zone of the Eastern Stock region: Graves Rocks and White Sisters, with *mt*W or *mt*E), or South (born in southern Southeast Alaska, Eastern Stock region: Forrester and Hazy rookeries, all with *mt*E). Regions of Southeast Alaska were: F, northern Outer Coast (OC); G, Glacier Bay; H, Lynn Canal; E, Frederick Sound; and D, central Outer Coast (Figure 1). *mt*W Total* = sum of WSR and MZ-*mt*W. Reproduced with permission from K. Hastings, (Hastings et al. 2020).

| Group | Region of Southeast Alaska | | | | |
|---|---|---|---|---|---|
| | F | G | H | E | D |
| | North OC | Glacier Bay | Lynn Canal | Fred. Sound | Central OC |
| Juveniles (1-3 years old) | | | | | |
| South | 0.298 | 0.208 | 0.282 | 0.522 | 0.461 |
| MZ-*mtE* | 0.326 | 0.449 | 0.421 | 0.302 | 0.523 |
| MZ-*mtW* | 0.258 | 0.272 | 0.288 | 0.166 | 0.004 |
| WSR | 0.118 | 0.071 | 0.009 | 0.010 | 0.012 |
| *mtW* Total* | 0.376 | 0.343 | 0.297 | 0.176 | 0.016 |
| | | | | | |
| Animals 4+ years old | | | | | |
| South | 0.203 | 0.207 | 0.510 | 0.765 | 0.665 |
| MZ-*mtE* | 0.411 | 0.396 | 0.375 | 0.170 | 0.290 |
| MZ-*mtW* | 0.314 | 0.322 | 0.098 | 0.053 | 0.014 |
| WSR | 0.072 | 0.075 | 0.017 | 0.012 | 0.031 |
| *mtW* Total* | 0.386 | 0.397 | 0.115 | 0.065 | 0.045 |
| | | | | | |
| All nonpups (1+ years old) | | | | | |
| South | 0.223 | 0.208 | 0.427 | 0.630 | 0.566 |
| MZ-*mtE* | 0.393 | 0.420 | 0.392 | 0.243 | 0.403 |
| MZ-*mtW* | 0.302 | 0.299 | 0.167 | 0.115 | 0.009 |
| **WSR** | **0.082** | **0.073** | **0.014** | **0.012** | **0.022** |
| *mtW* Total* | 0.384 | 0.372 | 0.181 | 0.127 | 0.031 |

## Conclusions

Based on the best available scientific information, as reported in several published, peer-reviewed papers (O'Corry-Crowe et al. 2006, Jemison et al. 2013, O'Corry-Crowe et al. 2014, Jemison et al. 2018, Hastings et al. 2020), we conclude the following:

- WDPS Steller sea lions occur east of 144° W. longitude year-round, but the proportions vary by region. NMFS lacks detailed information on seasonal variability in movement.
- WDPS Steller sea lions are common from Cape Suckling through Yakutat and northern Southeast Alaska to Sumner Strait (see Figures 1 and 2).
- WDPS Steller sea lions are found rarely in Sumner Strait or further south (especially south of Dixon Entrance where their presence is extremely unlikely). Steller sea lions also occur west of Southeast Alaska in the North Pacific Ocean (Himes Boor and Small 2012). Lacking data to indicate otherwise, we assume that WDPS Steller sea lions may occur in these offshore habitats in a frequency similar to their occurrence at terrestrial habitats in the same general region.
- The best available scientific information regarding the proportion of WDPS versus EDPS Steller sea lions likely to be in various regions of Southeast Alaska is reported in Hastings et al. (2020). Specifically, the proportion of WDPS Steller sea lions will be calculated based on Table 1 (*above*) using the "WSR" row for all non-pups (1+ years old) from the "western stock region" (i.e., **the second row from the bottom in Table 1**).
- For the reasons described by Hastings et al. (2020), it is not appropriate to discern the proportion of WDPS versus EDPS Steller sea lions likely to be in various regions of Southeast Alaska using only the percentage of branded animals observed at the nearest haulout. For most locations, few branded Steller sea lions are observed nearby, such that estimated proportions cannot be determined or would be extremely imprecise and potentially misleading (for example, 0–20 branded animals seen). Even for the few sites where sample sizes are large enough that proportions based on raw numbers might be considered reliable, estimating proportions of WDPS versus EDPS Steller sea lions based on such data would introduce several faulty assumptions as noted by Hastings et al. (2020).
- The use of habitat east of 144° W. longitude by WDPS Steller sea lions may change over time and new information may support different conclusions in the future. NMFS will update its conclusions on this issue if new information indicates modification is appropriate.

## References


Baker, A. R., T. R. Loughlin, V. Burkanov, C. W. Matson, R. G. Trujillo, D. G. Calkins, J. K. Wickliffe, and J. W. Bickham. 2005. Variation of mitochondrial control region sequences of Steller sea lions: the three-stock hypothesis. Journal of Mammalogy **86**:1075-1084.

Bickham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). Journal of Mammalogy **77**:95-108.

Gelatt, T. S., A. W. Trites, K. Hastings, L. Jemison, K. Pitcher, and G. O'Corry-Crowe. 2007. Population trends, diet, genetics, and observations of Steller sea lions in Glacier Bay National Park, in Piatt, J.F., and Gende, S.M., eds., Proceedings of the Fourth Glacier Bay Science Symposium, October 26–28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5047, 145-149.

Harlin-Cognato, A., J. W. Bickham, T. R. Loughlin, and R. L. Honeycutt. 2006. Glacial refugia and the phylogeography of Steller's sea lion (*Eumatopias jubatus*) in the North Pacific. Journal of Evolutionary Biology **19**:955-969. https://doi.org/10.1111/j.1420-9101.2005.01052.x

Hastings, K. K., L. A. Jemison, T. S. Gelatt, J. L. Laake, G. W. Pendleton, J. C. King, A. W. Trites, and K. W. Pitcher. 2011. Cohort effects and spatial variation in age-specific survival of Steller sea lions from southeastern Alaska. Ecosphere **2**. http://doi.org/10.1890/ES11-00215.1

Hastings, K. K., M. J. Rehberg, G. M. O'Corry-Crowe, G. W. Pendleton, L. A. Jemison, and T. S. Gelatt. 2020. Demographic consequences and characteristics of recent population mixing and colonization in Steller sea lions, *Eumetopias jubatus*. Journal of Mammalogy **101**:107-120. https://doi.org/10.1093/jmammal/gyz192

Himes Boor, G. K., and R.J. Small. 2012. Steller sea lion spatial-use patterns derived from a Bayesian model of opportunistic observations. Marine Mammal Science **28**(4), E375-E403. https://doi.org/10.1111/j.1748-7692.2011.00541.x

Hoffman, J. I., C. W. Matson, W. Amos, T. R. Loughlin, and J. W. Bickham. 2006. Deep genetic subdivision within a continuously distributed and highly vagile marine mammal, the Steller's sea lion (*Eumetopias jubatus*). Molecular Ecology **15**:2821-2832. https://doi.org/10.1111/j.1365-294X.2006.02991.x

Jemison, L. A., G. W. Pendleton, L. W. Fritz, K. K. Hastings, J. M. Maniscalco, A. W. Trites, and T. S. Gelatt. 2013. Inter-population movements of Steller sea lions in Alaska with implications for population separation. PLoS One **8**(8):e70167. https://doi.org/10.1371/journal.pone.0070167

Jemison, L. A., G. W. Pendleton, K. K. Hastings, J. M. Maniscalco, and L. W. Fritz. 2018. Spatial distribution, movements, and geographic range of Steller sea lions (*Eumetopias jubatus*) in Alaska. PLoS One **13**(12):e0208093. https://doi.org/10.1371/journal.pone.0208093

Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. Marine Mammal Science **8**:220-239. https://doi.org/10.1111/j.1748-7692.1992.tb00406.x

Mathews, E. A., J. N. Womble, G. W. Pendleton, L. A. Jemison, J. M. Maniscalco, and G. Streveler. 2011. Population growth and colonization of Steller sea lions in the Glacier

Bay region of southeastern Alaska: 1970s-2009. Marine Mammal Science **27**:852-880. https://doi.org/10.1111/j.1748-7692.2010.00455.x

Muto, M. M., V. T. Helker, R. P. Angliss, P. L. Boveng, J. M. Breiwick, M. F. Cameron, P. Clapham, S. P. Dahle, M. E. Dahlheim, and B. S. Fadely. 2019. Alaska Marine Mammal Stock Assessments, 2018.

NMFS. 2008. Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*). Revision. National Marine Fisheries Servies, Silver Spring, MD.

NMFS. 2013a. Occurrence of Western distinct population segement Steller sea lions east of 144° W. Longitude. Protected Resources Division, Alaska Region, National Marine Fisheries Service, 709 West 9th St, Juneau, Alaska 99802.

NMFS. 2013b. Status review of the Eastern distinct population segment of Steller sea lion (*Eumetopias jubatus*). 144pp + Appendices. Protected Resources Division, Alaska Region, National Marine Fisheries Service, 709 West 9th St, Juneau, Alaska 99802.

O'Corry-Crowe, G., B. L. Taylor, T. Gelatt, T. R. Loughlin, J. Bickham, M. Basterretche, K. W. Pitcher, and D. P. DeMaster. 2006. Demographic independence along ecosystem boundaries in Steller sea lions revealed by mtDNA analysis: implications for management of an endangered species. Canadian Journal of Zoology **84**:1796-1809. https://doi.org/10.1139/z06-167

O'Corry-Crowe, G., T. Gelatt, L. Rea, C. Bonin, and M. Rehberg. 2014. Crossing to safety: dispersal, colonization and mate choice in evolutionarily distinct populations of Steller sea lions, *Eumetopias jubatus*. Molecular Ecology **23**:5415-5434. https://doi.org/10.1111/mec.12944

Phillips, C. D., J. W. Bickham, J. C. Patton, and T. S. Gelatt. 2009. Systematics of Steller sea lions (*Eumetopias jubatus*): Subspecies recognition based on concordance of genetics and morphometrics. Museum of Texas Tech University, Number 283.

Phillips, C. D., T. S. Gelatt, J. C. Patton, and J. W. Bickham. 2011. Phylogeography of Steller sea lions: relationships among climate change, effective population size, and genetic diversity. Journal of Mammalogy, **92**(5):1091–1104. https://doi.org/10.1644/10-MAMM-A-305.1

Pitcher, K. W., P. F. Olesiuk, R. F. Brown, M. S. Lowry, S. J. Jeffries, J. L. Sease, W. L. Perryman, C. E. Stinchcomb, and L. F. Lowry. 2007. Abundance and distribution of the eastern North Pacific Steller sea lion (*Eumetopias jubatus*) population. Fishery Bulletin 105:102-115.

Rehberg, M., L. Jemison, J. N. Womble, and G. O'Corry-Crowe. 2018. Winter movements and long-term dispersal of Steller sea lions in the Glacier Bay region of Southeast Alaska. Endangered Species Research **37**:11-24. https://doi.org/10.3354/esr00909

Sease, J. L., W. Taylor, T. Loughlin, and K. Pitcher. 2001. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1999 and 2000. NOAA Technical Memorandum NMFS-AFSC **122**:60.

Trites, A. W., and P. A. Larkin. 1996. Changes in the abundance of Steller sea lions (*Eumetopias jubatus*) in Alaska from 1956 to 1992: How many were there? Aquatic Mammals **22**:153-166.