Alaska Marine Mammal Stock Assessments, ~~2022~~ 2023

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PREFACE

On 30 April 1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act (MMPA). Interactions between marine mammals and commercial fisheries are addressed under three new sections. This new regime replaced the interim exemption that had regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaska waters, along the Pacific Coast (including Hawaii), and along the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes, when available, a description of the stock's geographic range; a minimum population estimate; current population trends; current and maximum net productivity rates; optimum sustainable population levels and allowable removal levels; estimates of annual human-caused mortality and serious injury through interactions with commercial, recreational, and subsistence fisheries, takes by subsistence hunters, and other human-caused events (e.g., entanglement in marine debris, ship strikes); and habitat concerns. The commercial fishery interaction data will be used to evaluate the progress of each fishery towards achieving the MMPA's goal of zero fishery-related mortality and serious injury of marine mammals.

The Stock Assessment Reports should be considered working documents, as they are updated as new information becomes available. The Alaska Stock Assessment Reports were originally developed in 1995 (Small and DeMaster 1995). Revisions have been published for the following years: 1996 (Hill et al. 1997), 1998 (Hill and DeMaster 1998), 1999 (Hill and DeMaster 1999), 2000 (Ferrero et al. 2000), 2001 (Angliss et al. 2001), 2002 (Angliss and Lodge 2002), 2003 (Angliss and Lodge 2004), 2005 (Angliss and Outlaw 2005), 2006 (Angliss and Outlaw 2007), 2007 (Angliss and Outlaw 2008), 2008 (Angliss and Allen 2009), 2009 (Allen and Angliss 2010), 2010 (Allen and Angliss 2011), 2011 (Allen and Angliss 2012), 2012 (Allen and Angliss 2013), 2013 (Allen and Angliss 2014), 2014 (Allen and Angliss 2015), 2015 (Muto et al. 2016), 2016 (Muto et al. 2017), 2017 (Muto et al. 2018), 2018 (Muto et al. 2019), 2019 (Muto et al. 2020), 2020 (Muto et al. 2021)~~, and~~ 2021 (Muto et al. 2022), and 2022 (Young et al. 2023). Each Stock Assessment Report is designed to stand alone and is updated as new information becomes available. The MMPA requires Stock Assessment Reports to be reviewed annually for stocks designated as strategic, annually for stocks where there is significant new information available, and at least once every 3 years for all other stocks. NMFS reviewed new information for ~~35~~ 24 existing stocks (including all of the strategic stocks) in the Alaska Region for the ~~2022~~ 2023 Stock Assessment Report cycle and updated information or developed new reports for ~~9~~ 5 stocks contained in ~~7~~ 5 Stock Assessment Reports under NMFS' jurisdiction: ~~4~~ 3 strategic stocks (~~Southern Southeast Alaska Inland Waters harbor porpoise, Western North Pacific humpback whales, Mexico-North Pacific humpback whales,~~ Western stock of Steller sea lions, Eastern North Pacific stock of North Pacific right whales, and Western Arctic stock of bowhead whales) and ~~5~~ 2 non-strategic stocks (~~Eastern Bering Sea beluga whales, Eastern North Pacific Alaska Resident killer whales, Northern Southeast Alaska Inland Waters harbor porpoise, Yakutat/Southeast Alaska Offshore Waters harbor porpoise, and Hawai'i humpback whales~~Eastern stock of Steller sea lions and Sato's beaked whales stock). The Stock Assessment Reports for all of the Alaska stocks, however, are included in the final document to provide a complete reference. Those sections of each Stock Assessment Report containing substantial changes in ~~2022~~ 2023 are listed in Appendix 1. The authors solicit any new information or comments which would improve future Stock Assessment Reports.

In the ~~2022~~ 2023 Stock Assessment Reports, ~~stock structure was revised for the Southeast Alaska harbor porpoise stock, which was split into three stocks in one report: the Northern Southeast Alaska Inland Waters, Southern Southeast Alaska Inland Waters, and Yakutat/Southeast Alaska Offshore Waters harbor porpoise stocks. Stock structure was also revised for all North Pacific humpback whale stocks. The three existing North Pacific humpback whale stocks (Central North Pacific and Western North Pacific stocks contained in the Alaska SAR and the CA/OR/WA stock contained in the Pacific SAR) were replaced by five stocks (Western North Pacific, Hawai'i, and Mexico-North Pacific stocks contained in the Alaska SAR and the Central America/Southern Mexico-CA/OR/WA and Mainland Mexico-CA/OR/WA stocks contained in the Pacific SAR).~~a new stock was added for Sato's beaked whale, which is a newly recognized species.

New abundance estimates were calculated for the following Alaska stocks in the ~~2022~~ 2023 Stock Assessment Reports. For explanations of why estimates have changed, see the individual report for each stock:

- ~~Eastern Bering Sea beluga whales: The updated best estimate of abundance, derived from a 2017 aerial line-transect survey and corrected for various biases, is 12,269 beluga whales. This is an increase from the 2000 estimate of 6,994, which was considered to be an underestimate. Other sources of potential negative bias may still affect the estimate for 2017 but additional information is necessary for further refinement.~~
- ~~Eastern North Pacific Alaska Resident killer whales: The updated best estimate of abundance, derived from photo-identifications from 2005 to 2019, is 1,920 killer whales. This is considered an underestimate because some of the pods have not been photo-identified since 2005-2012 and researchers continue to encounter new whales.~~

- ~~Northern Southeast Alaska Inland Waters and Southern Southeast Alaska Inland Waters harbor porpoise: The best estimates of abundance, derived from a vessel survey in 2019, are 1,619 and 890 harbor porpoise, respectively. A current estimate of abundance is not available for the Yakutat/Southeast Alaska Offshore Waters stock.~~
- ~~Western North Pacific humpback whales: The best estimates of abundance for the stock (1,084) and the portion of the stock migrating to summering areas in U.S. waters (127) were derived from a reanalysis of the 2004-2006 SPLASH data (Wade 2021). Although these data are more than fifteen years old, the estimates are still considered valid minimum population estimates.~~
- ~~Hawaiʻi humpback whales: The best estimate of abundance, 11,278, was derived from a species distribution model and represents the peak abundance of humpback whales around the main Hawaiian Islands during 2020. Because the estimate is derived from the model output for a specific one-month time period, this may under-represent the full abundance of whales that overwinter in the region because individual whales may not have a very long residence time in Hawaiʻi.~~
- Western Steller sea lions: The updated best model estimated count, derived from aerial photographic and land-based surveys in 2021 and 2022, is 49,837 sea lions. This is a decrease from the previous estimate of 52,932. The model estimated count is not a total population abundance estimate because the count has not been corrected for animals at sea during the surveys or for pups that are born before or die after the surveys. New mixing between the Eastern and Western stocks in areas of northern Southeast Alaska are accounted for by adjusting the minimum abundance, mortality and serious injury, and PBR calculations.
- Eastern Steller sea lions: The updated best model estimated count, derived from aerial photographic and land-based surveys in 2015-2022, is 36,308 sea lions. This is a decrease from the previous estimate of 43,201. The model estimated count is not a total population abundance estimate because the count has not been corrected for animals at sea during the surveys or for pups that are born before or die after the surveys. New mixing between the Eastern and Western stocks in areas of northern Southeast Alaska are accounted for by adjusting the minimum abundance, mortality and serious injury, and PBR calculations.
- Western Arctic bowhead whales: The updated best estimate of abundance, derived from an inverse-variance weighted average of abundance estimates derived from ice-based counts and aerial line-transect surveys in 2019, is ~~14,025~~ 15,227 bowhead whales. This is an ~~decrease~~ increase from the previous estimate of ~~16,820~~ 14,025, which was derived from the 2019 ice-based estimate alone.~~; however, it is~~ All three of these estimates are considered to be ~~an~~ underestimates and not a true decline in abundance. ~~due to the abnormal ice conditions and migration route during the 2019 survey.~~During the ice-based survey, the ice conditions and the bowhead whale migration route were atypical, and any whales that did not migrate past Point Barrow were excluded from the survey design. The study area for the aerial survey did not encompass the entire known range of the stock during the survey period, and a small statistical bias has not been accounted for in the resulting abundance estimate.

The U.S. Fish and Wildlife Service (USFWS) has management authority for polar bears, sea otters, and walruses. The stock assessments for these species are published separately by USFWS and are available online at https://www.fws.gov/library/collections/marine-mammal-stock-assessment-reports.

Ideas and comments from the Alaska Scientific Review Group have significantly improved this document from its draft form. The authors wish to express their gratitude for the thorough reviews and helpful guidance provided by the Alaska Scientific Review Group members: John Citta, Beth Concepcion, Thomas Doniol-Valcroze, Donna Hauser, Nicole Wojciechowski, ~~Mike Miller,~~ Greg O'Corry-Crowe (Co-Chair in 2019-~~2022~~2023), Lorrie Rea, Megan Williams (Co-Chair in 2019-~~2022~~2023), Eric Regehr, ~~and~~ Kate Stafford, and Lori Quakenbush. We would also like to acknowledge the contributions from the NMFS Alaska Regional Office and the Communications Program of the Alaska Fisheries Science Center.

The information contained within the individual Stock Assessment Reports is from a variety of sources. Where feasible, we have attempted to use only published material. When citing information contained in this document, authors are reminded to cite the original publications, when possible.

CONTENTS*

*NMFS Stock Assessment Reports and Appendices revised in ~~2022~~2023 are in boldface.

Revised ~~12/30/2020~~ 8/29/2023

STELLER SEA LION (*Eumetopias jubatus*): Western ~~U.S.~~ Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

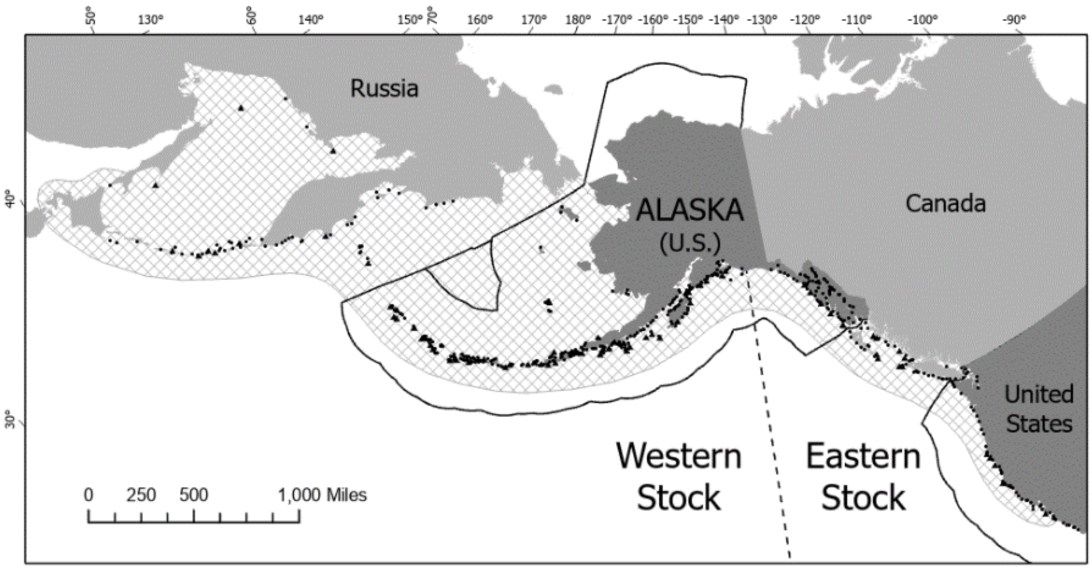


Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005, Olesiuk ~~2008~~2018). A black dashed line (144°W) indicates the stock boundary (Loughlin 1997) and a black line delineates the U.S. Exclusive Economic Zone.

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984) (Fig. 1). Outside of the breeding season (late May to July), large numbers of individuals, especially juveniles and males, disperse widely, probably to access seasonally important prey resources (Jemison et al. 2018). This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing of animals that were born in different regions (Sease and York 2003; Baker et al. 2005; Jemison et al. 2013, 2018; Hastings et al. ~~2019~~ 2020). The Western stock is transboundary, extending west from Cape Suckling in the Gulf of Alaska into Asia. During the breeding season, Steller sea lions, especially adult females, typically return to their natal rookery or a nearby breeding rookery to breed and pup (Raum-Suryan et al. 2002, Hastings et al. 2017).

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals among rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: differences in pup mass (Merrick et al. 1995, Loughlin 1997); and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two ~~distinct population segments (DPSs)~~ stocks of Steller sea lions were recognized ~~in the U.S.~~: the Eastern ~~DPS~~ stock, which includes animals born east of Cape Suckling, Alaska (144°W), and the Western ~~DPS~~ stock, which includes animals born at and west of Cape Suckling (Loughlin 1997; Fig. 1). These stocks are equivalent to the eastern and western distinct population segments (DPSs) identified under the Endangered Species Act (62 FR 24345, 62 FR 30772). ~~However, there is regular movement of Steller sea lions, especially juveniles and males outside the breeding season, between the Western DPS (males and females equally) and the Eastern DPS (almost exclusively males) across the DPS boundary (Jemison et al. 2013, 2018; Hastings et al. 2019). In this report, the Western DPS is equivalent to the Western stock and the Eastern DPS is equivalent to the Eastern stock.~~

All genetic analyses (Baker et al. 2005; Harlin-Cognato et al. 2006; Hoffman et al. 2006, 2009; O'Corry-Crowe et al. 2006) confirm a strong separation between Western and Eastern stocks, and O'Corry-Crowe et al. (2006) identified structure at the level of different oceanic regions within the Aleutian Islands. There may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009), although a review by Berta and Churchill (2012) characterized the status of these subspecies assignments as "tentative" and requiring further attention before their status can be determined. Work by Phillips et al. (2011) addressed the effect of climate change, in the form of glacial events, on the evolution of Steller sea lions and reported that the effective population size at the time of the event determines the impact of change on the population. The results suggested that during historic glacial periods, dispersal events were correlated with historically low effective population sizes, whereas range fragmentation type events were correlated with larger effective population sizes. This work again reinforced the separation of the Western and Eastern stocks by noting that ancient population subdivision likely led to the sequestering of most mitochondrial DNA (mtDNA) haplotypes as stock or subspecies-specific (Phillips et al. 2011).

Observations of marked sea lions indicate there is regular movement of Steller sea lions across the stock boundary, especially by juveniles and males outside the breeding season (Jemison et al. 2013, 2018; Hastings et al. 2020). During the breeding season, an equal number of male and female Western stock Steller sea lions have been observed in the Eastern stock area, while Eastern stock sea lions observed moving west have been almost exclusively males (Jemison et al. 2013, 2018; Hastings et al. 2020). Mixing of mostly breeding females occurred between Prince William Sound and northern Southeast Alaska, beginning in the 1990s (Gelatt et al. 2007; Jemison et al. 2013, 2018; O'Corry-Crowe et al. 2014; Rehberg et al. 2018). In 1998 a single Steller sea lion pup was observed on Graves Rock just north of Cross Sound in Southeast Alaska, and within 15 years (2013) pup counts increased to 551 (DeMaster 2014). Movements of animals marked as pups in both stocks corroborate the extensive genetic research findings for a strong separation between the two currently recognized stocks (Jemison et al. 2013, 2018). Mitochondrial and microsatellite analysis of pup tissue samples collected at Graves Rock in 2002 revealed that approximately 70% of the pups had mtDNA haplotypes that were consistent with those found in the Western stock (Gelatt et al. 2007). Similarly, a rookery to the south on the White Sisters Islands, where pups were first noted in 1990, was also sampled in 2002 and approximately 45% of those pups had Western stock haplotypes (O'Corry-Crowe et al. 2014). Hastings et al. (~~2019~~ 2020) estimated that a minimum of 38% and 13% of animals in the North Outer Coast-Glacier Bay and Lynn Canal-Frederick Sound regions in northern Southeast Alaska, respectively, carry genetic information unique to the Western stock. Collectively, this information demonstrates that these two most recently established rookeries in northern Southeast Alaska were partially to predominant~~e~~ly established by Western stock females (Jemison et al. 2013, 2018; O'Corry-Crowe et al. 2014; Rehberg et al. 2018; Hastings et al. ~~2019~~ 2020).

While movements of animals marked as pups in both stocks support these genetic results (Jemison et al. 2013, 2018; Hastings et al. 2020), overall the observations of marked Steller sea lion movements corroborate the extensive genetic research findings for a strong separation between the two currently recognized stocks. O'Corry-Crowe et al. (2014) concluded that the results of their study of the genetic characteristics of pups born on these new rookeries "demonstrates that resource limitation may trigger an exodus of breeding animals from declining populations, with substantial impacts on distribution and patterns of genetic variation." Jemison et al. (2018) also found that movement of Prince William Sound females east to these rookeries was negatively correlated with density: the population's declines prior to the early 2000s likely spurred these animals to move east in search of better foraging opportunities. This movement also revealed that this event is rare because colonists dispersed across an evolutionary boundary, suggesting that the causative factors behind recent declines are unusual or of larger magnitude than normally occur (O'Corry-Crowe et al. 2014).

Thus, although recent colonization events in the northern part of the Eastern stock area indicate movement of Western stock sea lions (especially adult females) into this area, the mixed part of the range remains geographically distinct (Jemison et al. 2013, 2018), and the discreteness between the Eastern and Western stocks remains. ~~Movement of Western stock sea lions south of these rookeries and Eastern stock sea lions moving to the west is less common (Jemison et al. 2013, O'Corry-Crowe et al 2014).~~

Hybridization among subspecies and species along a contact zone such as a stock boundary is not unexpected as the ability to interbreed is an ancestral condition, whereas reproductive isolation would be considered a recently derived condition. ~~As stated by NMFS and the U.S. Fish and Wildlife Service (USFWS) in a 1996 response to a previous comment regarding stock discreteness policy (61 FR 47222), "*The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment*" or stock.~~ The level of differentiation indicates long-term reproductive isolation resulting from four glacial refugia events 60,000 to 180,000 years before present (Harlin-Cognato et al. 2006). The fundamental concept overlying this distinctiveness is the collection of morphological, ecological, behavioral, and genetic evidence for stock differences initially described by Bickham et al. (1996) and Loughlin (1997) and supported by Baker et al. (2005), Harlin-Cognato et al. (2006), Hoffman et al. (2006, 2009), O'Corry-Crowe et al. (2006), ~~and~~ Phillips et al. (2009, 2011), and Hastings et al. (2020). As stated by NMFS and the U.S. Fish and Wildlife Service (USFWS) in a 1996 response to a previous comment regarding their joint DPS policy (61 FR 4722), “The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment” or stock.

~~Steller sea lions that breed in Asia are considered part of the Western stock in the 2008 Steller sea lion Recovery Plan (NMFS 2008).~~ In Asia, Steller sea lions seasonally inhabit coastal waters of Japan ~~in the winter~~during the non-breeding season and breeding rookeries ~~of Western stock animals outside of the U.S.~~ are ~~currently~~ only located in Russia (Burkanov and Loughlin 2005). Analyses of genetic data differ in their interpretation of ~~separation between~~ an Asian stock separate from the ~~and Alaska~~ Western stock of Steller sea lions. Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split in Russia between ~~the Commander Islands (Russia) and~~ Kamchatka and the Commander Islands, with the latter being~~that would~~ included ~~Commander Island sea lions within~~ as part of the Western ~~U.S.~~ stock with Alaska sea lions~~and animals west of there in an Asian stock~~. However, Hoffman et al. (2006) did not support a~~n Asian/Western~~ stock split based on their analysis of nuclear microsatellite markers indicating high rates of male gene flow. Further, Berta and Churchill (2012) concluded that a putative Asian stock is “not substantiated by microsatellite data since the Asian stock groups with the Western stock.” In the 2008 Steller sea lion Recovery Plan (NMFS 2008), sea lions that breed in Asia are considered part of the Western stock. ~~All genetic analyses (Baker et al. 2005; Harlin-Cognato et al. 2006; Hoffman et al. 2006, 2009; O’Corry-Crowe et al. 2006) confirm a strong separation between wWestern and eEastern stocks, and O’Corry-Crowe et al. (2006) identified structure at the level of different oceanic regions within the Aleutian Islands. There may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009), although a review by Berta and Churchill (2012) characterized the status of these subspecies assignments as “tentative” and requiring further attention before their status can be determined. Work by Phillips et al. (2011) addressed the effect of climate change, in the form of glacial events, on the evolution of Steller sea lions and reported that the effective population size at the time of the event determines the impact of change on the population. The results suggested that during historic glacial periods, dispersal events were correlated with historically low effective population sizes, whereas range fragmentation type events were correlated with larger effective population sizes. This work again reinforced the stock delineation concept by noting that ancient population subdivision likely led to the sequestering of most mtDNA haplotypes as stock or subspecies-specific (Phillips et al. 2011).~~

POPULATION SIZE

The Western stock of Steller sea lions decreased from 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). Since 2003, the abundance of the Western stock has increased, but there has been considerable regional variation in trend (Sease and Gudmundson 2002; Burkanov and Loughlin 2005; Fritz et al. 2013, 2016). Abundance surveys to count Steller sea lions are conducted in late June through mid-July starting approximately 10 days after the mean pup birth dates in the survey area (4-14 June) after approximately 95% of all pups are born (Pitcher et al. 2001, Kuhn et al. 2017). Modeled counts and trends are reported for the~~ total~~ Western stock in Russia and Alaska. The geographic range in Alaska is composed of~~ and the~~ six regions (eastern, central, and western Gulf of Alaska and eastern, central, and western Aleutian Islands)~~; that compose this geographic range. T~~the boundaries ~~for the six regions~~of which were identified based on metapopulation analysis of survey count data collected from 1976 to 1994 (York et al. 1996).

An updated agTrend model (R package; Johnson and Fritz 2014, Gaos et al. 2021) was used to estimate counts and trends by augmenting missing counts. The updated agTrend model uses the penalized spline model to reduce variance for years where missing data is interpolated (Gaos et al. 2021). This model improves upon the previous method, which used a random walk time series model (Johnson and Fritz 2014), providing more precise estimates. Non-pup counts do not account for animals at sea and therefore cannot be used as an abundance estimate. Pup counts are considered a census (i.e., total pup production) however, these counts do not account for pups that are born, or die, after the surveys.~~NMFS uses raw counts collected during the period from 1978 through 2019 to model counts and annual rates of change of non-pups and pups for regional aggregations using agTrend (Johnson and Fritz 2014). Using this model produces two types of count estimates: predicted and realized counts. Predicted counts are used to estimate trends and account for both observation and process errors. Realized counts use the standardized variance of raw counts at each site throughout the time series to estimate survey counts we could expect to collect if we had completely surveyed all sites. Therefore, the more complete the survey, the more similar raw counts are to realized counts, which is evident by smaller confidence intervals. Modeled counts, like raw counts, do not account for animals at sea; however, pup counts are considered a census of live pups as they are generally not in the water during the survey period.~~

Demographic multipliers (e.g., pup production multiplied by 4.5) and corrections for proportions of each age-sex class that are hauled out during the day in the breeding season (when aerial surveys are conducted) have been proposed as methods to estimate total population size from pup and/or non-pup counts (Calkins and Pitcher 1982, Higgins et al. 1988, Milette and Trites 2003, Maniscalco et al. 2006). There are several factors which make using demographic multipliers problematic~~ when applied to counts of Western Steller sea lions in Alaska~~, including the lack of more recent vital (survival and reproductive) rate information, the lack of vital rate information for the western and central Aleutian Islands, the large variability in abundance trends across the range (see Current Population Trend section below and Pitcher et al. 2007), and the large uncertainties related to reproductive status and foraging conditions that affect proportions hauled out (see review in Holmes et al. 2007).

The most recent comprehensive aerial photographic and land-based surveys of Western Steller sea lions in Alaska were conducted during the 2021 (Southeast Alaska and Gulf of Alaska east of Shumagin Islands) and 2022~~2018~~ (Aleutian Islands west of Shumagin Islands) ~~and 2019 (Southeast Alaska and Gulf of Alaska east of Shumagin Islands)~~ breeding seasons (Sweeney et al. ~~2018, 2019~~2022, 2023). The Western Steller sea lion pup and non-pup model-predicted count estimates in Alaska (U.S. range of the stock) in ~~2019~~ 2022 were 11,987~~12,581~~ (95% credible interval of 11,291-12,703~~11,308-14,051~~) and 37,333~~40,351~~ (34,274-40,245~~35,886-44,884~~), respectively.

Methods used to survey Steller sea lions in Russia differ from those used in Alaska, with ~~less use of aerial photography and~~ more use of skiff surveys and cliff counts for non-pups and ground counts for pups (Burkanov ~~2018a~~2020). Since 2016~~2015~~, the use of uncrewed aircraft systems (drones) has allowed more survey effort to collect aerial imagery, similar to survey methods used for the Alaska range (Burkanov ~~2018a~~2020). ~~The most recent total count of live pups on rookeries in Russia is available from counts conducted in 2016 and 2017, which totaled 5,629 pups, about 11% more than the 5,073 pups counted in 2013 and 2015 (Burkanov 2018b).~~ Counts and trends for non-pups and pups were modeled using agTrend for the six regions in Russia (Commander Islands, East Kamchatka, Kuril Islands, northern part of Sea of Okhotsk, Sakhalin Island, and western Bering Sea) that compose the Steller sea lion geographic range along the entire Asian coast, because the species is absent in Japan during the breeding season (Fig. 2). ~~Rookery pup counts represent more than 95% of pup counts at all sites (including haulouts) but are underestimates of total pup production. Modeled counts and trends are reported for non-pups only (there are not robust data available to model pup counts) for the six regions (Commander Islands, east Kamchatka, Kuril Islands, northern part of Sea of Okhotsk, Sakhalin Island, and western Bering Sea) that compose the geographic range in Russia (Fig. 2).~~ In ~~2017~~2022, the non-pup modeled count estimate was~~ modeled to be 13,691~~ 17,342 (95% credible interval of~~ 12,225-15,133~~ 13,944-21,354) and for pups 6,032 (95% credible interval of 5,555-6,541) ~~in Russia (Burkanov 2017, Johnson 2018)~~.

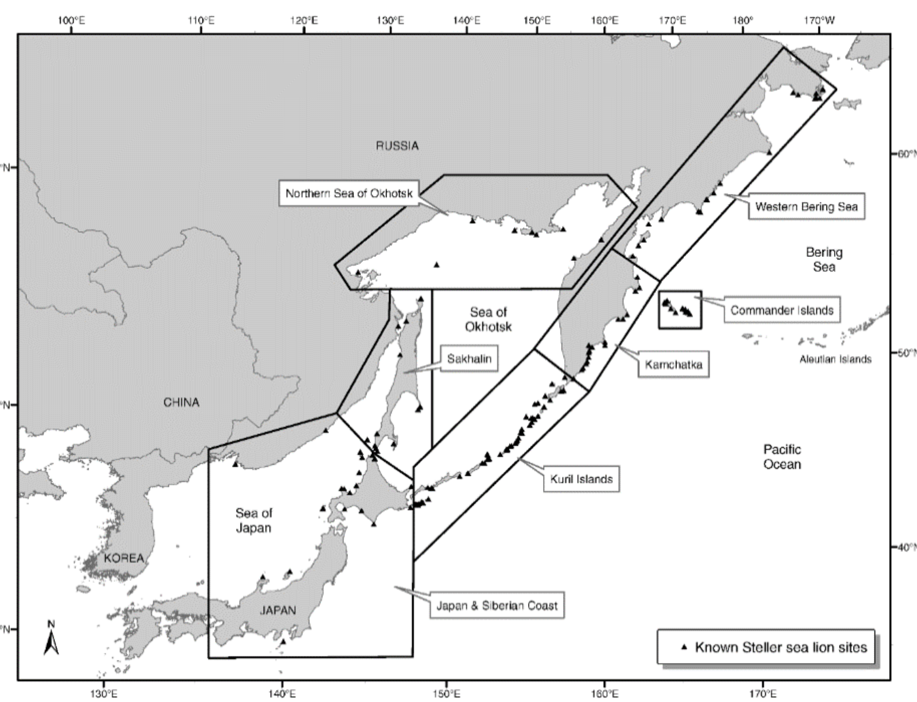


Figure 2. Steller sea lion survey regions along the Asian coast (Burkanov and Loughlin 2005).

Minimum Population Estimate

~~The minimum population estimate (N_{MIN}) can be defined by the 20th percentile of a log-normal distribution based on a population abundance estimate for the stock (Wade 1994). Because current population size (N) and a pup multiplier to estimate N are not known we cannot produce an abundance estimate. With agTrend we can produce a sum of non-pup and pup modeled counts, which don't account for non-pups at sea, or animals that are born or die after the survey. Therefore, the summed count estimate is lower than an abundance estimate and we should not use the 20th percentile of this number. We use the best estimate of the total count of Western Steller sea lions in Alaska as the minimum population estimate (N_{MIN}). The agTrend model (Johnson and Fritz 2014) was used to estimate Western Steller sea lion pup and non-pup counts of 12,581 and 40,351, respectively, in Alaska in 2019 (Sweeney et al. 2019). These sum to 52,932, which will be used as the N_{MIN} for the U.S. portion of the Western stock of Steller sea lions (NMFS 2016).~~

Steller sea lion non-pups from the Western stock occur in Southeast Alaska, east of the stock boundary line ~~in Southeast Alaska~~ (O'Corry-Crowe et al. 2006; Jemison et al. 2013, 2018; O'Corry-Crowe et al. 2014; Hastings et al. 2020). Hastings et al. (2020) reported 7-8% of non-pups that occurred in Southeast Alaska in the summer were born in the Western stock area. They principally occurred in the north outer coast (identified as population mixing zone "F," Table 1; Fig. 3) and Glacier Bay (G), and at lower proportions in Lynn Canal (H), Frederick Sound (E), and the Central Outer Coast (D). Using the Hastings et al. (2020) proportions for Western stock non-pups in Southeast Alaska allows for apportionment of modeled counts to the corresponding stock by adjusting the N_{MIN} to help account for movement between stocks.

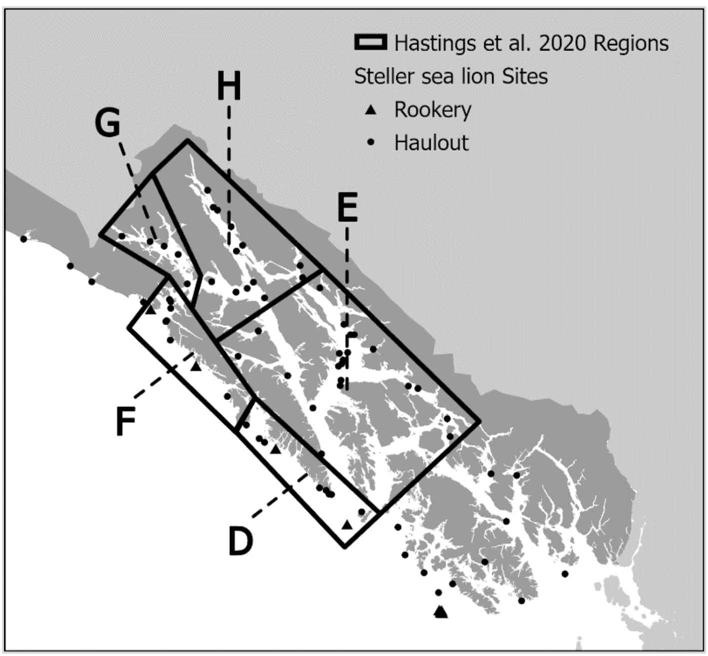


Figure 3. Hastings et al. (2020) mixing zones where non-pups born in the western stock area were reported to inhabit in different proportions, with most in the North Outer Coast (F) and Glacier Bay (G), and at lower proportions in Lynn Canal (H), Frederick Sound (E), and the Central Outer Coast (D) (Table 1).

AgTrend modeled non-pup predicted counts by site were aggregated into the population mixing zones and the Western stock proportion was applied to calculate the number of Western stock non-pups in Southeast Alaska (Table 1; Hastings et al. 2020). This total number of Western stock non-pups in Southeast Alaska (517) was added to the estimated total number of Western stock pups and non-pups. As discussed above, the current population size (N) is unknown as there is no method for deriving abundance estimates from agTrend modeled counts and modeled counts are considered "minimum" estimates of population size. Pup counts are considered a census (i.e., total pup production) however, these counts do not account for pups that are born, or die, after the surveys.

While there are conflicting interpretations around the distinction of an Asian stock separate from the Western stock, NMFS' Steller sea lion Recovery Plan for the management and recovery of the Western stock includes all of

Russia as a part of the Western stock. Therefore, we report the minimum population estimate for the entire Western stock of Steller sea lions in 2022 was 73,211 (summing: 17,342 non-pups and 6,032 pups in Russia, 37,333 non-pups and 11,987 pups in Alaska, and 517 Western stock non-pups in the Eastern stock area). The NMIN for the U.S. portion of the Western stock was 49,837 (summing: 37,333 non-pups, 11,987 pups, and 517 Western stock non-pups in the Eastern stock area).

Table 1. Steller sea lion non-pup apportionment to stock using the Hastings et al. (2020) proportions of Western stock non-pups in Southeast Alaska. Proportions were applied to agTrend modeled predicted counts to estimate the number of western- and eastern- born non-pups in the Hastings et al. (2020) population mixing zones.

Southeast Alaska Area	**Population Mixing Zone**	**Western Stock Non-Pup Proportion**	**Modeled Non-Pup Count**	**Western Stock Non-Pup Count**	**Eastern Stock Non-Pup Count**
Central Outer Coast	D	0.022	3,131	69	3,062
Frederick Sound	E	0.012	1,850	22	1,828
North Outer Coast	F	0.082	3,826	314	3,512
Glacier Bay	G	0.073	1,423	104	1,319
Lynn Canal	H	0.014	578	8	570
Remaining Southeast Alaska	I, B, C	-	6,298	-	6,298
TOTAL			17,106	517	16,589

Current Population Trend

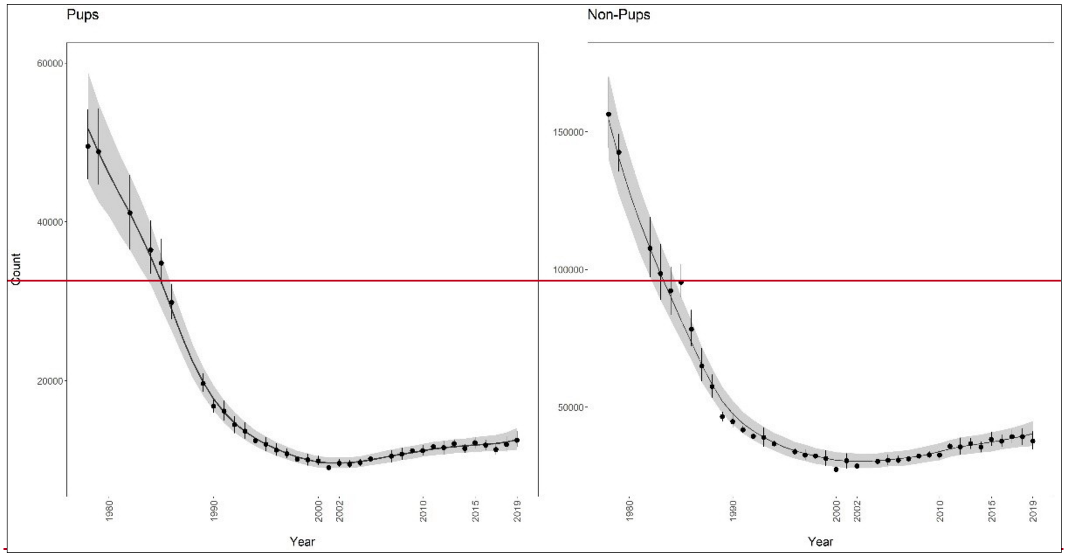
The first reported trend counts (sums of counts at consistently surveyed, large sites used to examine population trends) of Steller sea lions in Alaska were made in 1956-1960. Those counts indicated that there were at least 140,000 (no correction factor applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Counts from 1976 to 1979 totaled about 110,000 sea lions (no correction factor applied). The decline appears to have spread eastward to Kodiak Island during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). During the late 1980s, counts in Alaska overall declined at approximately 15% per year (NMFS 2008), which prompted the listing (in 1990) of the species as threatened range-wide under the Endangered Species Act (ESA). Continued declines in counts of Western Steller sea lions in Alaska in the 1990s (Sease et al. 2001) led NMFS to change the ESA listing status of the Western stock to endangered in 1997 (NMFS 2008). Surveys in Alaska in 2002~~, however,~~ were the first to note an increase in counts, which suggested that the overall decline of Western Steller sea lions stopped in the early 2000s (Sease and Gudmundson 2002).

~~Johnson and Fritz's (2014) agTrend model 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 (also see Fritz et al. 2013, 2016).~~ Using the updated agTrend model, ~~modeled~~we used count data from 1973 to 2022 for pups and 1978 to 2022 for non-pups ~~1978 to 2019 were used~~ to ~~produce~~ estimate trends for the ~~total~~ Western ~~DPS~~stock in Alaska, east and west of Samalga Pass, and the six central, western, and eastern Gulf of Alaska and Aleutian Island regions (Table 2).

Model results indicated that pup and non-pup counts of Western stock Steller sea lions in Alaska were at their lowest levels in 2002. Within the last 15-year period (2007 to 2022), pup and non-pup counts ~~and have~~ increased at ~~1.63~~0.50% y^{-1} and ~~1.82~~1.05% y^{-1}, respectively~~, between 2002 and 2019~~ (Table ~~1~~2; Fig. ~~3~~4; Sweeney et al. ~~2019~~2023). ~~However, t~~There are ~~strong~~ regional differences in trend across the range in Alaska, with positive or plateaued trends in the Gulf of Alaska and the eastern Aleutian Islands region, including the eastern Bering Sea (east of Samalga Pass, ~170°W), and generally negative or plateaued trends to the west of Samalga Pass, in the central and western Aleutian Islands (Table ~~1~~2; Figs. ~~4~~5 and ~~5~~6).

Table ~~1~~2. Trends (annual rates of change expressed as % y^{-1} with 95% credible interval) in counts of Western Steller sea lion pups and non-pups (adults and juveniles) in Alaska, by regional areas. The rates reported for the Western ~~DPS~~stock in Alaska; east and west of Samalga Pass;~~ and~~ eastern, central, and western Gulf of Alaska; ~~were calculated for the period from 2002 to 2019 (Sweeney et al. 2019). The rates reported for west of Samalga Pass~~ and eastern, central, and western Aleutian Islands were calculated for the period from 2007~~2002 (when the Western DPS as a whole began to rebound)~~ to 2022~~2018~~ (Sweeney et al. 2022, 2023~~2018~~).

Region	Latitude Range	Pups				Non-pups		
		Trend	-95%	+95%		Trend	-95%	+95%
Western ~~DPS~~stock in Alaska	144°W-172°E	~~1.63~~ 0.50	~~1.12~~ 0.04	~~2.16~~ 0.96		~~1.82~~ 1.05	~~1.29~~ 0.46	~~2.38~~ 1.69
East of Samalga Pass	144°-170°W	~~2.90~~ 1.35	~~2.37~~ 0.84	~~3.53~~ 1.91		~~2.71~~ 1.52	~~2.05~~ 0.82	~~3.35~~ 2.20
Eastern Gulf of Alaska	144°-150°W	~~2.68~~ 0.81	~~1.08~~ -0.53	~~4.36~~ 2.13		~~3.32~~ -0.21	~~1.42~~ -2.25	~~5.24~~ 1.81
Central Gulf of Alaska	150°-158°W	~~3.08~~ 2.32	~~1.76~~ 1.18	~~4.35~~ 3.43		~~3.40~~ 3.74	~~2.53~~ 2.80	~~4.32~~ 4.73
Western Gulf of Alaska	158°-163°W	~~3.37~~ 1.36	~~2.25~~ 0.46	~~4.52~~ 2.28		~~2.77~~ 1.22	~~1.47~~ 0.08	~~4.01~~ 2.45
Eastern Aleutian Islands	163°-170°W	~~2.54~~ 0.73	~~1.67~~ -0.31	~~3.46~~ 1.75		~~1.76~~ 1.09	~~0.50~~ -0.27	~~3.07~~ 2.46
West of Samalga Pass	170°W-172°E	~~-2.08~~ -2.17	~~-3.13~~ -2.94	~~-0.79~~ -1.41		~~-1.22~~ -0.70	~~-2.20~~ -2.04	~~-0.25~~ 0.72
Central Aleutian Islands	170°W-177°E	~~-1.60~~ -2.01	~~-2.75~~ -2.85	~~-0.21~~ -1.21		~~-0.53~~ -0.20	~~-1.64~~ -1.56	~~0.50~~ 1.36
Western Aleutian Islands	172°-177°E	~~-6.47~~ -4.10	~~-7.42~~ -5.09	~~-5.57~~ -3.07		~~-6.47~~ -5.78	~~-7.81~~ -8.02	~~-5.21~~ -3.44



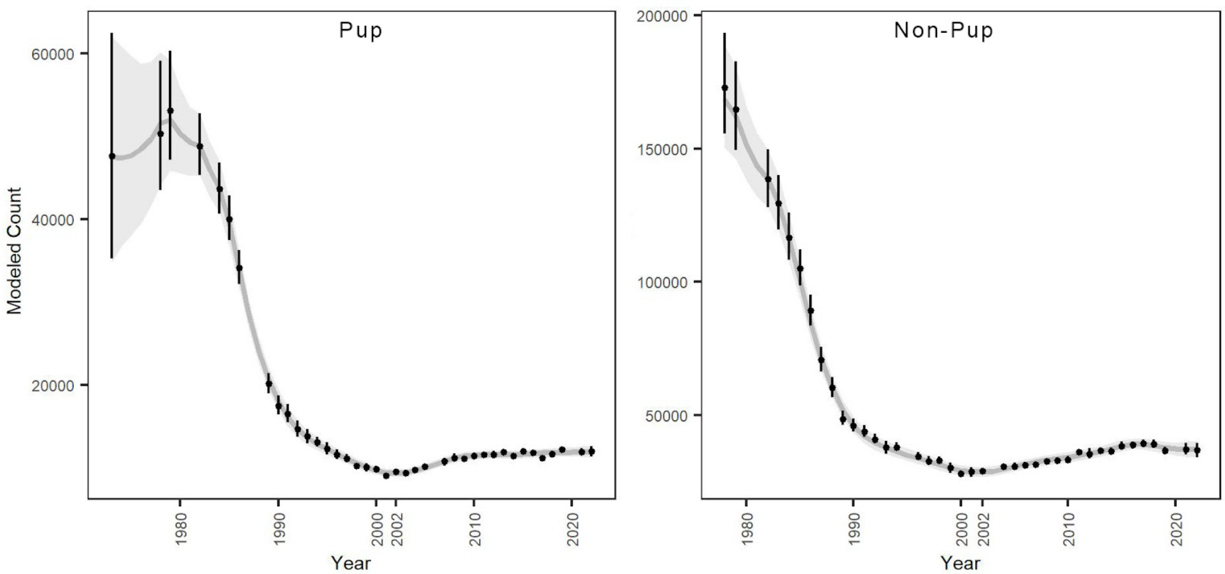


Figure ~~3~~4. Realized and predicted counts of Western Steller sea lion pups (left) and non-pups (right) in Alaska, from ~~1978~~1973 for pups and 1978 for non-pups to ~~2019~~ 2022. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the dark gray~~black~~ line surrounded by the lighter gray 95% credible interval.

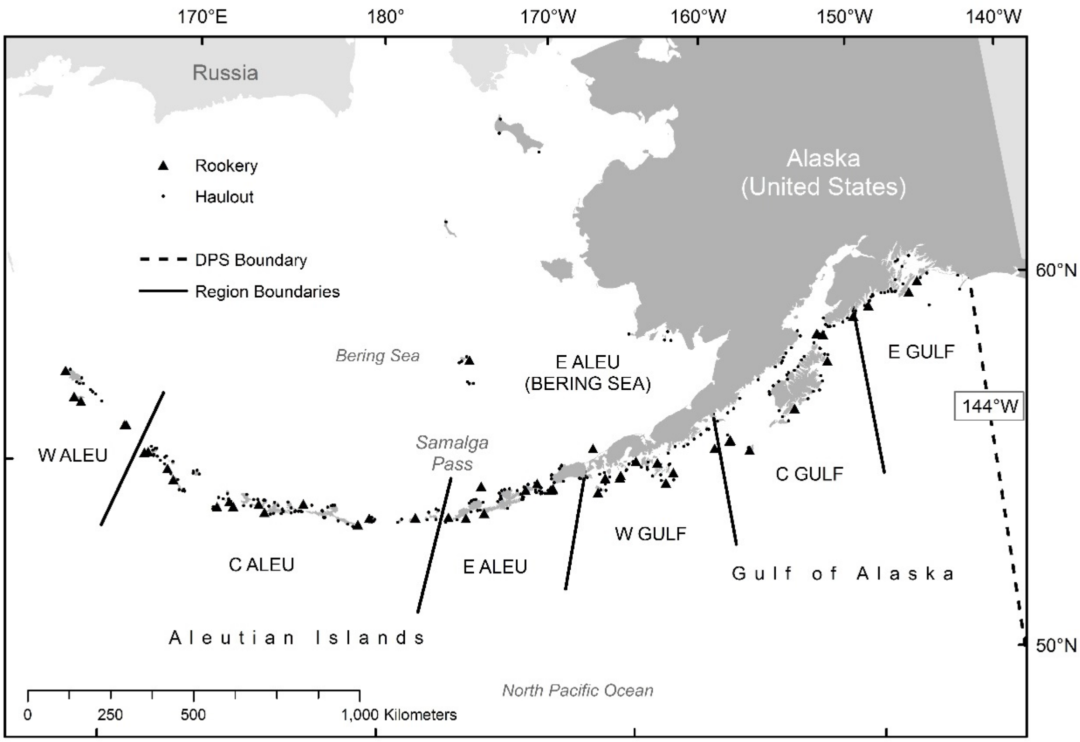


Figure ~~4~~5. Regions of Alaska used for Western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands regions, respectively (AFSC-MML-Alaska Ecosystems Program 2016).

In 2021~~2019~~, ~~Western DPS~~U.S. survey effort was focused in the Gulf of Alaska (Sweeney et al. 2022~~2019~~). Between 2015 and 2017, pup counts declined in the eastern (-33%) and central (-18%) Gulf of Alaska, counter to the continuous increases observed in both regions since 2002 (Sweeney et al. 2017). These declines may have been due to changes in availability of prey associated with warm ocean temperatures that occurred in the northern Gulf of Alaska from 2014 to 2016 (Bond et al. 2015, Peterson et al. 2016, von Biela et al. 2019, Yang et al. 2019, Suryan et al. 2021). There was also a movement of approximately 1,000 non-pups from the eastern to the central Gulf of Alaska regions, although the combined non-pup count in these two regions remained relatively stable between 2015 and 2017 (western Gulf of Alaska did not appear to change; Sweeney et al. 2017). In 2019, pup counts rebounded to 2015 levels; however, there was a decline in non-pup counts in the eastern, central, and western Gulf of Alaska regions (Sweeney et al. 2019). The eastern Gulf of Alaska region remained low in 2021, and the central Gulf of Alaska increased to 2010 levels. The western Gulf of Alaska showed the first signs of decline in 2021 after increasing since the early 2000s (Sweeney et al. 2022).

~~No new data were collected for the Aleutian Islands in the 2019 survey, but the 2020 survey effort will be focused in this area.~~ In 2022~~2018~~, survey effort was focused on~~in~~ the Aleutian Islands ~~with some opportunistic surveys in the Gulf of Alaska~~ (Sweeney et al. 2023~~2018~~). ~~The area west of Samalga Pass was significantly declining, especially in the western Aleutian Islands region.~~ From 2007 to 2022, pups declined west of Samalga Pass, especially in the western Aleutian Islands region, where non-pups have also continued to decline. The central Aleutian Island region plateaued; however, the eastern portion of this region, which was largely contributing to increases in counts in this region, has not been surveyed since 2016 or 2018. The eastern Aleutian Islands region, an area that had shown signs of recovery and was increasing since the early 2000s, has now plateaued for both pups and non-pups ~~have showed signs of recovery and have been increasing since the early 2000s~~.

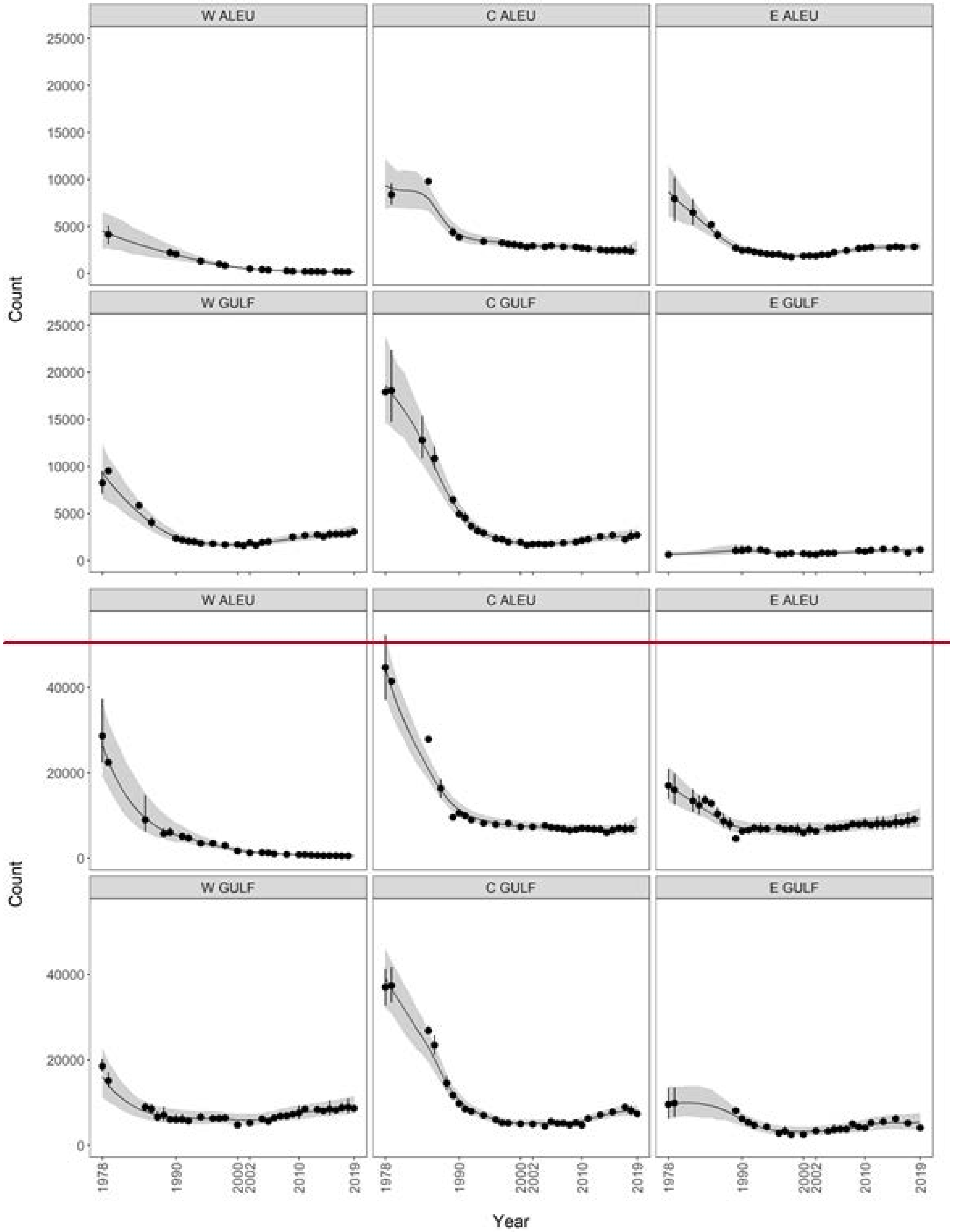
~~Since part of the Western stock began to recover in the early 2000s, net movement between the Eastern and Western stocks appears to be small during the breeding season (Jemison et al. 2018). For example, there was an estimated net 75 sea lions that moved from east to west in 2016 (Jemison et al. 2013, Fritz et al. 2016). Very few females moved from Southeast Alaska to the Western stock, while approximately 500 were estimated to move from west to east (net increase in the east). Males moved in both directions, but with a net increase in the west. As a result,~~

~~trends in counts estimated from breeding season surveys should be relatively insensitive, at a stock level, to inter-stock movements.~~

Describing population trends in Russia, Burkanov and Loughlin (2005) estimated the Russian Steller sea lion population (pups and non-pups) declined approximately 52% from the 1970s to the 1990s. Johnson (2018) estimated the non-pup count in Russia declined 1.3% y^{-1} between 2002 and 2017.~~;~~ The most recent agTrend estimate between 2007 and 2022 for non-pups was 1.04% y^{-1} (Table 3). ~~h~~However, just as in the U.S. portion of the Western stock, there were significant regional differences in population trend ~~in~~throughout Russia (Table ~~2~~3; Fig. ~~6~~7; Burkanov 2020~~2018a, Johnson 2018~~). The ~~significant~~ decline in non-pup counts continued ~~appears to be primarily driven by the decline~~ in the Kurils which, traditionally, represents the largest area in terms of non-pup counts (Burkanov and Loughlin 2005 ~~2018a, Johnson 2018~~). The growth was attributed to a significant increase in the Sakhalin region (Table 3; Fig. 7). ~~Moreover, it seems the statistically significant decline in the Kurils is the result of the 2015 survey, where there appeared to be a large reduction in comparison to previous years (Fig. 6; Johnson 2018).~~ Pup production continued ~~appeared~~ to decline in three of five ~~most~~ areas where breeding occurs in Russia (Kuril Islands, ~~eastern Kamchatka,~~ the Commander Islands, and the northern part~~s~~ of the Sea of Okhotsk ~~Iony rookery~~)~~;~~, while pup production continued to grow in the Sakhalin Region ~~only~~ (Tuleny Island ~~(Sakhalin region~~) and became equally important for the Asian population of Kurils. ~~part of the Sea of Okhotsk (Yamsky Islands rookery) had increasing pup counts between 2006 and 2017 (Burkanov 2018a, 2018b).~~

Table ~~2~~3. Trends (annual rates of change expressed as % y^{-1} with 95% credible interval) in non-pup counts for the Asian ~~stock~~ (Russia) portion of the Western stock of Steller sea lions and by region, from 2007~~2002~~ to ~~2017~~ 2022 (Johnson 2018, Gaos et al. 2021). See Figure 2 for regions.

Region	Trend	-95%	+95%
Asian portion of Western stock (Russia)	~~-1.3~~ 1.04	~~-2.6~~ -0.73	~~-0.1~~ 3.24
Commander Islands (CI)	~~-0.6~~ -0.30	~~-2.6~~ -4.43	~~1.2~~ 3.87
Kamchatka (KAM)	~~-0.8~~ 2.98	~~-3.0~~ -3.02	~~1.5~~ 9.49
Kuril (KUR)	~~-4.1~~ -2.15	~~-5.4~~ -4.16	~~-2.8~~ 0.26
Northern Sea of Okhotsk (NPSO)	~~0.9~~ 1.01	~~-2.0~~ -1.66	~~4.0~~ 3.89
Sakhalin (SAK)	~~0.9~~ 5.51	~~-2.3~~ 1.81	~~5.4~~ 10.67
Western Bering Sea (WBS)	~~-1.1~~ 0.63	~~-16.1~~ -12.26	~~10.2~~ 14.43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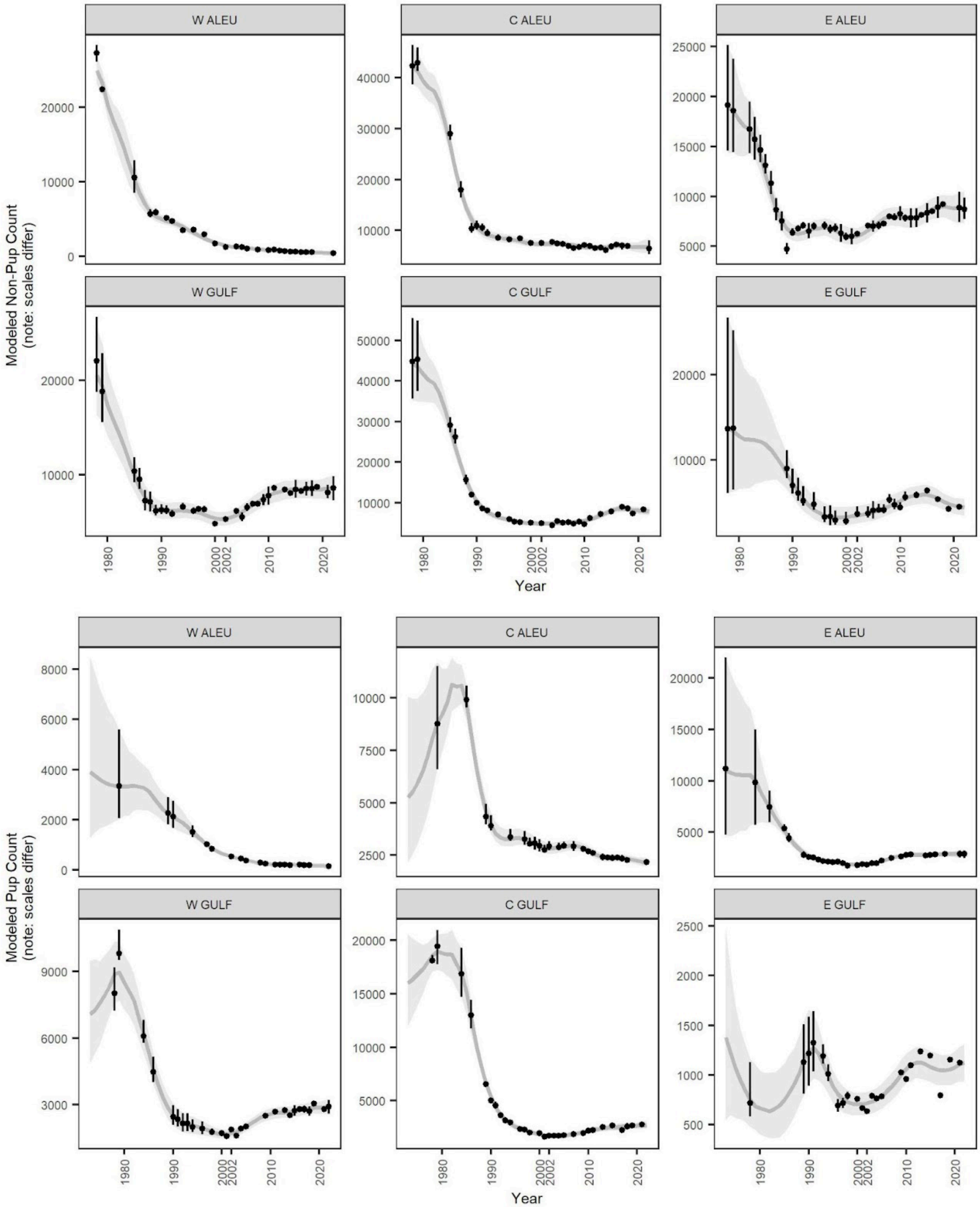

Figure ~~5~~6. Realized and predicted counts of Steller sea lion pups (top) and non-pups (bottom) in the six regions that compose the Western stock in Alaska, 1973 for pups and 1978 for non-pups to 2022~~1978 to 2019~~. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the dark gray~~black~~ line surrounded by the lighter gray 95% credible interval (Sweeney et al. ~~2018, 2019~~2023).

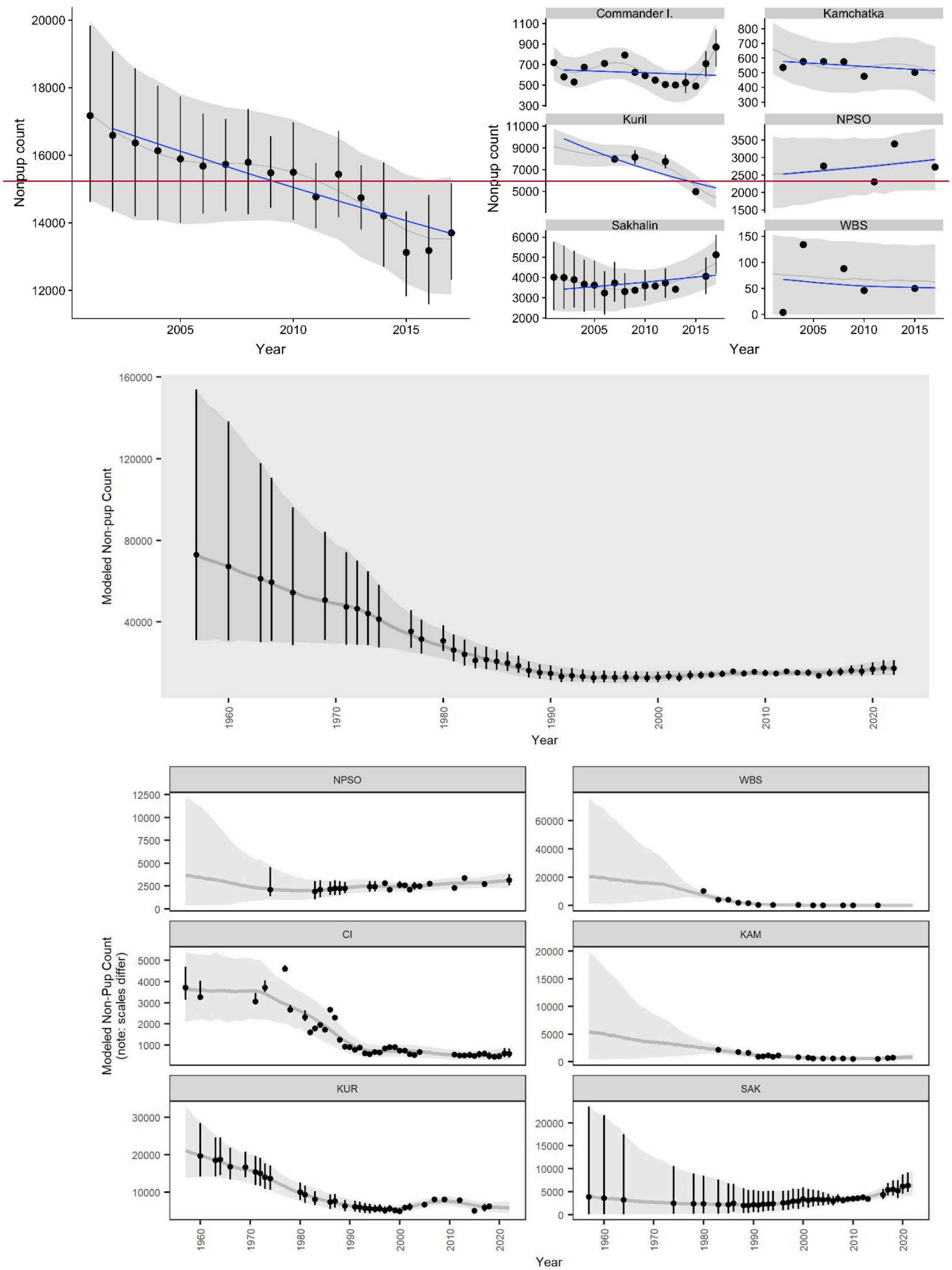

Figure ~~6~~7. Realized and predicted counts of Russian Steller sea lion non-pups ~~in Russia~~ (~~left~~above) and by region (~~right; Fig. 2~~below), ~~2002 to 2017~~ 1957-2022. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the ~~black~~ dark gray line surrounded by the lighter gray 95% credible interval. See Table 3 and Figure 2 for regions. ~~The blue line represents the trend based on constant average growth for the entire Asian stock as a whole.~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the maximum net productivity rate (R_{MAX}) for Steller sea lions. Until additional data become available, the default pinniped maximum theoretical net productivity rate of 12% will be used for this stock (NMFS ~~2016~~2023).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the default value for stocks listed as endangered under the ESA (NMFS ~~2016~~2023). Thus, for the Western stock of Steller sea lions (including Russia), PBR is 439 sea lions (73,211 × 0.06 × 0.1). The PBR for the U.S. portion of the Western stock of Steller sea lions~~, PBR~~ is ~~318~~ 299 sea lions (~~52,932~~ 49,837 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between ~~2014~~ 2017 and ~~2018~~ 2021 is listed, by marine mammal stock, in ~~Young~~Freed et al. (~~2020~~in prep.); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The minimum estimated mean annual level of human-caused mortality and serious injury for the U.S. portion of the Western ~~U.S.~~ Steller sea lion stock between ~~2014~~ 2017 and ~~2018~~ 2021 is ~~254~~ 267 sea lions: ~~37~~ 39 in U.S. commercial fisheries, 0.004 in Alaska subsistence fisheries, 0.2 in Alaska salmon hatcheries, ~~0.8~~ 1.9 in unknown (commercial, recreational, or Alaska subsistence) fisheries, ~~3.6~~ 6.6 in marine debris, ~~3.6~~ 0.8 due to ~~other causes (~~illegal shooting~~, mortality incidental to Marine Mammal Protection Act (MMPA) authorized research)~~, and ~~209~~ 218 in the Alaska Native subsistence harvest. The number of human-caused mortalities and serious injuries of Western Steller sea lions in the Asian portion of the range is unknown. ~~No observers have been assigned to several fisheries that are known to interact with this stock 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 Western stock animals that travel to parts of Southeast Alaska. Due to a lack of available resources, NMFS is not operating the Alaska Marine Mammal Observer Program (AMMOP) focused on marine mammal interactions that occur in fisheries managed by the State of Alaska.~~

The most recent data on Steller sea lion interactions with state-managed fisheries in Alaska are from the Southeast Alaska salmon drift gillnet fishery in 2012 and 2013 (Manly 2015), a fishery in which the majority of the Steller sea lions taken are likely to be from the Eastern stock, although sea lions carrying Western genetic material could be as high as 38% (Hastings et al. ~~2019~~ 2020). Counts of annual illegal gunshot mortality in the Copper River Delta should be considered minimums as they are based solely on aerial carcass surveys from ~~2015~~ 2017 to ~~2018~~ 2019, no data are available for ~~2014~~ 2020-2021, a cause of death for all carcasses found was not determined, and it is not likely that all carcasses are detected. Disturbance of Steller sea lion haulouts and rookeries can potentially cause disruption of reproduction, stampeding, or increased exposure to predation by marine predators (NMFS 2008; see also NMFS 1990, 1997). Effects of disturbance are highly variable and difficult to predict. Data are not available to estimate potential impacts from non-monitored activities, including disturbance near rookeries without 3-nmi no-entry buffer zones. Potential threats most likely to result in direct human-caused mortality or serious injury of this stock include subsistence harvest, incidental take, illegal shooting, disturbance at rookeries that could cause stampedes, and entanglement in fishing gear and marine debris.

Fisheries Information

Commercial fisheries

Information for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is available in Appendix 3 of the Alaska Stock Assessment Reports (observer coverage) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed ~~December 2020~~ August 2023).

Based on historical reports and their geographic range, Steller sea lion mortality and serious injury could occur in several fishing gear types, including trawl, gillnet, longline, and hook and line~~troll~~ fisheries. However, observer data are limited. Of these fisheries, only trawl fisheries are regularly observed, and gillnet fisheries have had limited observations in select areas over short time frames and with modest observer coverage. Consequently, there are little to no data on Steller sea lion mortality and serious injury in non-trawl fisheries. Therefore, the potential for fisheries-caused mortality and serious injury may be greater than is reflected in existing observer data.

Between ~~2014~~ 2017 and ~~2018~~ 2021, mortality and serious injury of Western Steller sea lions was observed or recorded via electronic monitoring in ~~10~~ 8 of the federally-managed commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: Bering Sea/Aleutian Islands Atka mackerel trawl, 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, ~~Gulf of Alaska Pacific cod trawl, Gulf of Alaska Pacific cod longline,~~ Gulf of Alaska flatfish trawl,~~ Gulf of Alaska rockfish trawl, and~~ Gulf of Alaska pollock trawl, and Gulf of Alaska sablefish longline fisheries, resulting in a mean annual mortality and serious injury rate of ~~22~~ 24 sea lions (Table ~~3~~4; Breiwick 2013; MML, unpubl. data).

AMMOP observers monitored the Alaska State-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording two incidental mortalities in 1991, extrapolated to 29 (95% CI: 1-108) for the entire fishery (Wynne et al. 1992; Table ~~3~~4). No incidental mortality or serious injury was observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean annual mortality rate of 15 sea lions for 1990 and 1991. It is not known whether this incidental mortality and serious injury rate is representative of the current rate in this fishery;~~.~~ between 2017 and 2021, only one Steller sea lion mortality, reported to the NMFS Alaska Region marine mammal stranding network, was attributed to the Prince William Sound salmon drift gillnet fishery (Freed et al. in prep.).

~~Between 2014 and 2018, Steller sea lion mortality resulting from entanglements in commercial longline gear (1 in 2015) and commercial salmon seine net (1 in 2018) was reported to the NMFS Alaska Region marine mammal stranding network (Young et al. 2020), resulting in a mean annual mortality and serious injury rate of 0.4 sea lions in commercial gear (Table 4). This mortality and serious injury estimate results from an actual count of verified human-caused deaths and serious injuries and is a minimum because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined.~~

The minimum estimated mean annual mortality and serious injury rate in U.S. commercial fisheries between ~~2014~~ 2017 and ~~2018~~ 2021 is ~~37~~ 39 Steller sea lions from this stock ~~(37 from observer data + 0.4 from stranding data)~~ (Table~~s 3 and~~ 4). All U.S. commercial fishery-related reports of mortality and serious injuries of this stock came from U.S. commercial fishery observer or electronic monitoring data. No observers have been assigned to several fisheries that are known to interact with this stock, thus, the estimated mortality and serious injury is likely an underestimate of the actual level.

Commercial fishery-related serious injuries averted (i.e., human intervention or self-release lessened the severity of the initial serious injury, leaving the animal with only non-serious or no injuries) and non-serious injuries are not included in the total estimate of annual human-caused mortality and serious injury that is compared to PBR, but are used to develop the List of Fisheries under Section 118 of the Marine Mammal Protection Act and inform management (e.g., take reduction planning and negligible impact determinations). No serious injuries of Western Steller sea lions were averted in U.S. commercial fishery interactions between 2017 and 2021. Additionally, there were no U.S. commercial fisheries with only non-serious injuries of western Steller sea lions between 2017 and 2021.

Table ~~3~~4. Summary of incidental mortality and serious injury (M/SI) of Western ~~U.S.~~ stock Steller sea lions in U.S. waters due to U.S. commercial fisheries between ~~2014~~ 2017 and ~~2018~~ 2021 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Breiwick 2013; MML, unpubl. data). The "Observed mortality" column does not include animals seriously injured or killed in unsampled hauls unless there were no observed mortalities or serious injuries in sampled hauls in that fishery that year. N/A indicates that data are not available. Methods for calculating percent observer coverage are described in Appendix 3 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed ~~mortality~~M/SI	Estimated ~~mortality~~M/SI (CV)	Mean estimated annual ~~mortality~~M/SI
Bering Sea/Aleutian Is. Atka mackerel trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~100~~ ~~100~~ ~~98~~ 100 100 100 100 99	~~0~~ ~~0~~ ~~0~~ 1 5 0 0 1	~~0~~ ~~0~~ ~~0~~ 1 (0.06) 5.1 (0.08) 0 0 1 (0.04)	~~1.2~~ 1.4 (CV = ~~0.07~~ 0.06)
Bering Sea/Aleutian Is. flatfish trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~100~~ ~~100~~ ~~99~~ 100 100 100 100 99	~~5~~ ~~6~~ ~~9~~ 13 8 12 14 17	~~5.0 (0.02)~~ ~~6.0 (0.02)~~ ~~9.0 (0.02)~~ 13 (0.01) 8.0 (0.02) 12.1 (0.02) 14.1 (0.02) 17.2 (0.03)	~~8.2~~ 13 (CV = 0.01)
Bering Sea/Aleutian Is. Pacific cod trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~80~~ ~~72~~ ~~68~~ 68 73 67 71 58	~~0~~ ~~0~~ ~~0~~ 1 1 0 0 0	~~0~~ ~~0~~ ~~0~~ 1 (0) 1 (0) 0 0 0	0.40 (CV = 0)
Bering Sea/Aleutian Is. pollock trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~98~~ ~~99~~ ~~99~~ 99 99 98 91 77	~~2~~ ~~1~~ ~~13~~ 6 6 4 10 5	~~2.0 (0.1)~~ ~~1 (0.07)~~ ~~13 (0.03)~~ 6.1 (0.05) 6.1 (~~0.04~~ 0.05) 4 (0.02) 11.2 (0.13) 6.5 (0.22)	~~5.7~~ 6.8 (CV = ~~0.02~~ 0.06)
~~Bering Sea/Aleutian Is. pollock trawl~~	~~2017~~	~~obs data~~	~~99~~	~~1[a]~~	~~N/A~~	~~0.2~~ ~~(CV = N/A)~~
Bering Sea/Aleutian Is. Pacific cod longline	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~64~~ ~~62~~ ~~57~~ 58 55 52 52 55	~~1~~ ~~3~~ ~~0~~ 1 0 0 0 0	~~1.7 (0.63)~~ ~~4.9 (0.36)~~ ~~0~~ 1.6 (0.61) 0 0 0 0	~~1.6~~ 0.32 (CV = ~~0.28~~ 0.61)

Fishery name	Years	Data type	Percent observer coverage	Observed ~~mortality~~M/SI	Estimated ~~mortality~~M/SI (CV)	Mean estimated annual ~~mortality~~M/SI
~~Gulf of Alaska Pacific cod longline~~	~~2014~~ ~~2015~~ ~~2016~~ ~~2017~~ ~~2018~~	~~obs data~~	~~31~~ ~~36~~ ~~30~~ ~~40~~ ~~29~~	~~0~~ ~~1~~ ~~0~~ ~~0~~ ~~0~~	~~0~~ ~~1.3 (0.5)~~ ~~0~~ ~~0~~ ~~0~~	~~0.3~~ ~~(CV = 0.5)~~
~~Gulf of Alaska Pacific cod trawl~~	~~2014~~ ~~2015~~ ~~2016~~ ~~2017~~ ~~2018~~	~~obs data~~	~~12~~ ~~13~~ ~~13~~ ~~11~~ ~~25~~	~~0~~ ~~0~~ ~~1~~ ~~0~~ ~~0~~	~~0~~ ~~0~~ ~~10 (0.9)~~ ~~0~~ ~~0~~	~~2.0~~ ~~(CV = 0.9)~~
Gulf of Alaska flatfish trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~47~~ ~~54~~ ~~39~~ 56 ~~34~~ 35 39 38 82	~~0~~ ~~0 (+1)[b]~~ ~~0~~ 0 0 2[a] 0 0	~~0~~ ~~0 (+1)[c]~~ 0 0 0 2 0 0	~~0 (+0.2)[d]~~ 0.40 (CV = N/A)
~~Gulf of Alaska rockfish trawl~~	~~2014~~ ~~2015~~ ~~2016~~ ~~2017~~ ~~2018~~	~~obs data~~	~~96~~ ~~93~~ ~~98~~ ~~98~~ ~~95~~	~~0~~ ~~0 (+1)[b]~~ ~~0~~ ~~0~~ ~~0~~	~~0~~ ~~0 (+1)[c]~~ ~~0~~ ~~0~~ ~~0~~	~~0 (+0.2)[d]~~ ~~(CV = N/A)~~
Gulf of Alaska pollock trawl	~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~14~~ ~~23~~ ~~27~~ 19 21 23 10 13	~~0~~ ~~0 (+5)[e]~~ ~~1~~ 0 0 0 1[b] 0	~~0~~ ~~0 (+5)[f]~~ ~~4.8 (0.89)~~ 0 0 0 1 0	~~1.0 (+1)[g]~~ 0.20 (CV = ~~0.89~~ N/A)
Gulf of Alaska sablefish longline	2017 2018 2019 2020 2021	obs data	10 9 12 7 11	0 0 2 0 0	0 0 9.4 (0.79) 0 0	1.9 (CV = 0.79)
Prince William Sound salmon drift gillnet	1990 1991	obs data	4 5	0 2	0 29.0	15 (CV = 1.0)
Minimum total estimated annual mortality						~~37~~ 39 (CV = ~~0.43~~ 0.38)

~~[a]This animal was discovered during a vessel offload. Because it could not be associated with a haul number, it was not included in the bycatch estimate for the fishery.~~
~~[b]Total mortality and serious injury observed in 2015: 0 sea lions in sampled hauls + 1 sea lion in an unsampled haul.~~
~~[c]Total estimate of mortality and serious injury in 2015: 0 sea lions (extrapolated estimate from 0 sea lions observed in sampled hauls) + 1 sea lion (1 sea lion observed in an unsampled haul).~~
~~[d]Mean annual mortality and serious injury for fishery: 0 sea lions (mean of extrapolated estimates from sampled hauls) + 0.2 sea lions (mean of number observed in unsampled hauls).~~
~~[e]Total mortality and serious injury observed in 2015: 0 sea lions in sampled hauls + 5 sea lions in unsampled hauls.~~
~~[f]Total estimate of mortality and serious injury in 2015: 0 sea lions (extrapolated estimate from 0 sea lions observed in sampled hauls) + 5 sea lions (5 sea lions observed in unsampled hauls).~~
~~[g]Mean annual mortality and serious injury for fishery: 1.0 sea lion (mean of extrapolated estimates from sampled hauls) + 1 sea lion (mean of number observed in unsampled hauls).~~
[a]Two animals were killed in unsampled hauls and represent a minimum estimate of mortality and serious injury in this fishery in this year.
[b]One mortality was detected via electronic monitoring while the fishery was operating on an exempted fishing permit. This mortality represents a minimum estimate of mortality and serious injury in this fishery in this year.

Non-commercial and unknown fisheries

Reports to the NMFS Alaska Region marine mammal stranding network and the Alaska Department of Fish and Game (ADF&G) of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality and serious injury data (Table ~~4~~5; ~~Young~~Freed et al. ~~2020~~in prep.). Steller sea lions from parts of the Western stock are known to regularly occur in parts of Southeast Alaska (Jemison et al. 2013, 2018; NMFS 2013), and higher rates of entanglement of Steller sea lions have been observed in this area (e.g., Raum-Suryan et al. 2009). ~~,~~From ~~2014~~ 2017 to ~~2018~~ 2021, one mortality was reported in an Alaska subsistence halibut longline fishery, resulting in a mean annual mortality and serious injury rate of 0.004 western Steller sea lions in Alaska subsistence fisheries. Other fishery-related mortality and serious injury included a mean of 0.2 sea lions in salmon hatchery nets and 1.9. in unknown (commercial, recreational, or Alaska subsistence) fishing gear (Table 5). ~~there were three reports of Steller sea lion interactions with salmon hook and line gear, in which an animal in poor body condition had a flasher lure hanging from its mouth and was believed to have ingested the hook, and one report of an animal that was entangled in unidentified hook and line gear, resulting in a mean annual mortality and serious injury rate of 0.8 sea lions in these unknown (commercial, recreational, or subsistence) fisheries (Table 4).~~ These~~is~~ mortality and serious injury estimates result~~s~~ from ~~an~~ actual counts of verified human-caused deaths and serious injuries and are~~is a~~ minimums because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. ~~Additionally, since Steller sea lions from parts of the Western stock are known to regularly occur in parts of Southeast Alaska (Jemison et al. 2013, 2018; NMFS 2013), and higher rates of entanglement of Steller sea lions have been observed in this area (e.g., Raum-Suryan et al. 2009), estimates based solely on stranding reports in areas west of 144°W longitude may underestimate the total entanglement of Western stock sea lions in fishery-related gear and marine debris.~~

An additional two Steller sea lions in the Eastern and Western stock mixing area of Southeast Alaska that were initially considered seriously injured due to hooking by unknown salmon hook and line gear (one in 2017 and one in 2018) were disentangled or dehooked and released, or presumed to have self released, with non-serious injuries (Freed et al. in prep.). None of these serious injuries averted were included in the estimate of the average annual mortality and serious injury rate for 2017 to 2021.

Table ~~4~~5. Summary of Western stock~~U.S.~~ Steller sea lion mortality and serious injury (M/SI) in U.S. waters, by year and type, reported to the NMFS Alaska Region marine mammal stranding network and Alaska Department of Fish and Game between ~~2014~~ 2017 and ~~2018~~ 2021 (~~Young~~Freed et al. ~~2020~~in prep.). In areas of Southeast Alaska where the western (wSSL) and eastern (eSSL) populations mix, the mean annual M/SI of both stocks (wSSL + eSSL) was multiplied by the mixing zone-specific proportion of western non-pups (Table 1; Hastings et al. 2020) to produce estimates for the Western stock (wSSL only). ~~N/A indicates that data are not available.~~

Cause of injury	~~2014~~	~~2015~~	~~2016~~	2017	2018	2019	2020	2021	Mean annual ~~mortality~~M/SI	
									wSSL + eSSL	wSSL only
Southeast Alaska – Mixing Zone D										
Hooked by Alaska subsistence halibut longline gear				0	0	0	0	1	0.2	0.004
Hooked by salmon hook and line gear*				4	0	1	1	3	1.8	0.040
Hooked by unknown hook and line gear*				0	1	0	0	0	0.2	0.004
Entangled in Southeast Alaska salmon hatchery pen				0	0	0	1	0	0.2	0.004
Entangled in unknown fishery gear*				0	0	1	0	0	0.2	0.004
Entangled in marine debris				3	3	2	0	0	1.6	0.035
Illegally shot				0	0	1	0	0	0.2	0.004
Southeast Alaska – Mixing Zone E										
Hooked by halibut hook and line gear*				0	1	0	0	0	0.2	0.002
Hooked by salmon hook and line gear*				4	0	1	0	0	1.0	0.012
Entangled in marine debris				3	2	1	0	0	1.2	0.014
Southeast Alaska – Mixing Zone F										
Hooked or entangled by salmon hook and line gear*				8	8	4	0	6	5.2	0.426
Hooked by unknown hook and line gear*				2	1	2	0	0	1.0	0.082
Entangled in unknown fishery gear*				0	0	0	1	0	0.2	0.016
Entangled in marine debris				2	8	1	0	3	2.8	0.230
Dependent pup of animal seriously injured by marine debris				0	1	0	0	0	0.2	0.016
Southeast Alaska – Mixing Zone G										
Hooked by salmon hook and line gear*				1	1	2	0	0	0.8	0.058
Entangled in marine debris				3	3	0	0	0	1.2	0.088
Southeast Alaska – Mixing Zone H										
Hooked by salmon hook and line gear*				3	0	1	1	1	1.2	0.017
Entangled in marine debris				3	2	1	0	1	1.4	0.020

All Other Areas in Western ~~U.S.~~ Stock Range										
Entangled in ~~commercial~~ Kodiak salmon hatchery seine net	~~0~~	~~0~~	~~0~~	0	1	0	0	0	-	0.2
~~Entangled in commercial longline gear~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~					~~0.2~~
Hooked by salmon hook and line gear*	~~1~~	~~0~~	~~0~~	1	1	1	0	0	-	0.6
Hooked ~~Entangled in~~ by unknown hook and line gear*	~~1~~	~~0~~	~~0~~	0	0	0	0	2	-	~~0.2~~ 0.4
Entangled in unknown trawl gear				0	0	0	1	0	-	0.2
Entangled in marine debris	~~3~~	~~6~~	~~1~~	3	5	2	8	13	-	~~3.6~~ 6.2
Illegally shot	~~N/A~~	~~8~~	~~1~~	0	0	3	1	0	-	~~3ª~~ 0.8
~~Incidental to MMPA-authorized research~~	~~0~~	~~1~~	~~2~~	~~0~~	~~0~~					~~0.6~~
Total in commercial fisheries										~~0.4~~ 0
Total in Alaska subsistence fisheries										0.004
Total in salmon hatchery nets										0.2
*Total in unknown (commercial, recreational, or Alaska subsistence) fisheries										~~0.8~~ 1.9
Total in marine debris (including dependent pup(s) of animal(s) seriously injured or killed by marine debris)										~~3.6~~ 6.6
Total due to ~~other causes (~~illegal~~ly~~ shoo~~t~~ing~~, incidental to MMPA-authorized research~~)										~~3.6~~ 0.8

~~ªDedicated effort to survey the Copper River Delta for stranded marine mammals began in 2015 in response to a high number of reported strandings, some of which were later determined to be human-caused (illegally shot). Dedicated surveys were also conducted in 2016, 2017, and 2018. Because similar data are not available for 2014 and survey effort was limited in 2018, the data were averaged over 3 years of survey effort (2015-2017) for a more informed estimate of mean annual mortality.~~

In summary, ~~T~~the minimum mean annual mortality and serious injury rate for all fisheries in the U.S. between ~~2014~~ 2017 and ~~2018~~ 2021, is 41 Western Steller sea lions based on observer data and stranding data for: U.S. commercial fisheries (~~37~~ 39 sea lions), Alaska subsistence fisheries (0.004 sea lions), salmon hatchery nets (0.2 sea lions), and ~~on stranding data for~~ unknown (commercial, recreational, or Alaska subsistence) fisheries (~~0.8~~ 1.9 sea lions)~~, is 38 Western Steller sea lions~~.

Alaska Native Subsistence/Harvest Information

NMFS ~~signed~~ has agreements with the Tribal Government of St. Paul Island (2000) and the Traditional Council of St. George Island (2001) to co-manage Steller sea lions and northern fur seals. NMFS also ~~signed~~ has an agreement with the Aleut Marine Mammal Commission (2006) for the conservation and management of all marine mammal subsistence species, with particular focus on Steller sea lions and harbor seals. These co-management agreements promote full and equal participation by Alaska Natives in decisions affecting the subsistence management of Steller sea lions (to the maximum extent allowed by law) as a tool for conserving Steller sea lion populations in Alaska (https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/co-management-marine-mammals-alaska, accessed ~~December 2020~~ August 2023).

Information on the subsistence harvest of Steller sea lions comes via ~~three~~ four sources: the Alaska Department of Fish and Game (ADF&G), the Ecosystem Conservation Office of the Aleut Community of St. Paul Island, ~~and~~ the Kayumixtax Eco-Office of the ~~Aleut Community~~Traditional Council of St. George Island, and the Aleut Marine Mammal Commission. 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, 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 Western ~~U.S.~~ stock Steller sea lions for ~~7~~seven communities on Kodiak Island in 2011 and for 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. Thus, the most recent 5 years of data available from the ADF&G (2004-2008) will be used for calculating an annual mortality and serious injury estimate for all areas except St. Paul, St. George,~~ and~~ Atka, and Akutan Islands (Wolfe et al. 2005, 2006, 2008, 2009a, 2009b; NMFS, unpubl. data) (Table ~~5~~6). Current ~~H~~harvest data are being collected ~~in near real-time~~ on St. Paul (Tribal Government of St. Paul Island, unpubl. data), ~~Island (e.g., Melovidov 2013) and~~ St. George (Traditional Council of St. George Island, unpubl. data), and Atka and Akutan Islands (Aleut Marine Mammal Commission, unpubl. data) ~~(e.g., Kashevarof 2015) and recorded within 36 hours of the harvest. The most recent 5 years of data from St. Paul (Melovidov 2013, 2014, 2015, 2016; NMFS, unpubl. data) and St. George (Kashevarof 2015; NMFS, unpubl. data) are for 2014 to 2018~~ (Table ~~5~~6). Since the cessation of ADF&G monitoring, there is an incomplete understanding of harvest levels statewide.

The mean annual subsistence harvest from this stock for all areas except St. Paul, St. George,~~ and~~ Atka, and Akutan Islands between 2004 and 2008 (172) combined with the mean annual harvest for St. Paul (~~30~~31), St. George (~~1.4~~0.6), ~~and~~ Atka (~~6~~10), and Akutan (4) Islands between ~~2014~~ 2017 and ~~2018~~ 2021 is ~~209~~218 w~~W~~estern Steller sea lions (Table ~~5~~6).

Other Mortality

Reports to the NMFS Alaska Region marine mammal stranding network of Steller sea lions entangled in marine debris or with injuries caused by other types of human interaction are another source of mortality and serious injury data. These mortality and serious injury estimates result from an actual count of verified human-caused deaths and serious injuries and are minimums because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. Between ~~2014~~ 2017 and ~~2018~~2021, reports to the stranding network resulted in mean annual mortality and serious injury rates of ~~three~~ 0.8 Western Steller sea lions illegally shot (most of which were observed during surveys of ~~in~~ the Copper River Delta), ~~(3-year average) and 3.6~~ 6.6 ~~observed~~ entangled in marine debris, and 0.016 dependent pups of an animal seriously injured by marine debris (Table ~~4~~5; ~~Young~~Freed et al. ~~2020~~in prep.). ~~Additional reports of Steller sea lion mortality due to gunshot wounds are not included in the estimate of the mean annual mortality and serious injury rate for 2014 to 2018 because it could not be confirmed that the animals were illegally shot rather than struck and lost in the Alaska Native subsistence harvest.~~

An additional six Steller sea lions in the Eastern and Western stock mixing area of Southeast Alaska that were initially considered seriously injured in marine debris (four in 2017, one in 2018, and one in 2019) were disentangled or dehooked and released, or presumed to have self released, with non-serious injuries (Freed et al. in prep.). None of these serious injuries averted were included in the estimate of the average annual mortality and serious injury rate for 2017 to 2021.

~~Mortality and serious injury may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2014 and 2018, there were three reports (one in 2015 and two in 2016) of mortality incidental to research on the Western U.S. stock of Steller sea lions (Table 4; Young et al. 2020), resulting in a mean annual mortality and serious injury rate of 0.6 sea lions from this stock.~~

Table ~~5~~6. Summary of the Alaska Native subsistence harvest data for Western ~~U.S.~~ stock Steller sea lions. As of 2009, data on community subsistence harvests are no longer being consistently collected. Therefore, the most recent 5 years of data (2004 to 2008) will be used for calculating an annual mortality and serious injury estimate for all areas except St. Paul, St. George,~~ and~~ Atka, and Akutan Islands. Data from St. Paul, St. George,~~ and~~ Atka, and Akutan Islands are still being collected and the most ~~recent 5 years of~~ data available ~~(2014 to 2018)~~ will be used. Mean annual harvest is calculated across only the years where data are available. N/A indicates that data are not available. No data are available for struck and lost animals at Akutan Island in 2020 and 2021.

	All areas except St. Paul, St. George, Atka, and Akutan Island~~s~~			St. Paul Island	St. George Island	Atka Island	Akutan Island
Year	**Number harvested**	**Number struck and lost**	**Total**	**Number harvested + Number struck and lost**	**Number harvested + Number struck and lost**	**Number harvested + Number struck and lost**	**Number harvested + Number struck and lost**
2004	136.8	49.1	185.9[a]				
2005	153.2	27.6	180.8[b]				
2006	114.3	33.1	147.4[c]				
2007	165.7	45.2	210.9[d]				
2008	114.7	21.6	136.3[e]				
~~2014~~	~~N/A~~	~~N/A~~	~~N/A~~	~~35[h]~~	~~1[g]~~	~~N/A~~	
~~2015~~	~~N/A~~	~~N/A~~	~~N/A~~	~~24[i]~~	~~3[g]~~	~~N/A~~	
~~2016~~	~~N/A~~	~~N/A~~	~~N/A~~	~~31[j]~~	~~2[j]~~	~~N/A~~	
2017	N/A	N/A	N/A	30~~[j]~~[f]	0~~[j]~~[g]	N/A	N/A
2018	N/A	N/A	N/A	28~~[j]~~[f]	1~~[j]~~[g]	6[h]	N/A
2019	N/A	N/A	N/A	33[f]	1[g]	6[h]	N/A
2020	N/A	N/A	N/A	33[f]	0[g]	20[h]	3[h]
2021	N/A	N/A	N/A	N/A	1[g]	7[h]	5[h]
Mean annual harvest	137	35	172	~~30~~ 31	~~1.4~~ 0.6	~~6~~ 10	4

[a] Wolfe et al. (2005); [b] Wolfe et al. (2006); [c] Wolfe et al. (2008); [d] Wolfe et al. (2009a); [e] Wolfe et al. (2009b);~~ [h] Melovidov (2015); [i] Melovidov (2016); [j] NMFS, unpubl. data~~ [f] Tribal Government of St. Paul Island, unpubl. data; [g] Traditional Council of St. George Island, unpubl. data; [h] Aleut Marine Mammal Commission, unpubl. data.

STATUS OF STOCK

The minimum estimated mean annual U.S. commercial fishery-related mortality and serious injury rate (~~37~~39 sea lions) is more than 10% of the PBR for the U.S. portion of the range (10% of PBR = ~~32~~30) and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. Based on available data, the minimum estimated mean annual level of human-caused mortality and serious injury (~~254~~267 sea lions) in the U.S. is below both the U.S. PBR level (~~318~~299) and the range-wide PBR level (439) for this stock. The Western ~~U.S.~~ stock of Steller sea lions is currently listed as endangered under the ESA and, therefore, designated as depleted under the MMPA. As a result, the stock is classified as a strategic stock. The population previously declined for unknown reasons that are not explained by the documented level of direct human-caused mortality and serious injury. Population trends and status of this stock relative to its Optimum Sustainable Population are unknown.

There are key uncertainties in the assessment of the Western ~~U.S.~~ stock of Steller sea lions. Some genetic studies support the separation of Steller sea lions in western Alaska from those in Russia.~~; population numbers in this assessment are only from the U.S. to be consistent with the geographic range of i~~Information on human-caused mortality and serious injury is currently only available for the U.S. portion of the stock's range. ~~We provide data for the Russian population for context for the entire Western DPS. There is some overlap in range between animals in the Western and Eastern stocks in northern Southeast Alaska.~~ The population abundance is based on counts of visible animals; the calculated N_{MIN} and PBR levels are conservative because there are no data available to correct for animals not visible during the visual surveys. There are multiple nearshore commercial fisheries operating within the stock's range that are not observed; thus, there is likely to be unreported fishery-related mortality and serious injury of Steller sea lions. Estimates of human-caused mortality and serious injury from stranding data are underestimated~~s~~ because not all animals strand nor are all stranded animals found, reported, or have the cause of death determined. Several factors may have been important drivers of the decline of the stock. However, there is uncertainty about threats currently impeding their recovery, particularly in the Aleutian Islands.

~~HABITAT CONCERNS~~OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Many factors have been suggested as causes of the steep decline in abundance of Western Steller sea lions observed in the 1980s, including competitive effects of fishing, environmental change, disease, contaminants, killer whale predation, incidental take, and illegal and legal shooting (Atkinson et al. 2008, NMFS 2008). A number of management actions have been implemented since 1990 to promote the recovery of the Western ~~U.S.~~ stock of Steller sea lions, including 3-nmi no-entry zones around rookeries, prohibition of shooting at or near sea lions, and regulation of fisheries for sea lion prey species (e.g., walleye pollock, Pacific cod, and Atka mackerel; see reviews by Fritz et al. 1995, McBeath 2004, Atkinson et al. 2008, NMFS 2008). Additionally, potentially deleterious events, such as harmful algal blooms (Lefebvre et al. 2016) and disease transmission across the Arctic (VanWormer et al. 2019) that have been associated with warming waters, could lead to potentially negative population-level impacts on Steller sea lions. Metal and contaminant exposure remains a focus of ongoing investigation. Total mercury concentrations measured in hair samples collected from pups in the western-central Aleutian Islands are the highest measured for this species and at levels that in other species cause neurological and reproductive effects (Rea et al. 2013, 2020), and organochlorine burdens were detected in tissue samples from across the range but were highest in pups sampled from the Aleutian Islands (Beckmen et al. 2016, Keogh et al. 2020).

The area of greatest (continued) decline in the U.S. remains in the western Aleutian Islands (west of Samalga Pass). Pacific cod and Atka mackerel are two of the primary prey species of Steller sea lions in the central and western Aleutian Islands (Sinclair et al. 2013, Tollit et al. 2017). In the ~~increasing~~ eastern Aleutian Islands region where Steller sea lion numbers are increasing, Rand et al. (2019) reported dense and consistent aggregations of Atka mackerel. However, in the western Aleutian Islands region, this important prey species was more spread out over a larger area during the non-breeding (i.e., “winter”) season (Fritz et al. 2019, Rand et al. 2019). Prey availability over winter is thought to be a key factor in energy budgets of Steller sea lions, especially for pregnant females and especially those supporting a pup and/or juvenile (NMFS 2010, Boyd 2000, Malavaer 2002, Winship et al. 2002, Williams 2005). This could result in increases in energy expenditures by Steller sea lions associated with finding and capturing prey, as evident by increased frequency and duration of foraging trips observed in juvenile Steller sea lions in this region (Lander et al. 2010). Prey species (e.g., Atka mackerel, Pacific cod, and walleye pollock) are likely to have lower overall abundance, less predictable spatial distributions, and altered demographics in fished versus unfished habitats (Hsieh et al. 2006, Barbeaux et al. 2013, Fritz et al. 2019). In 2011, the Pacific cod and Atka mackerel fisheries were closed and then re-opened in 2014. In the western Aleutian Islands region, modeled realized counts exhibited stability from 2014 to 2016 (and potentially an increase in pup counts), followed by continued declines since 2016 (Sweeney et al. 2016, 2017, 2018). Fritz et al. (2019) suggested that if nutrition is a driver of the decline, then it appears that other factors (than diet diversity, species mix, and energy density) may be acting. The literature does not prove (or disprove) a correlation between fisheries, sea lion population trends, and prey availability in the Aleutian Islands, and this hypothesis is an important area of investigation for Steller sea lions, especially in the Aleutian Islands.

The Pacific marine heatwave that occurred from 2014 to 2016, and subsequent warm waters in the north Pacific, especially the Gulf of Alaska, has been linked to large declines in productivity and impacts on groundfish populations (von Biela et al. 2019, Yang et al. 2019, Suryan et al. 2021), including survival of adult female Steller sea lions in Southeast Alaska, Prince William Sound, and Chiswell Island (Hastings et al. 2023). In fact, the concomitant decline in pup productivity in the eastern and central Gulf of Alaska regions observed from 2015 and 2017 may be related to the reduction of available prey in the area (Sweeney et al. 2017). In 2019, pup production in these regions rebounded to 2015 levels; however, there was a decline in non-pups that spanned all the Gulf of Alaska regions (Sweeney et al. 2019). These declines are concerning given that prior to 2017, these regions were showing relatively consistent and steady increases in counts (Sweeney et al. 2019). As Alaska waters, especially the Gulf of Alaska, continue to warm, it seems evident from ~~NOAA Fisheries~~NMFS’ Steller sea lion surveys that this could continue to impact the Western stock of Steller sea lions in the U.S. It is also possible that changes in foraging ability could affect Steller sea lion movements between and within the stocks (Jemison et al. 2018).

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STELLER SEA LION (*Eumetopias jubatus*): Eastern ~~U.S.~~ Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

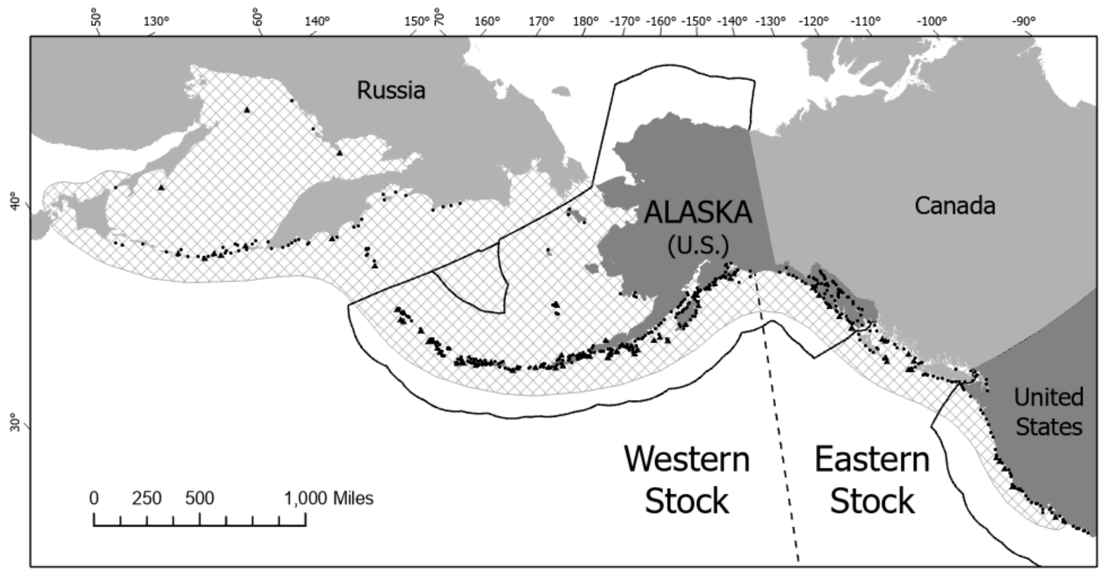


Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; ~~S. Majewski, Fisheries and Oceans Canada, pers. comm.~~Olesiuk 2018). A black dashed line (144°W) indicates the stock boundary (Loughlin 1997) and a black line delineates the U.S. Exclusive Economic Zone.

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984) (Fig. 1). Large numbers of individuals disperse widely outside of the breeding season (late May to July), probably to access seasonally important prey resources. This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing in foraging areas of animals that were born in different areas (Sease and York 2003). There is an exchange of sea lions across the stock boundary (144°W; dashed line in Fig. 1), especially due to the wide-ranging seasonal movements of juveniles and adult males (Baker et al. 2005; Jemison et al. 2013, 2018; Hastings et al. 2020). The Eastern stock is transboundary, extending from southeast Alaska, south through Canada, and down the west coast of the U.S. into California. During the breeding season, Steller sea lions, especially adult females, typically return to their natal rookery or a nearby breeding rookery to breed and pup (Raum-Suryan et al. 2002, Hastings et al. 2017). However, mixing of mostly breeding females from Prince William Sound (Western stock) to Southeast Alaska began in the 1990s and two new, mixed-stock rookeries were established (Gelatt et al. 2007; Jemison et al. 2013, 2018; O'Corry-Crowe et al. 2014).

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals among rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: differences in pup mass (Merrick et al. 1995, Loughlin 1997); and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two ~~separate~~ stocks of Steller sea lions were recognized ~~within U.S. waters~~: ~~an~~the Eastern ~~U.S.~~ stock, which includes animals born east of Cape Suckling, Alaska (144°W), and ~~a~~the Western ~~U.S.~~ stock, which includes animals born at and west of Cape Suckling (Loughlin 1997; Fig. 1). These stocks are equivalent to the eastern and western distinct population segments (DPSs) identified under the Endangered Species Act (62 FR 24345, 62 FR 30772).~~However, Jemison et al. (2013, 2018) determined there is regular movement of Steller sea lions from the western Distinct Population Segment (DPS) (males and females equally) and eastern DPS (almost exclusively males) across the DPS boundary. In this report, the western DPS is equivalent to the western stock and the eastern DPS is equivalent to the eastern stock.~~

All genetic analyses (Baker et al. 2005; Harlin-Cognato et al. 2006; Hoffman et al. 2006, 2009; O'Corry-Crowe et al. 2006) confirm a strong separation between ~~w~~Western and ~~e~~Eastern stocks, and there may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009), although a review by Berta and Churchill (2012) characterized the status of these subspecies assignments as "tentative" and requiring further attention before their status can be determined. Work by Phillips et al. (2011) addressed the effect of climate change, in the form of glacial events, on the evolution of Steller sea lions and reported that the effective population size at the time of the event determines the impact of change on the population. The results suggested that during historic glacial periods, dispersal events were correlated with historically low effective population sizes, whereas range fragmentation type events were correlated with larger effective population sizes. This work again reinforced the separation of the Western and Eastern stock~~s delineation concept~~ by noting that ancient population subdivision likely led to the sequestering of most mtDNA haplotypes as stock or subspecies-specific (Phillips et al. 2011).

Observations of marked sea lions indicate there is regular movement of Steller sea lions across the stock boundary outside the breeding season, especially by juveniles and males (Jemison et al. 2013, 2018; Hastings et al. 2020). During the breeding season, an equal proportion of male and female Western stock Steller sea lions have been observed in the Eastern stock area, while Eastern stock sea lions observed moving west have been almost exclusively male (Jemison et al. 2013, 2018; Hastings et al. 2020). In 1998 a single Steller sea lion pup was observed on Graves Rock just north of Cross Sound in Southeast Alaska, and within 15 years (2013) pup counts had increased to 551 (DeMaster 2014). Mitochondrial and microsatellite analysis of pup tissue samples collected in 2002 revealed that approximately 70% of the pups had mtDNA haplotypes that were consistent with those found in the western stock (Gelatt et al. 2007). Similarly, a rookery to the south on the White Sisters Islands, where pups were first noted in 1990, was also sampled in 2002 and approximately 45% of those pups had western stock haplotypes (O'Corry-Crowe et al. 2014). Collectively, this information demonstrates that these two most recently established rookeries in northern Southeast Alaska have been partially to predominant~~te~~ly established by western stock females (Jemison et al. 2013, 2018; Rehberg et al. 2018).

While movements of animals marked as pups in both stocks support these genetic results (Jemison et al. 2013, 2018; Hastings et al. 2020), overall the observations of marked Steller sea lion movements corroborate the extensive genetic research findings for a strong separation between the two currently recognized stocks. O'Corry-Crowe et al. (2014) concluded that the results of their study of the genetic characteristics of pups born on these new rookeries "demonstrates that resource limitation may trigger an exodus of breeding animals from declining populations, with substantial impacts on distribution and patterns of genetic variation. It also revealed that this event is rare because colonists dispersed across an evolutionary boundary, suggesting that the causative factors behind recent declines are unusual or of larger magnitude than normally occur."

Thus, although recent colonization events in the northern part of the ~~e~~Eastern stock area indicate movement of ~~w~~Western stock Steller sea lions (especially adult females) into this area, the mixed part of the range remains geographically distinct (Jemison et al. 2013), and the overall discreteness of the ~~e~~Eastern from the ~~w~~Western stock remains distinct. ~~Movement of western stock sea lions south of these rookeries and eastern stock sea lions moving to the west is less common (Jemison et al. 2013, O'Corry-Crowe et al 2014).~~ Hybridization among subspecies and species along a contact zone such as now occurs near the stock boundary is not unexpected, as the ability to interbreed is a primitive condition whereas reproductive isolation would be derived. ~~In fact, as stated by NMFS and the U.S. Fish and Wildlife Service (USFWS) in a 1996 response to a previous comment regarding stock discreteness policy (61 FR 47222), "*The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment*" or stock.~~ 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). The fundamental concept overlying this distinctiveness is the collection of morphological, ecological, behavioral, and genetic evidence for stock differences initially described by Bickham et al. (1996) and Loughlin (1997) and supported by Baker et al. (2005), Harlin-Cognato et al. (2006), Hoffman et al. (2006, 2009), O'Corry-Crowe et al. (2006), ~~and~~ Phillips et al. (2009, 2011), and Hastings et al. (2020). As stated by NMFS and the U.S. Fish and Wildlife Service (USFWS) in a 1996 response to a previous comment regarding their joint "DPS" policy (61 FR 4722), "The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment" or stock.

POPULATION SIZE

The ~~e~~Eastern stock of Steller sea lions has historically bred on rookeries located in Southeast Alaska, British Columbia (Canada), Oregon, and California. However, within the last several years a new rookery has become established on the outer Washington coast ~~(~~at the Carroll Island and Sea Lion Rock complex (Stocking and Wiles

2021)~~, with >100 pups born there in 2015 (R. DeLong and P. Gearin, NMFS-AFSC-MML, pers. comm.)~~. Abundance surveys to count Steller sea lions are conducted in late June through mid-July starting approximately 10 days after the mean pup birth dates in the survey area (4-14 June) after approximately 95% of all pups are born (Pitcher et al. 2001, Kuhn et al. 2017).~~Counts of pups on rookeries conducted near the end of the birthing season are nearly complete counts of pup production.~~ Researchers collaborated on a range-wide Eastern stock survey in 2021. The dates of the most recent aerial photographic and land-based surveys of eastern Steller sea lions have varied by region. Southeast Alaska was last surveyed in June and July ~~2017~~ 2021 (Sweeney et al. ~~2017~~ 2022~~; NMFS, unpubl. data~~), while counts used in population analyses for the contiguous U.S. are from ~~2014~~ 2015-2022 surveys in Washington (NMFS and Washington Department of Fish and Wildlife, unpubl. data), ~~and 2017 surveys of~~ Oregon (Oregon Department of Fish and Game, unpubl. data), and California (NMFS ~~and Oregon Department of Fish and Game~~, unpubl. data). Counts from ~~Canada (i.e.,~~ British Columbia~~)~~ are from the 2013 survey~~s~~ (Olesiuk 2018~~; Fisheries and Oceans Canada, unpubl. data~~). Counts from subsequent surveys in Canada in 2015 and 2021 were not yet publicly available to include in this report.

~~For trend and population estimates,~~ An updated agTrend model (~~an~~ R package; Johnson and Fritz 2014, Gaos et al. 2021) was used to estimate counts and trends by augmenting missing counts ~~in order to estimate 2017 counts~~. The updated agTrend model uses the penalized spline model to reduce variance for years where missing data is interpolated (Gaos et al. 2021). This model improves upon the previous method, which used a random walk-time series model (Johnson and Fritz 2014), providing more precise estimates. Non-pup counts do not account for animals at sea and therefore cannot be used as an abundance estimate. Pup counts are considered a census (i.e., total pup production), however, these counts do not account for pups that are born, or die, after the surveys.

Demographic multipliers (e.g., pup production multiplied by 4.5) and corrections for proportions of each age-sex class that are hauled out during the day in the breeding season (when aerial surveys are conducted) have been proposed as methods to estimate total population size from pup and/or non-pup counts (Calkins and Pitcher 1982, Higgins et al. 1988, Milette and Trites 2003, Maniscalco et al. 2006). There are several factors that make using demographic multipliers problematic, including the large variability in abundance trends across the range of the species and the fact that such correction factors have been calculated for the Western stock and not the Eastern.

The ~~2017~~ 2022 estimated total ~~e~~Eastern stock (including Canada) pup count ~~is~~was ~~18,450~~ 31,289 (95% credible interval of ~~15,030-22,253~~ 21,264-44,298). The ~~2017~~ 2022 estimated total ~~e~~Eastern stock non-pup count ~~is~~was ~~58,699~~ 66,150 (95% credible interval of ~~50,312-68,052~~ 49,688-84,914). These are count estimates and cannot be used ~~to represent a total population~~ as an abundance estimate as they do not account for animals at sea.

Minimum Population Estimate

Steller sea lion non-pups from the Western stock occur in Southeast Alaska, east of the stock boundary (O'Corry-Crowe et al. 2006; Jemison et al. 2013, 2018; O'Corry-Crowe et al. 2014; Hastings et al. 2020). Hastings et al. (2020) reported 7-8% of non-pups that occurred in Southeast Alaska in the summer were born in the Western stock area. They principally occurred in the north outer coast (identified as population mixing zone "F," Table 1; Fig. 2) and Glacier Bay (G), and at lower proportions in Lynn Canal (H), Frederick Sound (E), and the Central Outer Coast (D). Using the Hastings et al. (2020) proportions for Western stock non-pups in Southeast Alaska allows for apportionment of modeled counts to the corresponding stock by adjusting the minimum population estimate (N_{MIN}) to help account for movement between stocks.

AgTrend modeled non-pup predicted counts by site were aggregated into the population mixing zones, and the Western stock proportion was applied to calculate the number of Western stock non-pups in Southeast Alaska (Table 1; Hastings et al. 2020). This total number of Western stock non-pups in Southeast Alaska was subtracted from the total Eastern stock count of pups and non-pups. As discussed above, the current population size (N) is unknown as there is no method for deriving abundance estimates from agTrend modeled counts and modeled counts are considered "minimum" estimates of population size. Pup counts are considered a census (i.e., total pup production) however, these counts do not account for pups that are born, or die, after the surveys.

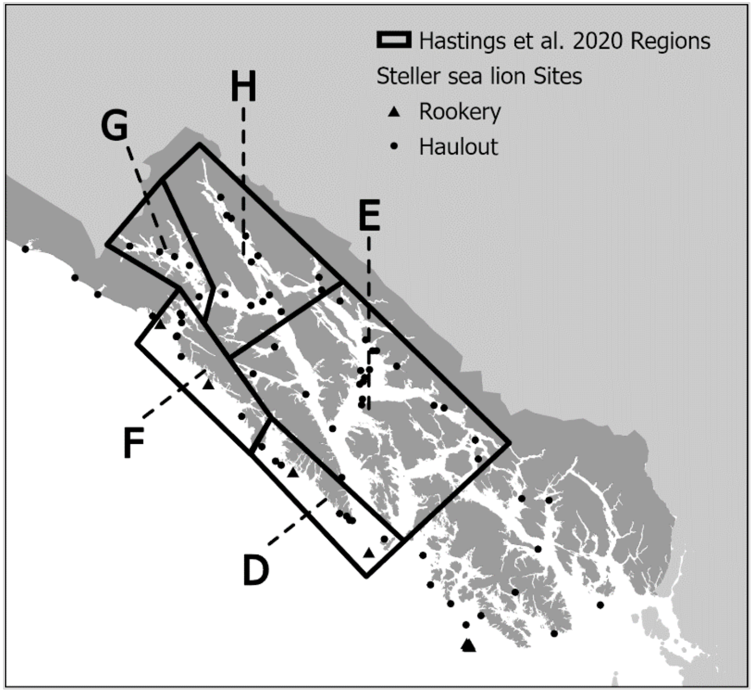


Figure 2. Hastings et al. (2020) mixing zones where non-pups born in the western stock area were reported to inhabit in different proportions, with most in the North Outer Coast (F) and Glacier Bay (G), and at lower proportions in Lynn Canal (H), Frederick Sound (E), and the Central Outer Coast (D) (Table 1).

As the most recent counts from Canada are almost a decade old and analyses have not been conducted to adjust the counts to account for potential abundance changes that may have occurred since the 2013 survey (NMFS 2023), we report only the N_{MIN} estimate for the U.S. portion of the Eastern Steller sea lion stock (excluding Canada and Western stock non-pups): 36,308 (summing 26,158 non-pups and 10,667 pup, and subtracting 517 Western stock non-pups in the Eastern stock area).~~Because current population size (N) and a pup multiplier to estimate N are not known, the best modeled estimates of the total count of eastern Steller sea lions is used as the minimum population estimate (N_{MIN}). These counts are considered minimum estimates of population size because they have not been corrected for animals that are at sea during, or pups born after, the surveys. The agTrend (Johnson and Fritz 2014) total count estimate of pups and non-pups for the entire eastern stock of Steller sea lions (including Canada; Olesiuk 2018) in 2017 is 77,149 (58,699 non-pups plus 18,450 pups). The total count estimate of pups and non-pups for the U.S. portion of the eastern stock of Steller sea lions (excluding Canada) is 43,201 (32,510 non-pups plus 10,691 pups) and is considered to be N_{MIN}.~~

Table 1. Steller sea lion non-pup apportionment to stock using the Hastings et al. (2020) proportions of Western stock non-pups in Southeast Alaska. Proportions were applied to agTrend modeled predicted counts to estimate the number of western- and eastern-born non-pups in the Hastings et al. (2020) population mixing zones.

Southeast Alaska Area	**Population Mixing Zone**	**Western Stock Non-Pup Proportion**	**Modeled Non-Pup Count**	**Western Stock Non-Pup Count**	**Eastern Stock Non-Pup Count**
Central Outer Coast	D	0.022	3,131	69	3,062
Frederick Sound	E	0.012	1,850	22	1,828
North Outer Coast	F	0.082	3,826	314	3,512
Glacier Bay	G	0.073	1,423	104	1,319
Lynn Canal	H	0.014	578	8	570
Remaining Southeast Alaska	I, B, C	-	6,298	-	6,298
TOTAL	-	-	17,106	517	16,589

Current Population Trend

Using the updated agTrend model, count data from 1971 to ~~2017~~ 2022 were modeled to estimate annual trends from ~~1987~~ 1992 to ~~2017~~ 2022 (30-year period). T~~his model indicates t~~he transboundary ~~e~~Eastern stock of Steller sea lion pups increased ~~at a rate of 4.25~~ 5.08% per year (95% credible intervals of ~~3.77-4.72~~ 4.30-6.08%) between ~~1987~~ 1992 and ~~2017~~ 2022~~based on an analysis of pup counts in California, Oregon, Washington, British Columbia, and Southeast Alaska~~ (Table ~~1~~2, Figs. ~~2~~3 and ~~3~~4). ~~A similar analysis of n~~Non-pups increased an estimated ~~counts in the same regions yielded an estimate of population increase of 3.22~~ 3.54% per year during the same time period (95% credible intervals of ~~2.82-3.65~~ 2.83-4.36%: Table 2~~1~~). ~~Pitcher et al. (2007) reported that the Eastern U.S. stock increased at a rate of 3.1% per year during a 25-year time period from 1977 to 2002; however, they used a slightly different method to estimate population growth than the methods reported in NMFS (2013).~~ The Eastern ~~U.S.~~ stock increase has been driven by growth in pup counts in all regions, including the new rookery in Washington (NMFS 2013; NMFS unpubl. data; Stocking and Wiles 2021).

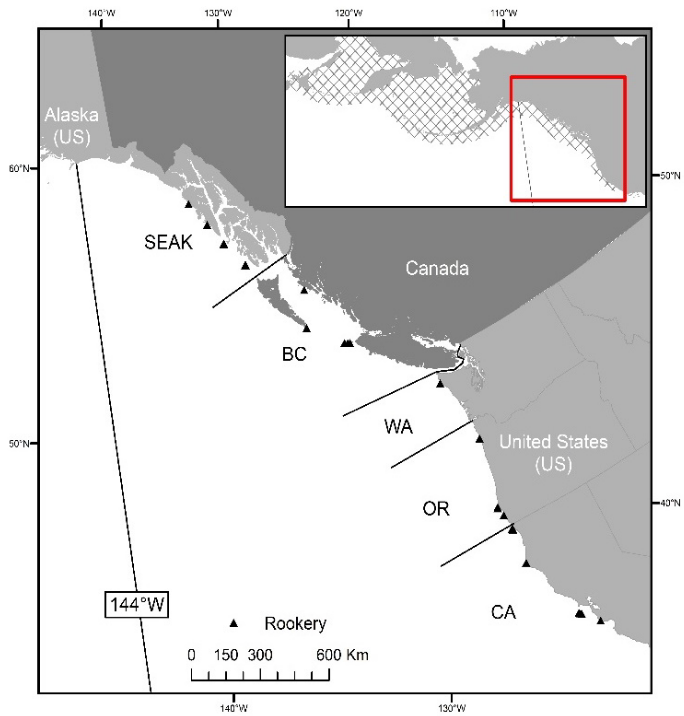
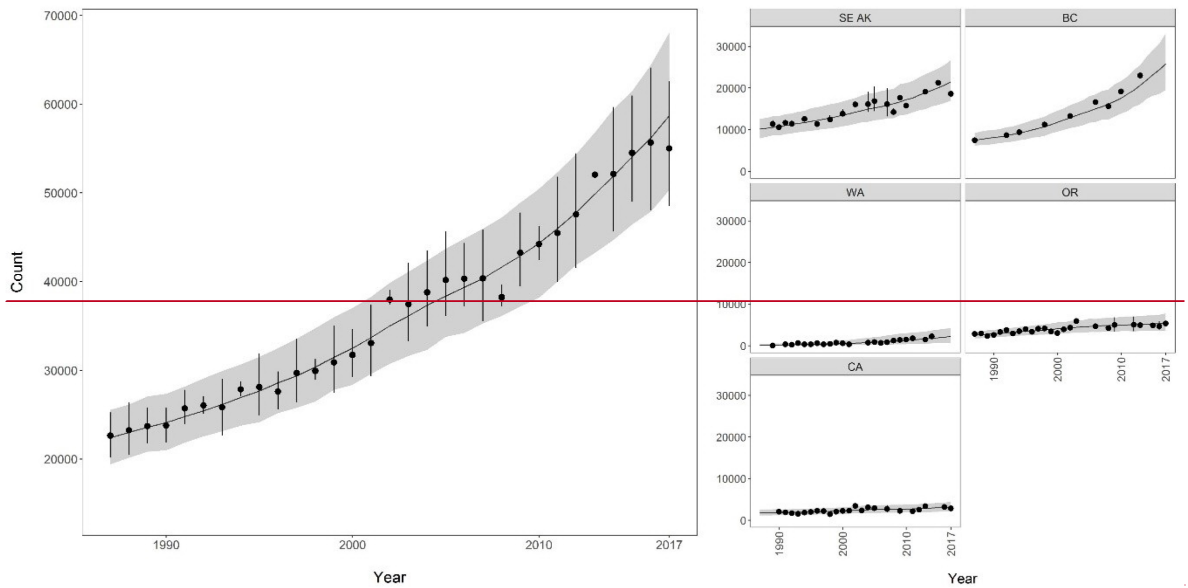


Figure ~~2~~3. The ~~e~~Eastern Steller sea lion rookery sites by region: Southeast Alaska (SEAK), British Columbia, Canada (BC), Washington State (WA), Oregon State (OR), and California State (CA).

Table ~~1~~2. Trends (annual rates of change expressed as % per year~~$^{-1}$~~ with 95% credible interval) of ~~e~~Eastern Steller sea lion non-pups (adults and juveniles) and pups, by region and total population~~, for 1987-2017~~ (Johnson and Fritz 2014, Gaos et al. 2021, Sweeney et al. ~~2017~~ 2022). California, Oregon, Washington, and Southeast Alaska trends are for the 1992-2022 time period, British Columbia trends are for 1992-2013.

	Non-Pup			Pup		
Region	**Trend**	**-95%**	**+95%**	**Trend**	**-95%**	**+95%**
California, U.S.	~~2.01~~ 1.66	~~0.83~~ 0.55	~~3.22~~ 2.68	~~3.44~~ 2.94	~~2.38~~ 2.39	~~4.55~~ 3.55
Oregon, U.S.	~~2.50~~ 1.61	~~1.58~~ 0.78	~~3.41~~ 2.41	~~3.72~~ 3.79	~~2.83~~ 3.31	~~4.48~~ 4.25
Washington, U.S.*	~~9.12~~ 5.69	~~6.06~~ 3.99	~~11.96~~ 7.36	16.17	5.58	26.78
British Columbia, Canada	~~4.18~~ 4.93	~~3.47~~ 4.07	~~4.96~~ 5.83	~~6.91~~ 8.03	~~5.89~~ 7.23	~~7.91~~ 8.82
Southeast Alaska, U.S.	~~2.45~~ 2.08	~~1.85~~ 1.56	~~3.08~~ 2.60	~~3.04~~ 2.51	~~2.49~~ 2.27	~~3.60~~ 2.76
Total Eastern Stock	~~3.22~~ 3.54	~~2.82~~ 2.83	~~3.65~~ 4.36	~~4.25~~ 5.08	~~3.77~~ 4.30	~~4.72~~ 6.08

* NMFS had not observed Steller sea lion pups born on known sites in Washington until a new rookery was established on the outer Washington coast (at the Carroll Island and Sea Lion Rock complex)~~), with a confirmed count of 45 pups in 2013 and >100 pups in 2015 (R. DeLong and P. Gearin, NMFS-AFSC-MML, pers. comm.)~~.



~~**Figure 3.** Estimated counts (modeled with agTrend) of Steller sea lion non-pups (adults and juveniles) for the eastern stock and the five regions: Southeast Alaska (SEAK), British Columbia, Canada (BC), Washington (WA), Oregon (OR), and California (CA) for 1987-2017 (Johnson and Fritz 2014, Sweeney et al. 2017).~~

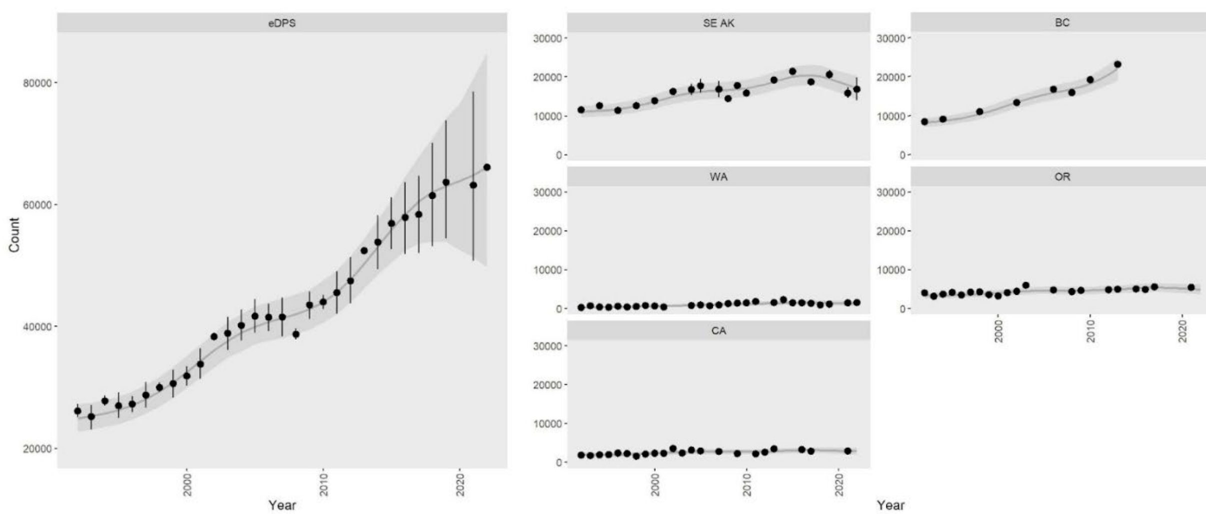


Figure 4. Estimated counts (modeled with agTrend) of Steller sea lion non-pups (adults and juveniles) for the Eastern stock and the five regions: Southeast Alaska (SEAK), British Columbia, Canada (BC), Washington (WA), Oregon (OR), and California (CA) for 1992-2022 (Gaos et al. 2021, Sweeney et al. 2021).

While the ~~e~~Eastern stock of Steller sea lions has been increasing in most~~all~~ regions from 1990 to ~~2017~~ 2022, the most significant continued growth has been observed in ~~Southeast Alaska and~~ British Columbia, Canada (Fig. 4~~3~~). The Southeast Alaska region was increasing from 1990 to 2017 but has appeared to level out since 2017. An abrupt decline of adult female Steller sea lion survival occurred in Southeast Alaska, Prince William Sound, and Chiswell Island during and following the severe North Pacific marine heatwave of 2014-2017 (Hastings et al. 2023). Southeast Alaska and British Columbia ~~These two regions~~ comprise almost ~~81~~ 87% of the total ~~e~~Eastern stock count. Non-pups in Oregon and Washington have been increasing since 1990, though at a lower rate. Non-pup counts in California ranged between 4,000 and 6,000 with no apparent trend from 1927 to 1947 ~~but~~ and then subsequently declined. At Año Nuevo Island off central California, a steady decline in abundance began in 1970 and there was an 85% reduction in the breeding population by 1987 (Le Boeuf et al. 1991). Non-pup counts increased slightly from 1989 to ~~2017~~ 2022, ranging from approximately 2,000 to ~~3,100~~ 3,200.

~~Net movement between the eastern and western stocks appears to be small during the breeding season, with an estimated net 75 sea lions moving from east to west in 2016 (Jemison et al. 2013, Fritz et al. 2016). As a result, trends in counts estimated from breeding season surveys should be relatively insensitive to inter-stock movements. Very few females move from Southeast Alaska to the western stock while approximately 500 were estimated to move from west to east (net increase in the east). Males move in both directions but with a net increase in the west. This pattern of movement is supported by mitochondrial DNA evidence that indicated that the newest rookeries in northern Southeast Alaska (eastern stock) were colonized in part by western females (Gelatt et al. 2007, O'Corry-Crowe et al. 2014).~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the maximum net productivity rate (R_{MAX}) for Steller sea lions. ~~Pitcher et al. (2007) observed a rate of population increase of 3.1% per year for the eastern stock but concluded this rate did not represent a maximum rate of increase. NMFS (2013) estimated that the eastern stock increased at rates of 4.18% per year using pup counts and 2.99% per year using non-pup counts between 1979 and 2009. Here, we estimated that counts of pups and non-pups increased at rates of 4.25% and 3.22% per year, respectively, between 1987 and 2017 (Table 1).~~ Until additional data become available, the maximum theoretical net productivity rate for pinnipeds of 12% will be used for this stock (NMFS ~~2016~~2023).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. On 4 December 2013, the ~~e~~Eastern DPS of Steller sea lions was removed from the list of threatened species under the Endangered Species Act (ESA; 78 FR 66140, 4 November 2013). NMFS' decision to delist this population was based on the information presented in the Status Review (NMFS 2013), the factors for delisting in section 4(a)(1) of the ESA, the biological and threats-based recovery criteria in the 2008 Recovery Plan (NMFS 2008), the continuing efforts to protect the species, and information received during public comment and peer review. NMFS' consideration of this information led to a determination that the ~~e~~Eastern DPS has recovered and no longer meets the definition of a threatened species under the ESA. As ~~recently~~ noted within the humpback whale ESA listing final rule (81 FR 62259, 8 September 2016), in the case of a species or stock that achieved its depleted status solely on the basis of its ESA status, such as the ~~e~~Eastern stock of Steller sea lions, the species or stock would cease to qualify as depleted under the terms of the definition set forth in Marine Mammal Protection Act (MMPA) Section 3(1) if the species or stock is no longer listed as threatened or endangered. Therefore, NMFS considers this stock not to be depleted and~~;~~ the recovery factor is 1.0 (recovery factor for a stock of unknown status that is known to be increasing). As discussed above, a range-wide count estimate is available, but the most recent counts from Canada are almost a decade old and analyses have not been conducted to adjust the counts to account for potential abundance changes that may have occurred since the 2013 survey, so only the N_{MIN} estimate for the U.S. portion of the Eastern Steller sea lion stock (excluding Canada and Western stock non-pups) is reported.~~, and t~~Thus, we calculate PBR for only the U.S. portion of the Eastern stock. The PBR for the U.S. portion of the Eastern stock of Steller sea lions is ~~= 2,592~~ 2,178 (~~43,201~~ 36,308 × 0.06 × 1.0). Excluding Western stock non-pups reduced the PBR by 32 sea lions.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between ~~2013~~ 2017 and ~~2017~~ 2021 is listed, by marine mammal stock, in ~~Delean~~Freed et al. (~~2020~~in prep.); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The minimum estimated mean annual level of human-caused mortality and serious injury for the U.S. portion of the Eastern ~~U.S.~~ Steller sea lion stock between ~~2013~~ 2017 and ~~2017~~ 2021 is ~~112~~ 93.2 sea lions: ~~24~~ 21.4 in U.S. commercial fisheries, ~~1.2 in recreational fisheries,~~ 2.3 in Washington tribal treaty fisheries, ~~0.2~~ 0.4 in Alaska subsistence fisheries, 0.2 in Southeast Alaska salmon hatchery pens, ~~32~~ 15.1 in unknown (commercial, recreational, Washington tribal, or Alaska subsistence) fisheries, ~~31~~ 15.6 in marine debris, ~~13~~ 27.2 due to other causes (illegally shot, and euthanized under NMFS-authorized MMPA section 120(f) permit ~~explosives, ship strike, and incidental mortality during direct removals of California sea lions under authorization of MMPA Section 120 in response to their predation on endangered salmon and steelhead stocks in the Columbia River~~), and 11 in the Alaska Native subsistence harvest (from the 2005 to 2008 and 2012 data, which are the most recent data available). The number of human-caused mortalities and serious injuries of Eastern Steller sea lions in Canada is unknown. Additional potential threats most likely to result in direct human-caused mortality or serious injury of this stock include incidental take in unmonitored fisheries, unreported entanglement in marine debris, and disturbance at rookeries that could cause stampedes.

Fisheries Information

Commercial fisheries

Information ~~(including observer programs, observer coverage, and observed incidental takes of marine mammals)~~ for federally-managed and state-managed U.S. commercial fisheries is ~~presented~~available in Appendix~~ces~~ 3~~-6~~ of the Alaska Stock Assessment Reports (for fisheries in Alaska waters) and Appendix 1 of the U.S. Pacific Stock Assessment Reports (for fisheries in Washington, Oregon, and California waters) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed August 2023).

Between ~~2013~~ 2017 and ~~2017~~ 2021, incidental mortality ~~and serious injury~~ of an eastern Steller sea lion~~s~~ was observed in ~~two~~one of the federally-managed U.S. commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: the ~~Gulf of Alaska halibut longline and~~ Gulf of Alaska sablefish longline fishery~~ies~~ in 2017 (Table 3~~2~~; Breiwick 2013; MML, unpubl. data). In addition, one mortality of an Eastern Steller sea lion was reported in this fishery via a Marine Mammal Authorization Program (MMAP) fisherman self-report in 2020. Because there were no observed mortalities or serious injuries of this stock in the Gulf of Alaska sablefish longline fishery in 2020, the MMAP-reported mortality is considered to be a minimum estimate for the stock in the fishery for 2020 (Table 4; Freed et al. in prep.).

Mortality and serious injury of Eastern Steller sea lions was also observed or recorded via electronic monitoring in six of the federally-managed U.S. commercial fisheries monitored by U.S. West Coast groundfish fisheries observers in ~~2012-2016~~ 2015-2019 (the most recent years for which bycatch estimates are available): the Washington/Oregon/California (WA/OR/CA) groundfish bottom trawl (catch shares), WA/OR/CA groundfish bottom and midwater trawl (~~shoreside hake sector~~catch shares with electronic monitoring), WA/OR/CA groundfish midwater trawl (at-sea hake catcher-processor sector), WA/OR/CA groundfish midwater trawl (at-sea hake mothership catcher vessel sector), WA/OR/CA sablefish hook and line (limited entry), and California halibut bottom trawl (open access) fisheries (Table 3~~2~~; Jannot et al. 2022~~2018; NWFSC, unpubl. data~~).

~~Mortality and serious injury of eastern Steller sea lions due to entanglement in Southeast Alaska commercial salmon drift gillnet (one in 2014) and interactions with Southeast Alaska commercial salmon troll gear (three in 2017) was reported by Marine Mammal Authorization Program (MMAP) fisherman self-reports and reports to the NMFS Alaska Region stranding network, respectively, between 2013 and 2017 (Table 3; Delean et al. 2020). Because observer data are not available for the Southeast Alaska commercial salmon drift gillnet and Southeast Alaska commercial salmon troll fisheries, this mortality and serious injury is used to calculate minimum mean annual mortality and serious injury rates of 0.2 and 0.6 eastern Steller sea lions, respectively, for these fisheries (Table 3). These mortality and serious injury estimates result from an actual count of verified human-caused deaths and serious injuries and are minimums because not all entangled animals strand or are self-reported nor are all stranded animals found, reported, or have the cause of death determined.~~

Commercial fishery-related serious injuries averted (i.e., human intervention or self-release lessened the severity of the initial serious injury, leaving the animal with only non-serious or no injuries) and non-serious injuries are not included in the total estimate of annual human-caused mortality and serious injury that is compared to PBR, but are used to develop the LOF under Section 118 of the MMPA and inform management (e.g., take reduction planning and negligible impact determinations). No serious injuries were averted in U.S. commercial fishery interactions between 2017 and 2021. Additionally, there were no U.S. commercial fisheries with only non-serious injuries of Eastern Steller sea lions between 2017 and 2021.

The minimum estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries between ~~2013~~ 2017 and ~~2017~~2021 is ~~24~~ 21.4 ~~e~~Eastern Steller sea lions, based on observer ~~data~~, electronic monitoring, and ~~stranding~~ MMAP data (Tables 3~~2~~ and 4~~3~~). Due to limited observer program coverage, no data exist on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to take Steller sea lions). As a result, the number of Steller sea lions taken in Canadian waters is not known.

Table ~~2~~3. Summary of incidental mortality and serious injury (M/SI) of Eastern ~~U.S.~~ stock Steller sea lions due to observed or electronically monitored U.S. commercial fisheries between ~~2013~~ 2017 and ~~2017~~ 2021 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate for Alaska fisheries (Breiwick 2013; MML, unpubl. data) and WA/OR/CA fisheries (Jannot et al. 2022~~2018; NWFSC, unpubl. data~~).

Fishery name	Years	Data type	Percent observer coverage	Observed ~~mortality~~M/SI	Estimated ~~mortality~~ M/SI	Mean estimated annual ~~mortality~~ M/SI
~~Gulf of Alaska halibut longline~~	~~2013~~ ~~2014~~ ~~2015~~ ~~2016~~ ~~2017~~	~~obs data~~	~~4.2~~ ~~11~~ ~~9.4~~ ~~9.5~~ ~~4.6~~	~~0~~ ~~0~~ ~~1~~ ~~0~~ ~~0~~	~~0~~ ~~0~~ ~~12~~ ~~0~~ ~~0~~	~~2.4~~ ~~(CV = 0.96)~~
Gulf of Alaska sablefish longline	~~2013~~ ~~2014~~ ~~2015~~ ~~2016~~ 2017 2018 2019 2020 2021	obs data	~~14~~ ~~19~~ ~~20~~ ~~14~~ ~~12~~10 9 12 7 11	~~0~~ ~~0~~ ~~1~~ ~~0~~ 1 0 0 0 0	~~0~~ ~~0~~ ~~6.9~~ ~~0~~ ~~11~~15 0 0 0 0	~~3.5~~ ~~(CV = 0.69)~~ 3.0 (CV = 0.97)
WA/OR/CA groundfish (bottom trawl - catch shares)	~~2012~~ ~~2013~~ ~~2014~~ 2015 2016 2017 2018 2019	obs data	~~99~~ ~~100~~ ~~100~~ 100 100 100 100 100	~~8~~ ~~6~~ ~~5~~ 8[a] 0 1[a] 0[a] 0	~~8~~ ~~6~~ ~~5~~ 8[a] 0 1[a] 0[a] 0	~~5.4~~ 1.8
WA/OR/CA groundfish (bottom and midwater trawl – catch shares with electronic monitoring)	2015 2016 2017 2018 2019	electronic monitoring data	100 100 100 100 100	0 0 1 0[a] 1	0 0 1 0[a] 1	0.4
~~WA/OR/CA groundfish (midwater trawl - shoreside hake sector)~~	~~2012~~ ~~2013~~ ~~2014~~ ~~2015~~ ~~2016~~	~~obs data~~	~~100~~ ~~100~~ ~~100~~ ~~100~~ ~~100~~	~~0~~ ~~0~~ ~~1~~ ~~0~~ ~~0~~	~~0~~ ~~0~~ ~~1~~ ~~0~~ ~~0~~	~~0.2~~
WA/OR/CA groundfish (midwater trawl - at-sea hake catcher-processor sector)	~~2012~~ ~~2013~~ ~~2014~~ 2015 2016 2017 2018 2019	obs data	~~100~~ ~~100~~ ~~100~~ 100 100 100 100 100	~~1~~ ~~2~~ ~~3~~ 0 21 1 4 0	~~1~~ ~~2~~ ~~3~~ 0 21 1 4 0	~~5.4~~ 5.2

Fishery name	Years	Data type	Percent observer coverage	Observed ~~mortality~~M/SI	Estimated ~~mortality~~ M/SI	Mean estimated annual ~~mortality~~ M/SI
WA/OR/CA groundfish (midwater trawl - at-sea hake mothership catcher vessel sector)	~~2012~~ ~~2013~~ ~~2014~~ 2015 2016 2017 2018 2019	obs data	~~98~~ ~~100~~ ~~100~~ 100 100 100 100 99	~~0~~ ~~0~~ ~~1~~ 0 2 8 8 0	~~0~~ ~~0~~ ~~1~~ 0 2 8 8 0	~~0.6~~ 3.6
WA/OR/CA sablefish (hook and line - limited entry)	~~2012~~ ~~2013~~ ~~2014~~ 2015 2016 2017 2018 2019	obs data	~~22~~ ~~22~~ ~~27~~ 42 33 37 46 39	~~0~~ ~~0~~ ~~0~~ 0 2 0 0 0	~~0.5~~ ~~0.4~~ ~~0.4~~ ~~0.3~~ 0.2 ~~2.4~~ 2.3 0.4 0.3 0.3	~~0.8~~ 0.7 (CV = 0.37)
California halibut (bottom trawl - open access)	~~2012~~ ~~2013~~ ~~2014~~ 2015 2016 2017 2018 2019	obs data	~~6~~ ~~6~~ ~~22~~ 33 ~~30~~ 31 26 26 27	~~0~~ ~~0~~ ~~0~~ 3 3 1 1 4	~~2.7~~ ~~3.4~~ ~~3.2~~ ~~6.1~~ 6.8 ~~6.1~~ 6.8 5.2 4.4 9.4	~~4.3~~ 6.5 (CV = 0.16)
Minimum total estimated annual mortality						~~23~~ 21.2 (CV = ~~0.56~~ 0.14)

[a]Jannot et al. (2022) misreport this value; the value in this table is correct.

Non-commercial, tribal, and unknown fisheries

Entanglement in marine debris and interactions with fisheries are a contributing factor in Steller sea lion injury and mortality (Allyn and Scordino 2020, Raum-Suryan and Suryan ~~et al. 2009~~ 2022). Reports to the NMFS West Coast Region and Alaska Region stranding networks and the Alaska Department of Fish and Game (ADF&G) of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear provide additional information on fishery-related mortality and serious injury (Table 4~~3~~; ~~Delean~~Freed et al. ~~2020~~in prep.). In addition, NMFS receives reports from the Northwest Indian Fisheries Commission of Steller sea lions taken in association with Washington tribal treaty fisheries (Table 4; NWIFC unpubl. data, Freed et al. in prep.).~~Between 2013 and 2017, reports of Steller sea lion interactions with Southeast Alaska recreational salmon troll and Southeast Alaska recreational hook and line fisheries resulted in a minimum mean annual mortality and serious injury rate of 1.2 Steller sea lions in recreational fisheries. One mortality reported in a subsistence halibut longline fishery in 2017 resulted in a mean annual mortality and serious injury rate of 0.2 Steller sea lions in subsistence fisheries between 2013 and 2017. Steller sea lion interactions with troll fisheries between 2013 and 2017 resulted in mean annual mortality and serious injury rates of 3.4 sea lions in the Southeast Alaska salmon troll fishery and 27 in unidentified troll fisheries, including the dependent pup of a seriously injured animal. In all but one case (in which the animal was entangled in gear), the sea lions had either ingested troll gear or were hooked in the mouth; however, it is not clear whether these interactions involved recreational or commercial components of the fisheries. Other fishery-related mortality and serious injury of eastern Steller sea lions between 2013 and 2017 (and the resulting mean annual mortality and serious injury rates) was due to interactions with trawl gear (0.4) and hook and line gear (1.2).~~

The minimum mean annual mortality and serious injury rate due to all non-commercial, tribal, and unknown fishery interactions reported ~~to the NMFS Alaska Region and ADF&G~~ between ~~2013~~ 2017 and ~~2017~~ 2021 is ~~33~~ 16.8

eastern Steller sea lions: 2.3 in association with Washington tribal treaty fisheries + ~~1.2 in recreational fisheries + 0.2~~ 0.4 in Alaska subsistence fisheries + 0.2 in the Southeast Alaska salmon hatchery pens + ~~32~~15.1 in unknown (commercial, recreational, Washington tribal, or Alaska subsistence) fisheries (Table ~~4~~3; ~~Delean~~Freed et al. ~~2020~~in prep.). These mortality and serious injury estimates result from an actual count of verified human-caused deaths and serious injuries and are minimums because not all entangled animals strand or are self-reported nor are all stranded animals found, reported, or have the cause of death determined.

An additional ~~eight~~two Steller sea lions in the Eastern and Western stock mixing area of Southeast Alaska that were initially considered seriously injured ~~in marine debris (one in 2014, one in 2015, and four in 2017),~~ due to hooking by unknown salmon hook and line gear (one in ~~2016~~2017 and one in 2018)~~, and Southeast Alaska salmon troll gear (one in 2017)~~ were disentangled and released, or were presumed to have self-released, with non-serious injuries (Freed et al. in prep.). ~~in Alaska waters, and one Steller sea lion pup with serious injuries caused by human harassment was rehabilitated and released with non-serious injuries in Washington waters in 2014 (Delean et al. 2020).~~ None of these ~~animals~~ serious injuries averted were included in the average annual mortality and serious injury rate for ~~2013 to~~ 2017 to 2021.

Table ~~3~~4. Summary of Eastern ~~U.S.~~ stock Steller sea lion mortality and serious injury (M/SI) in U.S. waters, by year and type, reported to the NMFS Alaska Region marine mammal stranding network, Northwest Indian Fisheries Commission, and ADF&G, and by fishermen self-reports, between ~~2013~~ 2017 and ~~2017~~ 2021 (~~Delean~~Freed et al. ~~2020~~in prep.). Sea lions euthanized in response to their predation on endangered salmon and steelhead stocks in the Columbia River under an MMPA section 120(f) permit are also included in this table. In areas of Southeast Alaska where the Western (wSSL) and Eastern (eSSL) populations mix, the mean annual mortality of both stocks (wSSL + eSSL) was multiplied by the mixing zone-specific proportion of Western stock non-pups (Table 1; Hastings et al. 2020) and subtracted from the total to produce estimates for the Eastern stock (eSSL only).

Cause of injury	~~**2013**~~	~~**2014**~~	~~**2015**~~	~~**2016**~~	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean annual ~~mortality~~M/SI**	
										wSSL + eSSL	eSSL only
Southeast Alaska – Mixing Zone D											
Hooked by Alaska subsistence halibut longline gear					0	0	0	0	1	0.2	0.2
Hooked by salmon hook and line gear*					4	0	1	1	3	1.8	1.8
Hooked by unknown hook and line gear*					0	1	0	0	0	0.2	0.2
Entangled in Southeast Alaska salmon hatchery pen					0	0	0	1	0	0.2	0.2
Entangled in unknown fishery gear*					0	0	1	0	0	0.2	0.2
Entangled in marine debris					3	3	2	0	0	1.6	1.6
Illegally shot					0	0	1	0	0	0.2	0.2
Southeast Alaska – Mixing Zone E											
Hooked by halibut hook and line gear*					0	1	0	0	0	0.2	0.2
Hooked by salmon hook and line gear*					4	0	1	0	0	1.0	1.0
Entangled in marine debris					3	2	1	0	0	1.2	1.2

Southeast Alaska – Mixing Zone F											
Hooked or entangled by salmon hook and line gear*					8	8	4	0	6	5.2	4.8
Hooked by unknown hook and line gear*					2	1	2	0	0	1.0	0.9
Entangled in unknown fishery gear*					0	0	0	1	0	0.2	0.2
Entangled in marine debris					2	8	1	0	3	2.8	2.6
Dependent pup of animal seriously injured by marine debris					0	1	0	0	0	0.2	0.2
Southeast Alaska – Mixing Zone G											
Hooked by salmon hook and line gear*					1	1	2	0	0	0.8	0.7
Entangled in marine debris					3	3	0	0	0	1.2	1.1
Southeast Alaska – Mixing Zone H											
Hooked by salmon hook and line gear*					3	0	1	1	1	1.2	1.2
Entangled in marine debris					3	2	1	0	1	1.4	1.4
All Other Areas in Eastern Stock Range											
~~Entangled in Southeast Alaska commercial salmon drift gillnet~~	~~0~~	~~1[a]~~	~~0~~	~~0~~	~~0~~						~~0.2~~
~~Hooked by Southeast Alaska commercial salmon troll gear~~	~~0~~	~~0~~	~~0~~	~~0~~	~~3~~						~~0.6~~
~~Hooked by SE Alaska recreational salmon troll gear~~	~~0~~	~~1~~	~~0~~	~~0~~	~~4~~						~~1~~
~~Hooked by Southeast Alaska recreational hook and line gear~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~						~~0.2~~
Hooked by AK Gulf of Alaska sablefish longline gear					0	0	0	1[a]	0	-	0.2
Hooked by Alaska subsistence halibut longline gear	~~0~~	~~0~~	~~0~~	~~0~~	1	0	0	0	0	-	0.2
Hooked by ~~Southeast Alaska~~ salmon hook and line~~troll~~ gear*	~~3~~	~~8~~	~~6~~	~~0~~	~~0~~ 5	1	2	1	3	-	~~3.4~~ 2.4
Washington tribal treaty salmon hook and line fishery[b]							0	5	0	-	1.7[c]
Washington tribal treaty salmon set gillnet fishery[b]							1	0	0	-	0.3[c]
Washington tribal treaty sablefish longline fishery[b]							1	0	0	-	0.3[c]
Hooked by unknown hook and line~~troll~~ gear*	~~3~~	~~41~~	~~26~~	~~42~~	~~17~~ 0	1	1	0	1	-	~~26~~ 0.6
~~Dependent pup of animal seriously injured (hooked) by troll gear*~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~						~~0.2~~

~~Entangled in troll gear*~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~						~~0.4~~
Entangled in unknown trawl gear*	~~0~~	~~1~~	~~0~~	~~0~~	1	0	0	0	0	-	~~0.4~~ 0.2
~~Hooked by hook and line gear*~~	~~0~~	~~0~~	~~0~~	~~2~~	~~2~~						~~0.8~~
~~Entangled in hook and line gear*~~	~~0~~	~~0~~	~~1~~	~~1~~	~~0~~						~~0.4~~
Entangled in unidentified fishing gear*					0	1	3	0	0	-	0.8
Entangled in marine debris	-	~~26~~	~~26~~	~~34~~	~~28~~ 15	11	8	0	2	-	~~29[b]~~ 7.2
Dependent pup of animal seriously injured by marine debris	-	~~3~~	~~2~~	~~2~~	0	2	0	0	0	-	~~1.8[b]~~ 0.4
Illegally shot[e]	~~17~~	~~13~~	~~15~~	~~13~~	1	2	8	9	5	-	~~12~~ 5.0
~~Dependent pup of animal illegally shot[e]~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~						~~0.2~~
~~Explosives~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~						~~0.2~~
~~Ship strike~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~						~~0.2~~
Euthanized under NMFS-authorized MMPA section 120(f) permit								6	38	-	22[d]
~~Incidental mortality during direct removals of California sea lions~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~						~~0.2~~
Total in commercial fisheries											~~0.8~~ 0.2
Total in recreational fisheries											~~1.2~~ 0
Total in Washington tribal fisheries											2.3
Total in Alaska subsistence fisheries											~~0.2~~ 0.4
Total in Southeast Alaska salmon hatchery pen											0.2
*Total in unknown (commercial, recreational, Washington tribal, or Alaska subsistence) fisheries											~~32~~ 15.1
Total in marine debris (including dependent pup(s) of animal(s) seriously injured or killed by marine debris)											~~31~~ 15.6
Total due to other sources (illegally shot, euthanized under NMFS-authorized MMPA section 120(f) permit~~explosives, ship strike, incidental mortality during direct removals of California sea lions~~)											~~13~~ 27.2

[a] Marine Mammal Authorization Program (MMAP) fisherman self report.
[b] Interactions reported by the NWIFC lack details on whether each interaction involved bycatch or lethal removal to prevent interference with fishing gear and/or catch. For purposes of this stock assessment report, these animals are considered to have been incidentally killed in association with Washington tribal treaty fishing operations.
[c] A 3-year average (using 2019-2021 data) was calculated for this category because data were not received from the NWIFC in 2017-2018.
[d] A 2-year average (using 2020-2021 data) was calculated for this category because intentional lethal take of eastern Steller sea lions on the waters of the Columbia River and its tributaries under MMPA Section 120(f) was not authorized prior to 2020.
~~[b] A 4-year average (using 2014 to 2017 data) was calculated for this category, since we did not receive data on mortality and serious injury due to marine debris entanglement from the ADF&G in 2013.~~
~~[e] Only animals reported to the NMFS West Coast Region are included in this table because animals reported to the NMFS Alaska Region are likely accounted for as "struck and lost" in the Alaska Native harvest.~~

All fisheries

In summary, ~~T~~the minimum estimated mean annual mortality and serious injury rate incidental to all fisheries in U.S. waters between ~~2013~~ 2017 and ~~2017~~ 2021 is ~~57~~ 39.4 Eastern stock Steller sea lions: ~~24~~ 21.4 in U.S. commercial fisheries ~~+ 1.2 in recreational fisheries~~ + 2.3 in Washington tribal treaty fisheries + ~~0.2~~0.4 in Alaska subsistence fisheries + 0.2 in Southeast Alaska salmon hatchery pens + ~~32~~ 15.1 in unknown (commercial, recreational, Washington tribal, or Alaska subsistence) fisheries.

Alaska Native Subsistence/Harvest Information

Information on the subsistence harvest of Steller sea lions is provided by the ADF&G. 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 in 2005-2008 (Wolfe et al. 2006, 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. Approximately 16 of the interviewed communities lie within the range of the Eastern ~~U.S.~~ stock. As of 2009, annual statewide data on community subsistence harvests are no longer being consistently collected. Data are being collected periodically in subareas. Between 2010 and 2017, monitoring occurred only in 2012 (Wolfe et al. 2013), when one animal was landed and eight animals were struck and lost. Therefore, the most recent 5 years of data (2005 to 2008 and 2012) will be used for calculating an annual mortality and serious injury estimate. The average number of animals harvested plus struck and lost is 11 animals per year during this 5-year period (Table 54). Since the cessation of ADF&G monitoring, there is an incomplete understanding of harvest levels statewide.

An unknown number of Steller sea lions from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small (Fisheries and Oceans Canada 2010). Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on management of the stock.

Table 45. Summary of the Alaska Native subsistence harvest data for Eastern ~~U.S.~~ stock Steller sea lions from 2005 to 2008 and in 2012. As of 2009, data on community subsistence harvests are no longer being consistently collected at a statewide level. Therefore, the most recent 5 years of data (2005 to 2008 and 2012) will be used for calculating an annual mortality and serious injury estimate.

Year	Number harvested	Number struck and lost	Estimated total number taken
2005	0	19	19[a]
2006	2.5	10.1	12.6[b]
2007	0	6.1	6.1[c]
2008	1.7	8.0	9.7[d]
2012	1	8	9[e]
Mean annual take (2005-2008 and 2012)	1.0	10	11

[a]Wolfe et al. (2006); [b]Wolfe et al. (2008); [c]Wolfe et al. (2009a); [d]Wolfe et al. (2009b); [e]Wolfe et al. (2013).

Other Mortality

Steller sea lions were ~~taken~~killed in British Columbia during commercial salmon farming operations. Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 45.8 Steller sea lions from ~~this~~the Eastern stock from 1999 to 2003 (Olesiuk 2004). Starting in 2004, aquaculture facilities were no longer permitted to shoot Steller sea lions (P. Olesiuk, Pacific Biological Station, BC, Canada, pers. comm.). However, Fisheries and Oceans Canada (2010) summarized that "illegal and undocumented killing of Steller Sea Lions is likely to occur in B.C." and reported "[s]everal cases of illegal kills have been documented (Fisheries and Oceans Canada, unpubl. data), and mortality may also occur outside of the legal parameters assigned to permit holders (e.g., for predator control or subsistence harvest)" but "…data on these activities are currently lacking."

Illegal shooting of Steller sea lions in U.S. waters was thought to be a potentially significant source of mortality prior to the listing of Steller sea lions as threatened under the ESA in 1990. Steller sea lion mortality and serious injury caused by gunshot wounds is reported to the NMFS Alaska Region and the NMFS West Coast Region stranding networks. Between ~~2013~~ 2017 and ~~2017~~2021, ~~59~~ 26 animals with gunshot wounds within the range of the Eastern stock (including one in the population mixing zone in Southeast Alaska) were reported to the NMFS West Coast Region and Alaska Region stranding networks, resulting in a minimum mean annual mortality and serious injury rate of ~~12~~ 5.2 Eastern Steller sea lions illegally shot from this stock ~~plus 0.2 dependent pups of seriously injured animals~~ (Table 4~~3~~; ~~Delean~~Freed et al. ~~2020~~in prep.). The Steller sea lions ~~An additional two Steller sea lions with gunshot wounds were~~ reported to the NMFS Alaska Region stranding network ~~between 2013 and 2017 (one each in 2016 and 2017)~~ were considered to be illegal shootings, not animals that were struck and lost during Alaska Native subsistence hunting. ~~Although it is likely that illegal shooting does occur in Alaska, these events are not included in the estimate of the average annual mortality and serious injury rate because it could not be confirmed that the deaths~~

~~were due to illegal shooting and were not already accounted for in the estimate of animals struck and lost in the Alaska Native subsistence harvest.~~

Other non-fishery human-caused mortality and serious injury of Steller sea lions reported to the NMFS Alaska Region stranding network between ~~2013~~ 2017 and ~~2017~~ 2021 (and the resulting minimum mean annual mortality and serious injury rates) were due to entanglement in marine debris (~~29~~15), dependent pups of animals seriously injured by marine debris (~~1.8~~0.6), ~~explosives (0.2), ship strikes (0.2),~~ and euthanized (22) ~~incidental mortality (0.2) during direct removals of California sea lions under authorization of MMPA Section 120~~ in response to their predation on endangered salmon and steelhead stocks in the Columbia River as authorized under a NMFS MMPA section 120(f) permit (Table ~~4~~3; ~~Delean~~Freed et al. ~~2020~~in prep.). These estimates result from an actual count of verified human-caused deaths and serious injuries and are minimums because not all animals strand or are self-reported nor are all stranded animals found, reported, or have the cause of death determined (via necropsy by trained personnel), and human-related stranding data are not available for British Columbia.

An additional six Steller sea lions in the Eastern and Western stock mixing area of Southeast Alaska that were initially considered seriously injured in marine debris (four in 2017, one in 2018, and one in 2019) were disentangled and released, or were presumed to have self-released, with non-serious injuries (Freed et al. in prep.). None of these serious injuries averted were included in the average annual mortality and serious injury rate for 2017 to 2021.

STATUS OF STOCK

Based on currently available data, the minimum estimated mean annual U.S. commercial fishery-related mortality and serious injury rate for this stock (~~24~~21.4 sea lions) is less than 10% of the ~~calculated~~U.S. PBR (10% of PBR = 218~~259~~) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. For the U.S. portion of the Eastern stock, ~~T~~the minimum estimated mean annual level of U.S. human-caused mortality and serious injury (~~112~~93.2 sea lions) does not exceed the U.S. PBR (~~2,592~~2,178) for this stock. The Eastern ~~U.S.~~ stock of Steller sea lions is not listed under the ESA and is not considered depleted under the MMPA. This stock is not classified as ~~a non-~~strategic ~~stock~~. Because the counts of ~~e~~Eastern stock Steller sea lions have steadily increased over a 30+ year period, this stock is likely within its Optimum Sustainable Population (OSP); however, no determination of its status relative to OSP has been made.

There are key uncertainties in the assessment of the Eastern ~~U.S.~~ stock of Steller sea lions. ~~There is some overlap in range between animals in the western and eastern stocks in northern Southeast Alaska.~~ The population is based on counts of visible animals; the calculated N_{MIN} and PBR levels, reported only for the U.S. portion of the stock, are conservative because there are no data available to correct for animals not visible during the visual surveys. Information on human-caused mortality and serious injury is currently only available for the U.S. portion of the stock's range. There are multiple nearshore commercial fisheries operating within the stock's range that~~which~~ are not observed; thus, there is likely to be unreported fishery-related mortality and serious injury of Steller sea lions. Estimates of human-caused mortality and serious injury from stranding data are negatively biased~~underestimates~~ because not all animals strand nor are all stranded animals found, reported, or have the cause of death determined.

~~HABITAT CONCERNS~~

~~Unlike the Western U.S. stock of Steller sea lions, there has been a sustained and robust increase in abundance of the Eastern U.S. stock throughout its breeding range. In the southern end of its range (Channel Islands in southern California), it has declined considerably since the late 1930s and several rookeries and haulouts south of Año Nuevo Island have been abandoned. Changes in the ocean environment, particularly warmer temperatures, may be factors that have favored California sea lions over Steller sea lions in the southern portion of the Steller sea lion's range (NMFS 2008).~~

~~The risk of oil spills to this stock may increase in the next several decades due to increased shipping, including tanker traffic, from ports in British Columbia and possibly Washington State (COSEWIC 2013, NMFS 2013, Wiles 2014) and LNG facility and pipeline construction (COSEWIC 2013).~~

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SATO'S BEAKED WHALE (*Berardius minimus*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

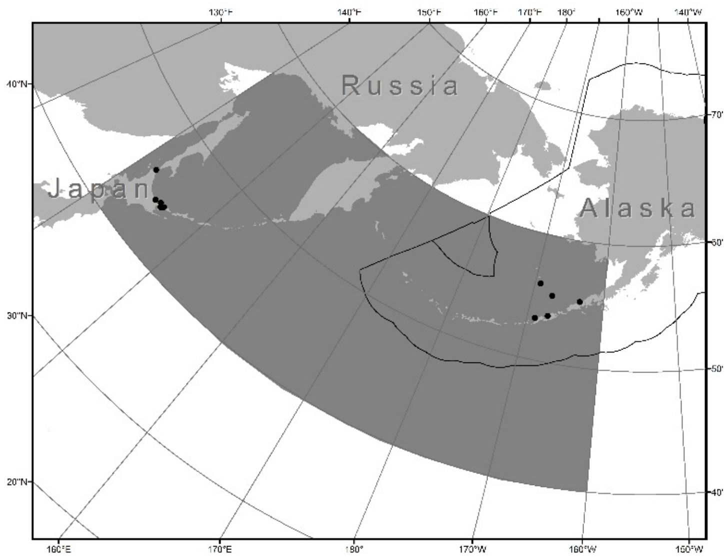

Figure 1. Approximate distribution of Sato's beaked whales in the western and central North Pacific (shaded area). Strandings (black dots) are also depicted (Kitamura et al. 2013, Morin et al. 2017, Yamada et al. 2019). This stock assessment considers only the portion of the stock occurring in U.S. waters (i.e., the U.S. Exclusive Economic Zone delineated by a black line).

Sato's beaked whale, or black beaked whale, is a newly described species which inhabits the western and central North Pacific (Fig. 1; Morin et al. 2017, Yamada et al. 2019, Brownell 2020, Fedutin et al. 2020). Reports from Japanese whalers of a "black" beaked whale smaller than the more common Baird's beaked whale and measurements from stranded animals suggested the existence of a separate species (Yamada et al. 2019). Strong genetic differences confirmed it to be distinct from the partly sympatric Baird's beaked whale (Kitamura et al. 2013, Morin et al. 2017, Yamada et al. 2019, Fedutin et al. 2020).

Although the existence of a smaller form of beaked whale off Japan has been suggested for years (Brownell and Kasuya 2021), the first confirmed observation of living Sato's beaked whales was made in 2021 (Fedutin et al. 2022). Twenty-three encounters were made off the west coast of Kunashir Island (the southernmost Kuril Island) from May to June 2021. The species identification was confirmed from one biopsy sample and fourteen individuals in groups of 4-5 animals were identified from photographs.

Our current information on geographic range comes from relatively few stranded or incidentally caught animals. From skull characteristics and genetics, specimens have been identified in northern Hokkaido, Japan; Sakhalin and Kunshir Islands, Russia; Unalaska Island, Bering Sea; and the Alaska Peninsula, U.S. (Morin et al. 2017, Fedutin et al. 2020). Because our knowledge of distribution is based on relatively few strandings, distribution is uncertain but appears to include waters between 40°N and 60°N, and 140°E and 160°W (Yamada et al. 2019).

This transboundary stock is defined as the *Berardius minimus* species.

POPULATION SIZE

Reliable estimates of population abundance are not available for this stock.

Minimum Population Estimate

It is not possible to produce a reliable minimum population estimate (N_{MIN}) for this stock, as estimates of abundance are not available.

Current Population Trend

There are no data on trends in population abundance for the Sato's beaked whale stock or for the portion of the stock within U.S. waters.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate (R_{MAX}) is not available for the Sato's beaked whale stock or for any portion of the stock within U.S. waters. Until additional data become available, the default cetacean maximum theoretical net productivity rate of 4% will be used for this stock (NMFS 2023).

POTENTIAL BIOLOGICAL REMOVAL

PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (NMFS 2023). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between 2017 and 2021 is listed, by marine mammal stock, in Freed et al. (in pre.); however, only the mortality and serious injury data are included in the Stock Assessment Reports. No human-caused mortality or serious injury of Sato's beaked whales was reported between 2017 and 2021. Potential threats most likely to result in direct human-caused mortality or serious injury of this stock include vessel strikes and interactions with fisheries.

Fisheries Information

Information for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is available in Appendix 3 of the Alaska Stock Assessment Reports (observer coverage) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed December 2022).

Between 2017 and 2021, no fisheries-related mortality or serious injury of Sato's beaked whales was reported in U.S. waters.

Alaska Native Subsistence/Harvest Information

There is no known subsistence harvest of Sato's beaked whales by Alaska Natives.

Other Mortality

In Japanese waters, Sato's beaked whales are sometimes killed in the small-type whaling operations that occur in the southern Okhotsk Sea off the northern coast of Hokkaido (Brownell and Kasuya 2021). In this same region the species is also occasionally taken as bycatch (Yamada et al 2019, Brownell 2020, Brownell and Kasuya 2021).

STATUS OF STOCK

Sato's beaked whales are not designated as depleted under the Marine Mammal Protection Act or listed as threatened or endangered under the Endangered Species Act. However, *Berardius* spp., including Sato's beaked whales, are included in Appendix I under the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are not available. Because the PBR is unknown, the mean annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching a zero mortality and serious injury rate is unknown. However, because human-caused mortality and serious injury is thought to be minimal, this stock is presumed to be non-strategic.

There are key uncertainties in the assessment of Sato's beaked whales. There is very little information available on the species' range, population structure, and habitat use. Therefore, reliable estimates of the minimum population size, population trends, and PBR are not available.

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NORTH PACIFIC RIGHT WHALE (*Eubalaena japonica*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

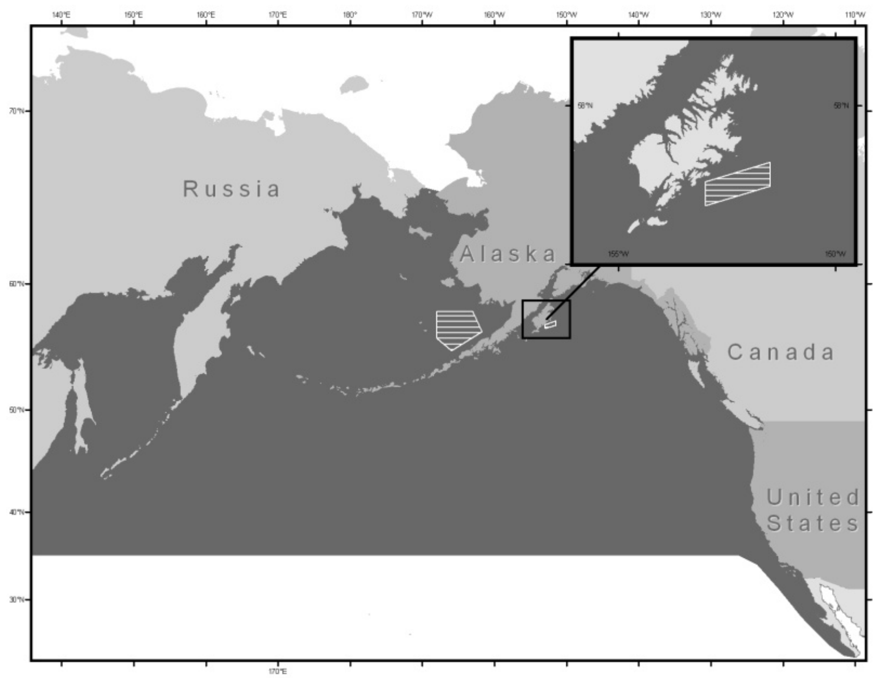

Figure 1. Approximate historical distribution of North Pacific right whales in the North Pacific (dark shaded area). Striped areas indicate North Pacific right whale critical habitat (73 FR 19000, 8 April 2008).

Once distributed widely across the North Pacific from North America to the Far East, North Pacific right whales (*Eubalaena japonica*) are today among the world's rarest marine mammals (Wade et al. 2011). A distinct geographic distribution, different catch and recovery histories, and recent genetic analysis have led to the generally accepted belief that the species comprises eastern and western populations that are largely or wholly discrete (Brownell et al. 2001, LeDuc et al. 2012, Pastene et al. 2022). The summer range of the eastern stock includes the Gulf of Alaska and the Bering Sea, while the western stock is believed to feed in the Okhotsk Sea and in pelagic waters of the northwestern North Pacific. The winter calving grounds of both stocks remain unknown.

Right whales were the subject of intensive commercial exploitation, beginning in the Gulf of Alaska in 1835, and by 1849 were already seriously depleted in the eastern Pacific (Scarff 1986, 1991; Josephson et al. 2008). Additional hunting in the 1850s reduced the population in the western Pacific, and by 1900 the species was effectively considered commercially extinct throughout its range. Although there were sporadic opportunistic catches in the early 20th century, the stock was likely undergoing a modest recovery by about 1960; however, this was entirely negated by large illegal catches by the U.S.S.R. in the 1960s, which likely wiped out the bulk of the eastern population (Ivashchenko and Clapham 2012, Ivashchenko et al. 2017).

Analysis of whaling records from the 19th century, together with the more recent Soviet catches, has shown that right whales were broadly distributed across the eastern North Pacific (Scarff 1986, Brownell et al. 2001, Ivashchenko and Clapham 2012). There are sporadic records from below 20°N, but the bulk of the data show right whales concentrated north of 35°N. This includes coastal and offshore waters ranging from Washington State and British Columbia through the Gulf of Alaska, Alaska Peninsula, Aleutian Islands, and Bering Sea.

Modern information on the summer and autumn distribution of right whales has been derived from dedicated vessel and aerial surveys, bottom-mounted acoustic recorders, and vessel surveys for fisheries ecology and management that have also included dedicated marine mammal observers. Aerial and vessel surveys for right whales (LeDuc et al. 2001, Wade et al. 2006, Clapham et al. 2013, Matsuoka et al. 2021) have occurred in a portion of the southeastern Bering Sea (Fig. 1) where right whales have been observed or acoustically detected in most summers since 1996 (Goddard and Rugh 1998, Munger et al. 2008, Rone et al. 2012, Wright 2017). North Pacific right whales have been observed consistently in this area, although it is clear from historical and Japanese sighting survey data (Fig. 2) that right whales often range outside this area and occur elsewhere in the Bering Sea (Scarff 1986, Moore et al. 2000, 2002; LeDuc et al. 2001; Clapham et al. 2004; Matsuoka et al. 2021). Because of the paucity of right whales in the eastern North Pacific, sightings today are relatively rare and are often of single individuals (Fig. 2). In the summer of 2017, however, the International Whaling Commission's (IWC) Pacific Ocean Whale and Ecosystem Research (POWER) survey used a combination of passive acoustic monitoring and visual sightings to find ~~15~~12 right whales in the southeastern Bering Sea (Matsuoka et al. ~~2017~~2021). The majority of these sightings (~~10~~7 of ~~15~~12 animals) were in Bristol Bay approximately 60 nmi east of the North Pacific right whale critical habitat, with others in the critical habitat itself. Three additional right whales were sighted during the 2018 IWC POWER survey (Matsuoka et al. ~~2018~~2021). Two were within the critical habitat, while the third was sighted approximately 5 nmi south of St. Lawrence Island, in the northern Bering Sea.

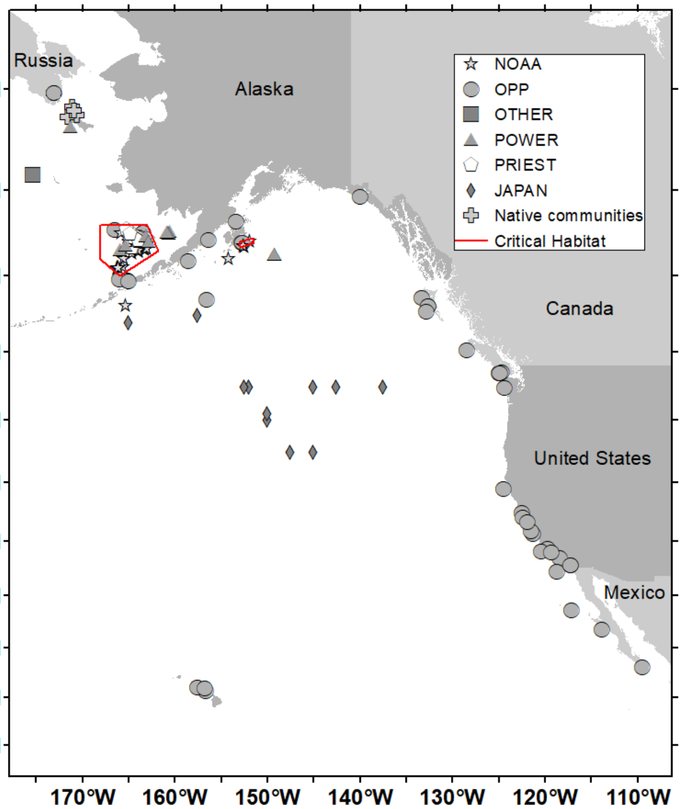

Figure 2. Location of all Eastern North Pacific right whale sightings in the North Pacific by platform since 1970. PRIEST = BOEM-NOAA (Pacific RIght whale Ecology STudy) survey (2007-2010); NOAA = other NOAA surveys (1998-2021); POWER = IWC's Pacific Ocean Whale and Ecosystem Research survey (2012, 2017-2018); POP = opportunistic sighting documented in MML's Platforms of Opportunity database (1973-2023); Japan = Japanese sighting survey (1973-1979); Other = Bering Sea (Navarin Basin) survey (Brueggeman et al. 1984).

Bottom-mounted acoustic recorders were deployed in the southeastern Bering Sea (2000-present) and the northern Gulf of Alaska (1999-2001, 2019-present) to document the seasonal distribution of right whale calls. Analysis of the data from those recorders supports the survey data and shows that right whales remain in the southeastern Bering Sea from May through December with peak call detection in September (Mellinger et al. 2004, Munger et al. 2008, Stafford and Mellinger 2009, Stafford et al. 2010, Clapham et al. 2013, Wright 2017, Wright et al. 2019). Recorders deployed by the Alaska Fisheries Science Center's Marine Mammal Laboratory indicated that North Pacific right whales occurred in two passes of the eastern Aleutian Islands (Umnak and Unimak Pass) (Wright 2017, Wright et al. 2018). No North Pacific right whale calls were detected from January to April in the southeastern Bering Sea, which supports the theory that North Pacific right whales migrate out of the Bering Sea during winter months (Wright 2017). However, a recent sighting of two skim-feeding North Pacific right whales in February 2022 just north of Unimak Pass is the first photographic evidence of overwintering by this species in the Bering Sea.

There continues to be debate regarding the northern extent of the right whale's range, specifically whether they once commonly occurred in the northern Bering Sea and north of the Bering Strait. Records from historical whaling in such areas are often compromised by uncertainty regarding whether these could have been bowhead whales; the extent of overlap between the two species remains unclear. In recent years, there have been a few reliable records of right whales in this region: an individual right whale was visually identified north of St. Lawrence Island in November 2012, an individual was sighted on 26 June 2018 by hunters off of St. Lawrence Island on the northeast side of Sivuqaq mountain and on 15 May 2019 about 37 nmi northwest of Savoonga (G. Sheffield, University of Alaska Fairbanks, Nome, AK), and the IWC POWER cruise recorded a single right whale just south of St. Lawrence in July 2018 (Matsuoka et al. ~~2018~~2021). This latter individual was subsequently observed and photographed by an ecotourism cruise in Pengkingney Fjord in Russian waters just south of the Bering Strait (~~D. Brown, Heritage Expeditions~~Filatova et al. 2019). Passive acoustic monitoring from 2008 to 2016 of the northern Bering Sea detected calls matching the North Pacific right whale up-call criterion in late fall through spring only in 2016 (Wright et al. 2019). It remains unknown whether these recent northern detections and sightings represent a reoccupation of their historical distribution or a northward shift in their distribution.

There have been far fewer sightings of right whales in the Gulf of Alaska than in the Bering Sea (Brownell et al. 2001); although, until the summer of 2015, survey effort was lacking in the Gulf, notably in the offshore areas where right whales commonly occurred during whaling days (Ivashchenko and Clapham 2012). Nonetheless, sightings in the Gulf of Alaska since the cessation of whaling are extremely rare (Fig. 2), and there have been only a few acoustic detections (Mellinger et al. 2004, Širović et al. 2015).

~~Three~~Four separate surveys have occurred in the Gulf of Alaska in the summer. In summer 2013, the U.S. Navy-funded Gulf of Alaska Line-Transect Survey (GOALS-II) surveyed for marine mammals within the Temporary Maritime Activities Area (TMAA) using visual line-transect methods and passive acoustic monitoring (Rone et al. 2014). In August 2015, a dedicated vessel survey for right whales was conducted by NMFS using visual and acoustic survey techniques, surveying both the shelf and deeper waters to the south (Rone et al. 2017). ~~And i~~In summer 2019, the IWC POWER cruise systematically surveyed the northern Gulf of Alaska, within the U.S. Exclusive Economic Zone, from Umnak Pass in the Aleutian Islands to the Canadian border in the eastern North Pacific (Matsuoka et al. 2020). In all three surveys, right whales were acoustically detected in the Barnab~~u~~as Trough area off Kodiak Island, but were not visually observed. However, in summer 2021, the Pacific Marine Assessment Program for Protected Species (PacMAPPS) cruise surveyed the shelf and slope of the northern Gulf of Alaska, from the west side of Kodiak Island to Kayak Island near Chugach, Alaska. Four North Pacific right whales were sighted during this survey, two in Barnabas Trough near the southern end of the critical habitat and two near the Trinity Islands to the southwest of Kodiak Island (Crance et al. 2022). One of the individuals sighted in Barnabas Trough was matched to an animal that was seen by Canada's Department of Fisheries and Oceans (DFO) off Haida Gwaii in British Columbia on 12 June earlier that year (Little 2021), which marks the first time a North Pacific right whale has been initially sighted in British Columbia and then resighted elsewhere.

Most of the illegal Soviet catches of right whales occurred in offshore areas, including a large area to the east and southeast of Kodiak Island (Doroshenko 2000, Ivashchenko and Clapham 2012); the Soviet catch distribution closely parallels that seen in plots of 19th-century American whaling catches by Townsend (1935). Whether this region remains an important habitat for this species is currently unknown. The recent PacMAPPS sightings and acoustic detection of right whales in coastal waters east of Kodiak Island indicate at least occasional use of this area; however, the lack of visual detections of right whales during the GOALS-II cruise in July 2013, the NMFS cruise in August 2015, and the IWC POWER cruise in 2019 adds to the concern that right whales may today be extremely rare in the Gulf of Alaska. To date, there have been no matches of photographically identified individuals between the Gulf of Alaska and the Bering Sea, and there is no information to address the question of whether these regions are connected or whether they form largely separate subpopulations.

As noted above, the location of winter calving grounds for North Pacific right whales has long been a mystery. North Atlantic (*E. glacialis*) and Southern Hemisphere (*E. australis*) right whales calve in coastal waters during the winter months. However, in the eastern North Pacific no such calving grounds have been identified (Scarff 1986). Migratory patterns of North Pacific right whales are unknown, although it is thought they migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly including offshore waters (Braham and Rice 1984, Scarff 1986, Clapham et al. 2004). A right whale sighted off Maui in April 1996 (Salden and Michelsen 1999) was identified 119 days later and 4,111 km north in the Bering Sea (Kennedy et al. 2011); to date this is the only low- to high-latitude match of an individually identified right whale in the eastern North Pacific. There is one other modern record from Hawaii of a right whale, an animal seen twice in March and April 1979 (Herman et al. 1980, Rowntree et al. 1980) (Fig. 2).

Although there were a handful of sightings of right whales in the eastern North Pacific from Japanese sighting surveys in the 1970s (Fig. 2), sightings in that area since then have been extremely rare. Two sightings of individual right whales occurred off British Columbia in 2013, one in June and one in October (Ford et al. 2016). The two different individuals represent the first right whale sightings in Canadian waters since the 1950s. Another right whale sighting was made by the Canadian Coast Guard in the same area in June 2018. Most recently, a right whale was sighted off Vancouver Island in May 2020, and another was sighted off Haida Gwaii in June 2021. The timing of these sightings lends support to the theory that right whales migrate to more temperate waters during the winter.

Occasional sightings of right whales have been made off California and off Baja California, Mexico (Fig. 2); this includes two recent records from California in 2017~~,~~ (off La Jolla and in the Channel Islands~~, (~~both of which were single whales) as well as a sighting of a single skim-feeding right whale off Año Nuevo, CA in April 2022 and an animal in Monterey Bay in March 2023. While the scarcity of records from this region superficially suggests (as did Brownell et al. 2001) that it lacked historical importance for the species, this ignores the fact that right whales had been severely depleted in their feeding grounds prior to 1854, when the first coastal whaling station was established in California. It remains possible that California and Mexico, and possibly offshore waters of Hawaii, were once the principal calving grounds for right whales from the Gulf of Alaska and Bering Sea.

The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: distinct geographic distribution; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: evidence for some isolation of populations. Based on this limited information, two transboundary stocks of North Pacific right whales are currently recognized: a Western North Pacific stock (feeding primarily in the Sea of Okhotsk) and an Eastern North Pacific stock (feeding primarily in the southeastern Bering Sea) (Rosenbaum et al. 2000, Brownell et al. 2001, LeDuc et al. 2012, Pastene et al. 2022).

In summary, the range of the right whale in the North Pacific was historically broad, with feeding grounds in the Bering Sea, Gulf of Alaska, Okhotsk Sea, and northwestern North Pacific; all of these areas remain inhabited today from May to December.

POPULATION SIZE

The historical (pre-whaling) population size of the North Pacific right whale is unknown. However, Scarff (1991) estimated that 26,500 to 37,000 animals were killed during the period from 1839 to 1909, with the majority being taken in a single decade (1840 to 1849). The U.S.S.R. illegally killed an estimated 771 right whales in the eastern and western North Pacific, with the majority (662) killed between 1962 and 1968 (Ivashchenko et al. 2017). These takes severely impacted the two populations concerned, notably in the east (Ivashchenko and Clapham 2012, Ivashchenko et al. 2013). Of the 662 right whales killed in the 1960s, 517 were taken in the eastern North Pacific, including 366 in the Gulf of Alaska, 31 in the Aleutian Islands, 116 in the Bering Sea, and 4 in unspecified pelagic waters (Ivashchenko et al. 2013).

Earlier estimates of population size were at best speculative. Based on sighting data, Wada (1973) estimated a total population of 100-200 right whales in the North Pacific in 1970. Rice (1974) stated that only a few individuals remained in the Eastern North Pacific stock and that for all practical purposes the stock was extinct because no sightings of a mature female with a calf had been confirmed since 1900. However, various sightings made since 1996 have invalidated this view (Wade et al. 2006, Zerbini et al. 2015, Ford et al. 2016, Matsuoka et al. ~~2017~~2021). Brownell et al. (2001) suggested from a review of sighting records that the abundance of this species in the western North Pacific was likely in the "low hundreds," including the population in the Sea of Okhotsk.

The North Pacific Right Whale Photo-identification Catalogue currently contains a minimum of ~~26~~30 confirmed unique individual whales from the eastern North Pacific. ~~From 2008 to 2018~~Since 2017, ~~26~~28 right whales have been sighted, 18 of which have been~~were~~ photographically identified to individuals. Of the 18 identified, 8 animals were confirmed new and added to the catalog and 10 were matched to previously known individuals~~, some repeatedly~~ (~~Clapham et al. 2013; Ford et al. 2016;~~ Matsuoka et al. ~~2017, 2018~~2021).~~ Including individuals observed more than once across years, this comprises 8 animals photographed in 2008 (all in the Bering Sea), 7 in 2009 (Bering Sea), 3 in 2010 (1 in the Bering Sea, 2 off Kodiak), 2 in 2011 (Bering Sea), 1 in 2012 (Gulf of Alaska), 2 in 2013 (both off British Columbia),~~ Fifteen~~14~~ animals were sighted in 2017: ~~(~~12 in the Bering Sea (8 matched, 2 confirmed new, 2 unconfirmed new), 1 near ~~in~~ Kodiak, 1 in the Channel Islands (confirmed new), and 1 near La Jolla, CA. ~~and 3~~Four were sighted in 2018 in the Bering Sea (1 matched, 2 confirmed new, 1 not identified) ~~in 2018~~. One right whale was sighted near St. Lawrence Island in 2019, and one right whale was sighted in 2020 off Vancouver Island; neither was identified. Four were sighted in 2021 in the Gulf of Alaska: 1 matched and 3 confirmed new (one of which was first sighted off British Columbia by DFO a month prior). Three right whales were sighted in 2022: 2 near Unimak

Pass, Aleutian Islands and 1 off Año Nuevo, CA. A single whale was seen in Monterey Bay, CA, in 2023.~~The number of unique right whales decreased from previous years as a result of obtaining better quality photographs that allowed for additional internal matches in the catalogue.~~

LeDuc et al. (2012) analyzed 49 biopsy samples from 24 individual right whales, all but one of which were from the eastern North Pacific. The analysis revealed a male-biased sex ratio and a loss of genetic diversity that appeared to be midway between that observed for right whales in the North Atlantic and the Southern Hemisphere. The analysis also suggested a degree of separation between eastern and western populations, a male:female ratio of 2:1, and a low effective population size for the Eastern North Pacific stock, which LeDuc et al. (2012) considered to be at "extreme risk" of extirpation. Six biopsy samples were obtained from right whales in the Bering Sea during the IWC POWER cruises (3 in 2017, 3 in 2018), all from individuals of previously unknown sex. None were obtained during the 2019 or 2021 cruises. Of the six whales sampled, five were male and only one was female. In 2022, Pastene et al. re-analyzed all genetic samples, including those from the 2012 LeDuc study. After removing duplicates, 32 individual eastern North Pacific right whale samples were included. For the eastern stock, the proportion of males was 0.75, indicating a higher (3:1) male-biased sex ratio than LeDuc's 2:1 (Pastene et al. 2022). However, despite the high proportion of males and the extremely low population size, the eastern stock showed relatively high genetic diversity (Pastene et al. 2022). Finally, the results of the Pastene et al. study confirmed that the two populations of North Pacific right whales are genetically distinct. ~~This suggests that the sex ratio may in fact be more skewed toward males than previously believed, which would put the population at even greater risk~~. ~~These samples have not yet been integrated into the overall sample for reanalysis; while this may change the male:female ratio, it is unlikely to change the overall conclusions of LeDuc et al. (2012).~~

The only recent estimate of abundance comes from mark-recapture analyses of photo-identification and genetic data. Photographic (18 identified individuals) and genotype (21 identified individuals) data through 2008 were used to calculate the first mark-recapture estimates of abundance for right whales in the Bering Sea and Aleutian Islands, resulting in separate estimates of 31 (95% CL: 23-54; CV = 0.226) and 28 (95% CL: 24-42), respectively (Wade et al. 2011). The abundance estimates are for the last year of each study, corresponding to 2008 for the photo-identification estimate and 2004 for the genetic identification estimate. Wade et al. (2011) also estimated that the population consisted of 8 females (95% CL: 7-18) and 20 males (95% CL: 17-37).

The Wade et al. (2011) estimates may relate to a subpopulation that uses the Bering Sea; there is no estimate for right whales in the Gulf of Alaska, and to date there have been no photo-identification matches between the two regions. Consequently, the total size of the Eastern North Pacific population may be somewhat higher than the Wade et al. (2011) estimates. However, given the extreme paucity of ~~recent~~ sightings in the Gulf of Alaska, it seems unlikely that the overall abundance is significantly larger.

Minimum Population Estimate

The minimum estimate of abundance (N_{MIN}) of Eastern North Pacific right whales is 26 whales based on the 20th percentile of the photo-identification estimate of 31 whales (CV = 0.226: Wade et al. 2011). This estimate is more than 10 years old. ~~will be 12 years old in 2020, and the 2016 guidelines for preparing Stock Assessment Reports (NMFS 2016) recommend that N_{MIN} be considered unknown if the abundance estimate is more than 8 years old; h~~However, given that the stock has an extremely low abundance~~ of this stock and the~~, very low calf production, and no known anthropogenic mortality or serious injuryit seems unlikely that the current abundance is significantly different.

Current Population Trend

Due to a low resighting rate and the extremely low population size, no estimate of trend in abundance is available for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Due to insufficient information, the default cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% is used for this stock (NMFS ~~2016~~2023). However, given the small apparent size, male bias, and very low calf production in this population, this rate is likely to be unrealistically high.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the recommended value for cetacean stocks which are listed as endangered (NMFS ~~2016~~2023). A reliable estimate of N_{MIN} for this stock is 26 whales based on the mark-recapture estimate of 31 whales

(CV = 0.226: Wade et al. 2011). The calculated PBR level for this stock is therefore 0.05 (26 × 0.02 × 0.1), which would be equivalent to one take every 20 years. However, the male bias likely results in lower than expected calf production and, thus, this PBR could be overestimated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between ~~2014~~2017 and ~~2018~~2021 is listed, by marine mammal stock, in ~~Young~~Freed et al. (~~2020~~in prep.); however, only the mortality and serious injury data are included in the Stock Assessment Reports. No human-caused mortality or serious injury of Eastern North Pacific right whales was reported between ~~2014~~2017 and ~~2018~~2021; although, given the remote nature of the known and likely habitats of North Pacific right whales, it is very unlikely that any mortality or serious injury in this population would be observed. Consequently, it is possible that the current absence of reported mortality or serious injury due to entanglement in fishing gear, vessel~~ship~~ strikes, or other anthropogenic causes (e.g., oil spills) is not a reflection of the true situation.

Fisheries Information

Information for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is available in Appendix 3 of the Alaska Stock Assessment Reports (observer coverage) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed ~~December 2020~~January 2023).

There are no historical reports of fisheries-caused mortality or serious injury of Eastern North Pacific right whales. However, given what we know about susceptibility of other large whales to fisheries-caused mortality and serious injury in the eastern North Pacific and elsewhere, ~~we assume that the~~ potential for such interactions with ~~exists for~~ North Pacific right whales almost certainly exists. Entanglement in fishing gear, including lobster pot and sink gillnet gear, is a significant source of mortality and serious injury for North Atlantic right whales (Knowlton et al. 2022). Mortality and serious injury of humpback, ~~whales and~~ fin ~~whales in trawl gear~~, gray ~~whales in gillnet gear~~, and bowhead whales in a variety of gear types, including trawl, gillnet, and pot gear ~~(George et al. 2017)~~ has been documented (Muto et al. 2022, Carretta et al. 2022, George et al. 2017). While much of the Alaska and U.S. West Coast trawl fleet has observer coverage, several gillnet fisheries and pot fisheries in the range of Eastern North Pacific right whales do not. Therefore, the potential for fisheries-caused mortality and serious injury may be greater than is reflected in existing observer data.

Right whales, presumably from the Western North Pacific population, have suffered fisheries-caused mortality or serious injury. Gillnets were implicated in the death of a right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994). The Marine Mammal Commission reported that in February 2015, a young right whale was found entangled in aquaculture gear in South Korea; much of the gear was cut off, but the whale's fate is unknown. In October 2016, an entangled right whale was reported to have died while being disentangled in Volcano Bay, Hokkaido, Japan. And in July 2018, fishermen in the Sea of Okhotsk took video of a right whale that was entangled in the rope of a crab pot but later freed itself. No other incidental takes of right whales are known to have occurred in the North Pacific, although two photographs from the North Pacific Right Whale Photo-identification Catalogue show possible fishing gear entanglement (A. Kennedy, NMFS-AFSC-MML, pers. comm., 21 September 2011; Ford et al. 2016). The right whale photographed on 25 October 2013 off British Columbia and northern Washington State showed evidence of probable fishing gear entanglement (Ford et al. 2016). Given the very small estimate of abundance, any mortality or serious injury incidental to commercial fisheries would be considered significant. ~~Entanglement in fishing gear, including lobster pot and sink gillnet gear, is a significant source of mortality and serious injury for North Atlantic right whales (Waring et al. 2014).~~

Alaska Native Subsistence/Harvest Information

Subsistence hunters in Alaska and Russia do not hunt animals from this stock.

Other Mortality

Vessel~~Ship~~ strikes are considered one of the primary sources of human-caused mortality and serious injury of right whales in the North Atlantic (Cole et al. 2005; Henry et al. 2012, 2019; Hayes et al. 2018), and it is ~~possible~~likely that right whales in the North Pacific are also vulnerable to this source of mortality. However, due to their rare occurrence and scattered distribution, it is not currently ~~im~~possible to assess the threat of vessel~~ship~~ strikes to the Eastern North Pacific stock of right whales. There is concern that increased shipping through Arctic waters and the Bering Sea, with retreating sea ice, may increase the potential risk to right whales from shipping.

Overall, given the remote nature of the known and likely habitats of North Pacific right whales, it is very unlikely that any mortality or serious injury in this population would be observed. Consequently, it is possible that the current absence of reported vessel~~ship~~-strike-related or other anthropogenic mortality or serious injury in this stock is not a reflection of the true situation.

STATUS OF STOCK

The right whale is listed as endangered under the Endangered Species Act of 1973, and therefore designated as depleted under the Marine Mammal Protection Act. In 2008, NMFS relisted the North Pacific right whale as endangered as a separate species (*Eubalaena japonica*) from the North Atlantic species, *E. glacialis* (73 FR 12024, 06 March 2008). As a result, the stock is classified as a strategic stock. The abundance of this stock is considered to represent only a small fraction of its pre-commercial whaling abundance, i.e., the stock is well below its Optimum Sustainable Population (OSP). The minimum estimated mean annual level of human-caused mortality and serious injury is unknown for this stock. The reason(s) for the apparent lack of recovery for this stock is (are) also unknown. Brownell et al. (2001) and Ivashchenko and Clapham (2012) noted the devastating impact of extensive illegal Soviet catches in the eastern North Pacific in the 1960s, and both suggested that the prognosis for right whales in this area was poor. Biologists working aboard the Soviet factory ships that killed right whales in the eastern North Pacific in the 1960s considered that the fleets had caught close to 100% of the animals they encountered (Ivashchenko and Clapham 2012); accordingly, it is quite possible that the Soviets killed the great majority of the animals in the population at that time. In its review of the status of right whales worldwide, the IWC expressed "considerable concern" over the status of this population (IWC 2001)~~, which is currently the most endangered stock of large whales in the world for which an abundance estimate is available~~. A genetic analysis of biopsy samples from North Pacific right whales found ~~an apparent loss of genetic diversity,~~ low frequencies of females and calves, extremely low effective population size, and ~~possible~~genetic isolation from conspecifics in the western Pacific indicating that right whales in the eastern North Pacific are in severe danger of immediate extirpation from the eastern North Pacific (LeDuc et al. 2012, Pastene et al. 2022).

There are key uncertainties in the assessment of the Eastern North Pacific stock of North Pacific right whales. The abundance of this stock is critically low and migration patterns, calving grounds, and breeding grounds are not well known. There appear to be ~~considerably~~ three times more males than females in the population and calf production is very low (Pastene et al. 2022). PBR is designed to allow stocks to recover to, or remain above, the maximum net productivity level (MNPL) (Wade 1998). An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP, and that some surplus growth could be removed while still allowing recovery. However, the Eastern North Pacific right whale population is far below historical levels and at a very small population size, and small populations can have different dynamics than larger populations from Allee effects and stochastic dynamics. Although there is currently no known direct human-caused mortality, given the small number of animals estimated to be in the population, any human-caused mortality or serious injury from vessel~~ship~~ strikes or commercial fisheries is likely to have a serious population-level impact.

~~HABITAT CONCERNS~~OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

NMFS conducted an analysis of right whale distribution in historical times and in more recent years and stated that principal habitat requirements for right whales are dense concentrations of prey (Clapham et al. 2006) and, on this basis, proposed two areas of critical habitat: one in the southeastern Bering Sea and another south of Kodiak Island (70 FR 66332, 2 November 2005). In 2006, NMFS issued a final rule designating these two areas as northern right whale critical habitat, one in the Gulf of Alaska and one in the Bering Sea (71 FR 38277, 6 July 2006; Fig. 1). In 2008, NMFS redesignated the same two areas as Eastern North Pacific right whale critical habitat under the newly recognized species name, *E. japonica* (73 FR 19000, 8 April 2008; Fig. 1).

Potential threats to the habitat of this population derive primarily from commercial shipping and fishing vessel activity. There is considerable fishing activity within portions of the critical habitat of this species, increasing the risk of entanglement. However, photographs of right whales in the eastern North Pacific to date have shown little evidence of entanglement scars; the sole exception is the animal photographed in the Strait of Juan de Fuca in October 2013 (Ford et al. 2016). Unimak Pass is a choke-point for shipping traffic between North America and Asia, with shipping density and risk of an accidental spill highest in the summer (Renner and Kuletz 2015), a time when right whales are believed to be present (Wright et al. 2018). The high volume of large vessels transiting Unimak Pass (e.g., 7,803 voyages through Unimak Pass by vessels larger than 400 gross tons from 2014-2018; Sullender et al. 2021 ~~1,961 making 4,615 transits in 2012: Nuka Research and Planning Group, LLC 2014a, 2014b~~), a subset of which continue north through the Bering Sea, increases both the risk of vessel~~ship~~ strikes and the risk of a large or very large oil spill in areas in which right whales may occur. The risk of accidents in Unimak Pass, specifically, is predicted to increase in the coming decades, and studies indicate that more accidents are likely to involve container vessels (Wolniakowski et al. 2011).

Past offshore oil and gas leasing has occurred in the Gulf of Alaska and Bering Sea in the northern areas of known right whale habitat. The Bureau of Ocean Energy Management (BOEM) proposed an Outer Continental Shelf leasing plan for 2007-2012 that prioritized lease sales for the North Aleutian Basin in 2010 and 2012 (Aplin and Elliott 2007), but it was later withdrawn by Presidential Executive Order. Therefore, the North Aleutian Basin was not included in the 2017-2022 national lease schedule by BOEM, nor in BOEM's proposed 2023-2028 lease program, and there are no residual active leases from past sales. ~~However, BOEM has announced plans to replace the 2017-2022 OCS plan (with a new 2019-2024 leasing plan) and to reconsider all current moratoria on offshore oil and gas exploration and extraction (82 FR 30886, 3 July 2017)~~. It is noteworthy that two tagged right whales were observed to briefly visit the North Aleutian Basin area, one in 2004 and one in 2009 (Zerbini et al. 2015). The development of oil fields off Sakhalin Island in Russia is occurring within habitat of the western North Pacific population of right whales (NMFS 2006). However, no oil exploration or production is currently underway in offshore areas of the Bering Sea or Gulf of Alaska, and no lease sales are currently scheduled to occur in those areas (excepting Cook Inlet). The possibility remains that there will be lease sales in these areas in the future, even though no discoveries have yet been announced and most leases have not contained commercially viable deposits (NMFS 2006). However, in Cook Inlet, lease sales are ~~planned~~ongoing (the ~~next~~most recent federal sale under the existing 2017-2022 leasing plan ~~will~~ occurred in December 2022~~2021~~ and state sales currently occur annually) and exploration activity is occurring in both state and federal waters. BOEM (2016) conducted an oil spill model for lower Cook Inlet that suggested if a very large oil spill occurs in offshore waters it will impact right whale habitat around Kodiak Island and along the Alaska Peninsula. Although there is currently no oil and gas activity in the Alaska Chukchi Sea, oil exploration and production is ongoing in the Beaufort Sea, and this will likely include an increased level of associated vessel traffic through the Bering Sea en route to and from the Arctic, which could increase risks to right whales from vessel~~ship~~ strikes.

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BOWHEAD WHALE (Balaena mysticetus): Western Arctic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

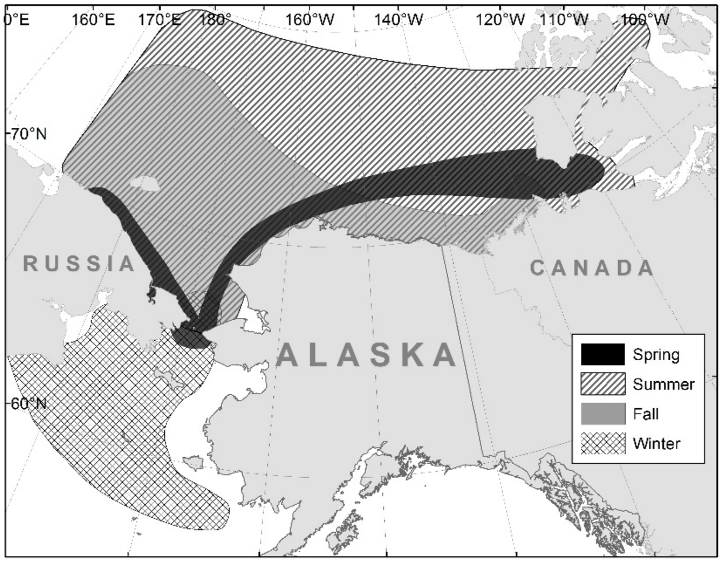


Figure 1. Annual range of the Western Arctic stock of bowhead whales by season from satellite tracking data, 2006-2017 (map based on Quakenbush et al. (2018): Fig. 2).

Western Arctic bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 60°N and south of 75°N in the western Arctic Basin (Braham 1984, Moore and Reeves 1993). For management purposes, four stocks of bowhead whales are recognized worldwide by the International Whaling Commission (IWC 2010). Small stocks, comprising only a few hundred individuals, occur in the Sea of Okhotsk and the offshore waters of Spitsbergen (Zeh et al. 1993, Shelden and Rugh 1995, Wiig et al. 2009, Shpak et al. 2014, Boertmann et al. 2015, Vacquié-Garcia et al. 2017). Bowhead whales occur in western Greenland (Hudson Bay and Foxe Basin) and eastern Canada (Baffin Bay and Davis Strait), and evidence suggests that these should be considered one stock based on genetics (Postma et al. 2006, Bachmann et al. 2010, Heide-Jørgensen et al. 2010, Wiig et al. 2010), aerial surveys (Cosens et al. 2006), and tagging data (Dueck et al. 2006; Heide-Jørgensen et al. 2006; IWC 2010, 2011). This stock, previously thought to include only a few hundred animals, may number over ~~a thousand (Heide-Jørgensen et al. 2006, Wiig et al. 2011) and perhaps over~~ 6,000 (IWC 2008, Doniol-Valcroze et al. 2015, Frasier et al. 2015). The only stock found within U.S. waters is the Western Arctic stock (Fig. 1), also known as the Bering-Chukchi-Beaufort Seas stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). The IWC Scientific Committee concluded, in several reviews of the extensive genetic and satellite telemetry data, that the weight of evidence is most consistent with one Western Arctic bowhead whale stock that migrates throughout waters of northern and western Alaska and northeastern Russia (IWC 2008, 2018).

The majority of the Western Arctic stock migrates annually from wintering areas in the northern Bering and southern Chukchi seas (December to April), through the Chukchi Sea and Beaufort Sea in the spring (April through May), to the eastern Beaufort Sea (Fig. 1) where they spend much of the late spring and summer (May through September). During late summer and autumn (September through December), this stock migrates back to the Chukchi Sea and then to the Bering Sea (Fig. 1) to overwinter (Braham et al. 1980; Moore and Reeves 1993; Quakenbush et al. 2010, 2018; Citta et al. 2015). During winter and spring, bowhead whales are closely associated with sea ice (Moore and Reeves 1993, Quakenbush et al. 2010, Citta et al. 2015, Druckenmiller et al. 2018). The bowhead whale spring migration follows fractures in the sea ice along the coast to Point Barrow, generally in the shear zone between the shorefast ice and the mobile pack ice, then continues offshore on a direct path to the Cape Bathurst polynya (Citta et al. 2015). In most years, during summer, a large proportion of the population is in the relatively ice-free waters of

Amundsen Gulf in the eastern Beaufort Sea (Citta et al. 2015), an area where industrial activity related to petroleum exploration often occurs (e.g., Richardson et al. 1987, Davies 1997). Summer aerial surveys conducted in the western Beaufort Sea during July and August of 2012-2019~~7~~ have had relatively high sighting rates of bowhead whales, including cows with calves and feeding animals, in some years and within localized areas within the western Beaufort Sea (Clarke et al. 2018a, 2018b, 2022), suggesting interannual variability in bowhead whale summer distribution. Additionally, data from a satellite-tagging study conducted between 2006 and 2018 indicated that, although most tagged whales began to leave the Canadian Beaufort Sea in September, the timing of their westward migration across the Beaufort Sea was highly variable; furthermore, all tagged whales observed in summer and fall in Beaufort and Chukchi waters near Point Barrow were known to have returned from Canada (Quakenbush and Citta 2019). Timing of the onset of the westward migration across the Beaufort Sea is associated with oceanographic conditions in the eastern Beaufort Sea, and although there is interannual variability, the migration appears to be occurring later (Citta et al. 2018, Clarke et al. 2018b, Stafford et al. 2021). During the autumn migration, bowhead whales generally inhabit shelf waters across the Beaufort Sea (Citta et al. 2015). The autumn migration across the Chukchi Sea is more dispersed (Clarke et al. 2016). During winter in the Bering Sea, bowhead whales often use areas covered by nearly 100% sea ice, even when polynyas are available (Quakenbush et al. 2010, Citta et al. 2015).

This stock assessment report assesses the abundance and Alaska Native subsistence harvest of Western Arctic bowhead whales throughout the transboundary stock's entire geographic range. Human-caused mortality and serious injury, other than Alaska Native subsistence harvest, is estimated for the portion of the range within U.S. waters (i.e., the U.S. Exclusive Economic Zone) because relevant data are generally not available for the broader range of the stock. However, some pot gear entanglements and rope scars detected in U.S. waters may have been caused by Russian pot fisheries (Citta et al. 2014).

POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling, starting in the early 16th century near Labrador, Canada (Ross 1993), and spreading to the Bering Sea in the mid-19th century (Braham 1984, Bockstoce and Burns 1993, Bockstoce et al. 2007). Woodby and Botkin (1993) summarized previous efforts to estimate bowhead whale population size~~-~~ prior to the onset of commercial whaling. They reported a minimum worldwide population estimate of 50,000, with 10,400 to 23,000 in the Western Arctic stock (dropping to less than 3,000 at the end of commercial whaling). Brandon and Wade (2006) used Bayesian model averaging to estimate that the Western Arctic stock consisted of 10,960 bowhead whales (9,190 to 13,950; 5th and 95th percentiles, respectively) in 1848 at the start of commercial whaling.

The Aboriginal Whaling Scheme (IWC 2018) requires that abundance estimates be updated at least every 10 years as input into the Strike Limit Algorithm (SLA) that the IWC approved for estimating a safe strike limit for aboriginal subsistence hunting. Ice-based visual and acoustic counts have been conducted since 1978 (Krogman et al. 1989; Table 1). These counts have been corrected for whales missed due to distance offshore since the mid-1980s, using acoustic methods described in Clark et al. (1994). Correction factors were estimated for whales missed during a watch (due to visibility, number of observers, and offshore distance) and when no watch was in effect (through interpolations from sampled periods;~~)~~ ~~(~~Zeh et al. 1993, Givens et al. 2016). The spring ice-based estimates of abundance have not been corrected for a small portion of the population that may not migrate past Point Barrow during the period when counts are made. According to Melnikov and Zeh (2007), 470 bowhead whales (95% CI: 332-665) likely migrated to Chukotka instead of Barrow in spring 2000 and 2001. More recent satellite tagging data also indicate that only a small proportion (~4%) of the population migrates to Chukotka in spring (Quakenbush and Citta 2019).

Bowhead whales were identified from aerial photographs taken in 1985 and 1986, and again in 2003 and 2004, and the results were used in a sight-resight analysis (Table ~~2~~1). These population estimates and their associated errors (Raftery and Zeh 1998, Schweder et al. 2009, Koski et al. 2010) are comparable to the estimates obtained from the combined ice-based visual and acoustic counts~~ (Raftery and Zeh 1998, Schweder et al. 2009, Koski et al. 2010)~~. An aerial photographic survey was conducted near Point Barrow concurrently with the ice-based spring census in 2011, which, in addition to an abundance estimate based on sight-resight data, also provided a revised survival estimate for the population (Givens et al. 2018;~~) (~~ Table ~~2~~1). However, because the 2011 ice-based estimate had a lower coefficient of variation (CV) than the estimate derived from the aerial photographs, the IWC Scientific Committee considered the ice based~~is~~ estimate the most appropriate for management and use in the SLA (IWC 2018).

In 2019, a spring ice-based visual survey and a summer aerial line-transect survey were conducted to provide independent estimates of abundance. For the 2019 ice-based survey, Givens et al. (2021~~a~~b) ~~produced~~presented an ~~initial~~ estimate of abundance of ~~12,505 whales (CV = 0.228)~~ 14,025 whales (CV=0.228; Table 1), which included a new correction factor to account for disturbance to the migration from powered skiffs. Givens et al. (2021b)~~but~~

acknowledged that ~~the~~this estimate ~~was~~is likely biased low due to numerous factors, including closed leads in the sea ice that inhibited survey effort early in the migration; unprecedented wide leads later in the migration that resulted in an unusual migration route that was sometimes too distant from observers to detect whales; and an unusually short observation platform compared to previous surveys~~; and hunters' heavy use of powered skiffs near the observation platform, which likely disturbed the whales during the survey. Givens et al. (2021b) developed a correction factor to account for the disturbance to the migration from powered skiffs, resulting in the best estimate of abundance from the 2019 ice-based survey of 14,025 whales (CV = 0.228)~~. The 2019 aerial line-transect survey data were analyzed using a spatially-explicit density surface model, resulting in an estimated abundance of 17,175 whales (CV = 0.237; Ferguson et al. 2022; Table 1). The aerial survey abundance estimate is likely biased low because the study area did not encompass the entire known range of the stock during summer and because the estimate was not corrected for a purely statistical bias that arises in certain cases when estimates of random effects are transformed using a nonlinear function to produce a derived variable (Ferguson et al. 2022; Thorson and Kristensen 2016). Both the ice-based and aerial line-transect abundance estimates from 2019 were -endorsed by the IWC Scientific Committee as Category 1A (acceptable for providing management advice using an Aboriginal Whaling Management Procedure Strike Limit Algorithm; IWC 2021, 2022).~~Aboriginal Whaling Management Procedure Strike Limit Algorithm; IWC 2021, 2022).abundance estimate from the aerial line-transect surveys is presently in review.~~

~~**Table 1.** Summary of abundance estimates for the Western Arctic stock of bowhead whales. The historical estimates were made by back-projecting using a simple recruitment model. Historical estimates are from Woodby and Botkin (1993); 1978-2001 estimates are from George et al. (2004) and Zeh and Punt (2005). All other estimates were developed by corrected ice-based census counts. The 2019 estimate is reported in Givens et al. (2021a, 2021b).~~

~~**Year**~~	~~**Abundance range or estimate (CV)**~~	~~**Year**~~	~~**Abundance estimate (CV)**~~
~~Historical~~	~~10,400-23,000~~	~~1985~~	~~5,762 (0.253)~~
~~End of commercial whaling~~	~~1,000-3,000~~	~~1986~~	~~8,917 (0.215)~~
~~1978~~	~~4,765 (0.305)~~	~~1987~~	~~5,298 (0.327)~~
~~1980~~	~~3,885 (0.343)~~	~~1988~~	~~6,928 (0.120)~~
~~1981~~	~~4,467 (0.273)~~	~~1993~~	~~8,167 (0.017)~~
~~1982~~	~~7,395 (0.281)~~	~~2001~~	~~10,545 (0.128)~~
~~1983~~	~~6,573 (0.345)~~	~~2011~~	~~16,820 (0.052)~~
		~~2019~~	~~14,025 (0.228)~~

~~**Table 2.** Summary of abundance estimates for the Western Arctic stock of bowhead whales from aerial sight-resight surveys. Estimates are reported in da Silva et al. 2000, 2007 (1986 estimate), Koski et al. 2010 (2004 estimate), and Givens et al. 2018 (2011 estimate). LB = lower bound of 95% confidence interval.~~

~~**Year**~~	~~**Abundance range or estimate (CV)**~~	~~**Survival estimate (LB)**~~
~~1986~~	~~4,719 - 7,331~~	~~0.985 (0.958)~~
~~2004~~	~~12,631 (0.2442)~~	
~~2011~~	~~27,133 (0.217)~~	~~0.996 (0.976)~~

Table 1. Summary of abundance estimates for the Western Arctic stock of bowhead whales. The historical estimates were made by back-projecting using a simple recruitment model and are from Woodby and Botkin (1993). Ice-based census count estimates for 1978-2001 are reported in George et al. (2004) and Zeh and Punt (2005), for 2011 in Givens et al. (2016), and for 2019 in Givens et al. (2021a, 2021b). Aerial sight-resight survey estimates for 1986 are reported in da Silva et al. (2000, 2007); for 2004 in Koski et al. (2010); and for 2011 in Givens et al. (2018). The 2019 aerial line-transect survey estimate is reported in Ferguson et al. (2022).

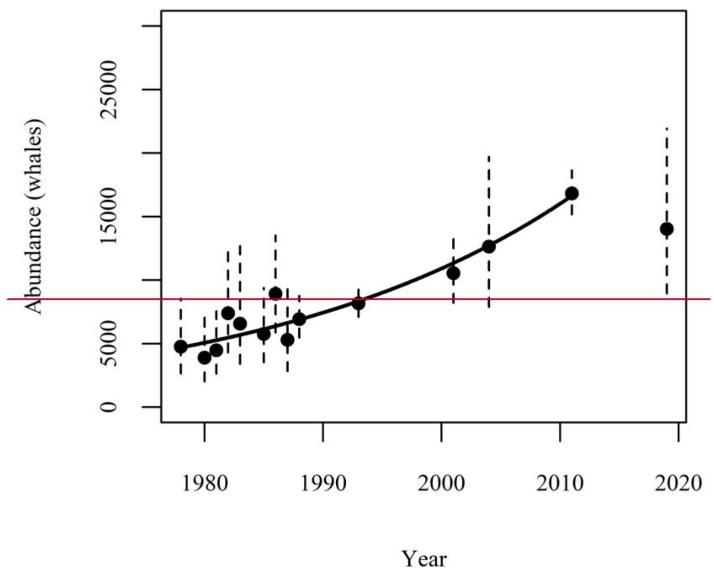
Year	**Abundance range or estimate (CV)**	**Method**
Historical	10,400-23,000	recruitment model back projection
End of commercial whaling	1,000-3,000	recruitment model back projection
1978	4,765 (0.305)	ice-based census count
1980	3,885 (0.343)	ice-based census count
1981	4,467 (0.273)	ice-based census count
1982	7,395 (0.281)	ice-based census count
1983	6,573 (0.345)	ice-based census count
1985	5,762 (0.253)	ice-based census count
1986	8,917 (0.215)	ice-based census count
1986	4,719 - 7,331	aerial sight-resight surveys
1987	5,298 (0.327)	ice-based census count
1988	6,928 (0.12)	ice-based census count
1993	8,167 (0.017)	ice-based census count
2001	10,545 (0.128)	ice-based census count
2004	12,631 (0.244)	aerial sight-resight surveys
2011	16,820 (0.052)	ice-based census count
2011	27,133 (0.217)	aerial sight-resight surveys
2019	14,025 (0.228)	ice-based census count
2019	17,175 (0.237)	aerial line-transect survey
-	-	-

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for the Western Arctic stock is calculated from Equation 1 from the potential biological removal (PBR) guidelines (NMFS 2023a): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Because there are two equally valid abundance estimates for 2019, N was computed as the inverse-variance weighted average of the ice-based and aerial line-transect abundance estimates (NMFS 2023a). The resulting N is 15,227 whales (CV(N)=0.165) and N_{MIN} is 13,264~~3~~ whales. ~~Using the 2019 population estimate (N) from the ice-based survey of 14,025 and its associated CV(N) of 0.228 (Table 1), N_{MIN} for this stock of bowhead whales is 11,603 whales.~~

Current Population Trend

Based on concurrent passive acoustic and ice-based visual surveys, Givens et al. (2016) reported that the Western Arctic stock of bowhead whales increased at a rate of 3.7% (95% CI = 2.9-4.6%) from 1978 to 2011, during which time abundance tripled from approximately 5,000 to approximately 16,820 whales (Givens et al. 2016;~~)~~ ~~(~~Fig. 2). The population trend since 2011 has not been formally analyzed. Although the ice-based abundance estimate from 2019 (Givens et al. 2021a, 2021b) is lower than that from 2011, Givens et al. (2021a) do not interpret this to be a true decline in population abundance due to the abnormal ice conditions and migration route that were not accounted for in the abundance estimate and likely resulted in an underestimate of abundance. Schweder et al. (2009) estimated the yearly growth rate to be 3.2% (95% CI = 0.5-4.8%) between 1984 and 2003 using a sight-resight analysis of aerial photographs.



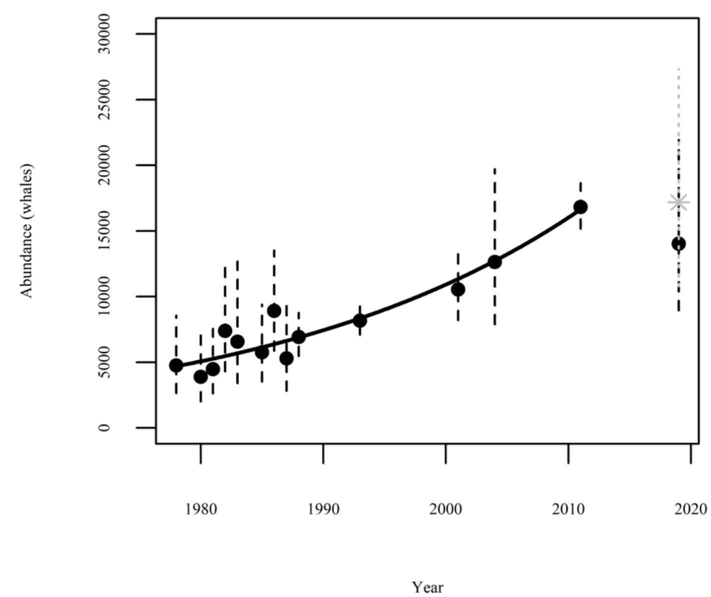


Figure 2. Estimated abundance and trend of Western Arctic bowhead whales, 1978-2011 (Givens et al. 2016), as computed from ice-based counts and acoustic data collected during bowhead whale spring migrations past Point Barrow, Alaska. The 2019 ice-based abundance estimate and confidence interval (Givens et al. 2021a, 2021b) are ~~also~~ shown as a black dot and the 2019 aerial survey line-transect estimate and confidence interval (Ferguson et al. 2022) are shown as a gray asterisk; however, the trend line has not been extended because a formal analysis has not been conducted to determine whether the population is likely to have continued to increase exponentially.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The presumed current estimate for the rate of increase for the Western Arctic stock of bowhead whales (3.7%: 95% CI = 2.9-4.6%: Givens et al. 2016) should not be used as an estimate of the maximum net productivity rate (R_{MAX}) because the population is currently being harvested and the population has been estimated to be at a substantial fraction of its carrying capacity (Brandon and Wade 2006); therefore, this stock may not be growing at its maximum rate. Thus, the cetacean maximum theoretical net productivity rate of 4% will be used for the Western Arctic stock of bowhead whales (NMFS 2023a).

POTENTIAL BIOLOGICAL REMOVAL

PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock has been set at 0.5 rather than the default value of 0.1 for endangered species because population levels are not known to be decreasing (Givens et al. 2021a, 2021b) in the presence of ~~a~~ known take (NMFS 2023a). Thus, PBR derived from the inverse-variance weighted average of the 2019 abundance estimates is 133 whales (13,263 × 0.02 × 0.5). ~~is 116 whales (11,603 × 0.02 × 0.5).~~ The calculation of a PBR level for the Western Arctic bowhead whale stock is required by the MMPA even though the subsistence harvest quota is established under the authority of the IWC based on an extensively tested SLA (IWC 2003). The quota is based on subsistence need or the ability of the bowhead whale population to sustain a harvest, whichever is smaller. The IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock~~,~~ because it is managed under the Whaling Convention Act, an international treaty. In 2018, the IWC revised the bowhead whale subsistence quota (IWC 2018 Schedule amendment). Under the revisions, the total block quota for 2019 to 2025 is 392 landed whales (an average of 56/year), with no more than 67 strikes per year, except that any unused portion of a strike quota from the three prior quota blocks can be carried forward and added to the strike quotas of subsequent years, provided that no more than 50% of the annual strike limit (i.e., no more than 33 strikes) is added to the strike quota for any one year (IWC 2018 Schedule amendment, section 13(b)1). Hence, 67 strikes are allocated annually, with the possibility of adding 33 strikes if they are available from the prior three quota blocks. A bilateral agreement between the United States and the Russian Federation ensures that the total quota of bowhead whales struck will not exceed the limits set by the IWC. Under this bilateral arrangement, the Chukotka Natives in Russia may use no more than seven strikes and Alaska Natives may use no more than 93 strikes per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between ~~2016~~2017 and ~~2020~~2021 is listed, by marine mammal stock, in Freed et al. (~~2022~~in prep.); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The minimum estimated mean annual level of human-caused mortality and serious injury for Western Arctic bowhead whales between ~~2016~~2017 and ~~2020~~2021 is ~~56~~57 whales, calculated as the sum of subsistence takes by Alaska Natives (~~55~~57; mean actual number of landed whales plus mean annual struck and lost mortality) plus whales landed in subsistence takes by Natives of Russia (~~0.8~~0.4; struck and lost whales not reported). ~~Several~~ Two bowhead whales harvested by Alaska Natives were found to have been seriously injured by unknown (commercial, recreational, or subsistence) fisheries prior to harvest (mean of ~~0.6~~0.4/year; Freed et al. ~~2022~~in prep.); to avoid double counting, these are not added to the total mortality and serious injury for the stock. Potential threats most likely to result in direct human-caused mortality or serious injury of individuals in this stock include entanglement in fishing gear and vessel strikes due to increased vessel traffic (from increased commercial shipping in Bering Strait and the Chukchi and Beaufort seas).

Fisheries Information

Information for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is available in Appendix 3 of the Alaska Stock Assessment Reports (observer coverage) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed May 2023).

Based on historical reports and the stock's geographic range, pot fishery gear is the only documented source of fisheries-caused bowhead whale mortality and serious injury. The levels of interactions are unknown, even for observed fisheries. While some finfish pot and crab pot fisheries have onboard observers, the observers are unlikely to observe interactions unless an animal is anchored in gear. In most cases, large whale interactions occur while the pots are left untended to fish or "soak" and the whale swims away with gear attached. Because an observer generally cannot determine if a missing pot was lost due to whale entanglement, mortality and serious injury events are seldom reported in these fisheries. Therefore, the potential for fisheries-caused mortality and serious injury may be greater than is reflected in existing observer data. Additionally, bowhead whales may become entangled in derelict pot gear and such interactions also would ~~also~~ not be reflected in observer data.

There are no observer program records of bowhead whale mortality or serious injury incidental to U.S. commercial fisheries in Alaska; however, there have been reports of bowhead whale mortality and serious injury due to entanglement in fishing gear (Table ~~3~~2). Because no U.S. commercial fisheries occur in the Beaufort or Chukchi seas, bowhead whale mortality or injury that can be associated with U.S. commercial fisheries is currently attributed to interactions with fisheries in the Bering Sea. Citta et al. (2014) found that the distribution of satellite-tagged bowhead whales in the Bering Sea spatially, but not temporally, overlapped areas where commercial pot fisheries occurred and noted the potential risk of entanglement in lost gear. George et al. (2017) analyzed scarring data for bowhead whales harvested between 1990 and 2012 to estimate the frequency of line entanglement. Approximately 12.2% of the harvested whales examined for signs of entanglement (59/485) had scar patterns that were identified as definite entanglement injuries (29 whales with possible entanglement scars were excluded). Most of the entanglement scars occurred on the peduncle, and entanglement scars were rare on smaller subadult and juvenile whales (body length <10 m), possibly because young whales are less likely to survive entanglements and have had fewer years during which to acquire entanglement scars (George et al. 2017). The authors suspected the entanglement scars were largely the result of interactions with commercial pot gear (including derelict gear) in the Bering Sea. A review of the photo-identification catalog from 1985 to 2011 found the probability of scarring due to entanglement was about 2.2% per year (95% CI: 1.1-3.3%), with 12.4% of living bowhead whales photographed in 2011 showing evidence of entanglement (George et al. 2019).

Between ~~2016~~2017 and ~~2020~~2021, there were ~~three~~two reports of bowhead whale mortality or serious injury caused by interactions with fishing gear (Table ~~3~~2). ~~Three~~Two of the bowhead whales taken in the Alaska Native subsistence hunt in 2017 were seriously injured prior to harvest due to entanglement in pot gear suspected (but not confirmed) to be from Bering Sea commercial pot fisheries (~~Rolland et al. 2019,~~ Freed et al. ~~2022~~in prep.), resulting in a mean annual mortality and serious injury rate of ~~0.6~~0.4 bowhead whales in unknown (commercial, recreational, or subsistence) fisheries between ~~2016~~2017 and ~~2020~~2021 (Table ~~3~~2). These ~~three~~two whales are also included in the Alaska Native subsistence harvest for 2017 (Table ~~4~~3).

Thus, the minimum estimated mean annual mortality and serious injury rate in unknown (commercial, recreational, or subsistence) fisheries between ~~2016~~2017 and ~~2020~~2021 is ~~0.6~~0.4 whales (Table ~~3~~2; Freed et al. ~~2022~~in prep.), although the actual rates are currently unknown. These mortality and serious injury estimates result from actual counts of verified human-caused deaths and serious injuries and are minimums because not all entangled animals are found, reported, or have the cause of death determined.

Table 2~~3~~. Summary of mortality and serious injury of Western Arctic bowhead whales, by year and type, reported between ~~2016~~2017 and ~~2020~~2021 (NMFS Alaska Region marine mammal stranding network, ~~Rolland et al. 2019,~~ Freed et al. ~~2022~~in prep.).

Cause of injury	**~~2016~~**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean annual mortality**
Entangled in Bering Sea/Aleutian Island~~.~~ pot gear*	~~0~~	~~3~~2	0	0	0	0	~~0.6~~0.4
*Total in unknown (commercial, recreational, or subsistence) fisheries							~~0.6~~0.4

Alaska Native Subsistence/Harvest Information

NMFS ~~signed~~has an agreement with the Alaska Eskimo Whaling Commission (in 1998, as last amended in 2019) to protect the bowhead whale and Alaska Native culture. This co-management agreement promotes full and equal participation by Alaska Natives in decisions affecting the subsistence management of marine mammals (to the maximum extent allowed by law) as a tool for conserving marine mammal populations in Alaska (https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/co-management-marine-mammals-alaska, accessed May 2023).

Alaska Natives have been taking bowhead whales for subsistence purposes for at least 2,000 years (Marquette and Bockstoce 1980, Stoker and Krupnik 1993). Subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters, primarily from 11 Alaska communities, take approximately 0.1-0.5% of the Western Arctic bowhead whale stock per year (Philo et al. 1993, Suydam et al. 2011). Under this quota, the number of bowhead whales landed by Alaska Natives between 1974 and ~~2020~~2021 ranged from 8 to ~~55~~57 whales per year (Suydam and George 2012; Suydam et al. 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020; George and Suydam 2014; Scheimreif et al. 2021, 2022). The maximum number of strikes per year is set by a quota which is determined by subsistence needs and bowhead whale abundance and trend estimates (Stoker and Krupnik 1993;~~)~~ ~~(~~see the Potential Biological Removal section). Suydam and George (2012) summarized Alaska subsistence harvests of bowhead whales from 1974 to 2011 and reported a total of 1,149 whales landed by hunters from 12 villages, with Utqiaġvik (formerly Barrow) landing the most whales (n = 590) and Shaktoolik landing only one. Alaska Natives landed ~~228~~238 bowhead whales between ~~2016~~2017 and ~~2020~~2021 and ~~49~~46 of the ~~61~~62 whales that were struck and lost were determined to have died or had a poor chance of survival, resulting in a mean annual take (number of whales landed + struck and lost mortality) of ~~55~~57 whales (Table ~~4~~3)~~; however, because a mean annual 0.6 whales were determined to have been seriously injured in fishery interactions prior to harvest, the total subsistence harvest by Alaska Natives between 2016 and 2020 is 54 whales~~. Unlike the NMFS process for determining serious injuries (described in NMFS 2023b), the estimates of struck and lost mortality in the subsistence harvest are based on the Whaling Captains' assessment of the likelihood of survival (see criteria described in Suydam et al. 1995). The number of whales landed at each village varies greatly from year to year, as success is influenced by village size, bowhead migratory patterns, and ice and weather conditions. The efficiency of the hunt (the percent of whales struck that are retrieved) has increased since the implementation of the bowhead whale quota in 1978. In 1978, the efficiency was about 50%. In ~~2020~~2021, ~~54~~57 of ~~69~~70 whales struck were landed, resulting in an efficiency of ~~78~~81% and the mean efficiency for 2010 to ~~2019~~2020 was ~~77~~78% (Scheimreif et al. ~~2021~~2022).

~~Indigenous~~ Native Peoples in Canada and Russia also take whales from this stock. No catches of Western Arctic bowhead whales were reported by Canadian hunters between ~~2016~~2017 and ~~2020~~2021.~~; however, two bowhead whales were landed in Russia in 2016 (Ilyashenko and Zharikov 2017), o~~One bowhead whale was landed in Russia in 2017 (Zharikov 2018), none in 2018 (Zharikov et al. 2019), ~~and~~ one in 2019 (Zharikov et al. 2020), none in 2020 (Sidorov et al. 2021), and none in 2021 (Sidorov et al. 2022), resulting in an average annual take of ~~0.8~~0.4 (landed) whales by Indigenous Russians between ~~2015~~2017 and ~~2019~~2021~~, which are the most recent data available~~.

The total mean annual subsistence take between 2017 and 2021 is ~~56~~57 bowhead whales: ~~55~~57 whales taken by Alaska Natives ~~between 2016 and 2020~~ (equals the number of landed whales plus the struck and lost mortality; Table ~~4~~3) plus ~~0.8~~0.4 whales landed by Indigenous Russians (struck and lost whales not reported)~~ between 2015 and 2019~~.

Table ~~4~~3. Summary of the Alaska Native subsistence harvest of Western Arctic bowhead whales between ~~2016~~2017 and ~~2020~~2021.

Year	Landed	Struck and lost	Struck and lost mortality[a]	Total (landed + struck and lost mortality)
~~2016[b]~~	~~47~~	~~12~~	~~12~~	~~59~~
2017[~~c~~b]	50	7	5	55
2018[~~d~~c]	47	21	17	64
2019[~~e~~d]	30	6	2	32
2020[~~f~~e]	54	15	13	67
2021[f]	57	13	9	66
Mean annual number taken (landed + struck and lost mortality)				~~55~~57

[a]Struck and lost mortality includes animals determined to have died or had a poor chance of survival (per the criteria described in Suydam et al. 1995); ~~[b]Suydam et al. (2017);~~ [~~c~~b]Suydam et al. (2018); [~~d~~c]Suydam et al. (2019); [~~e~~d]Suydam et al. (2020); [~~f~~e]Scheimreif et al. (2021); [f] Scheimreif et al. (2022).

Other Mortality

Pelagic commercial whaling for bowhead whales was conducted from 1849 to 1914 in the Bering, Chukchi, and Beaufort seas (Bockstoce et al. 2007). During the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling population was killed, and effort remained high into the 20th century (Braham 1984). Woodby and Botkin (1993) estimated that the pelagic whaling industry harvested 18,684 whales from this stock. From 1848 to 1919, shore-based whaling operations (including landings as well as struck and lost estimates from the U.S., Canada, and Russia) took an additional 1,527 whales (Woodby and Botkin 1993). An unknown percentage of the whales taken by the shore-based operations were harvested for subsistence purposes. Historical harvest estimates likely underestimate the actual harvest as a result of under-reporting of the Soviet catches (Yablokov 1994) and incomplete reporting of struck and lost whales.

~~Transient killer whales are known to prey on bowhead whales. In a study of marks on bowhead whales taken in the subsistence harvest between spring 1976 and fall 1992, 4.1% to 7.9% had scars indicating that they had survived attacks by killer whales (George et al. 1994). Of 377 complete records for killer whale scars collected from 1990 to 2012, 29 whales (7.9%) had scarring "rake marks" consistent with killer whale injuries and another 10 had possible injuries (George et al. 2017). A higher rate of killer whale rake mark scars occurred from 2002 to 2012 than in the previous decade. George et al. (2017) noted this may be due to better reporting and/or sampling bias, an increase in killer whale population size, an increase in occurrence of killer whales at high latitudes (Clarke et al. 2013), or a longer open water period offering more opportunities to attack bowhead whales. The Aerial Surveys of Arctic Marine Mammals (ASAMM) project photo-documented bowhead whale carcasses that had injuries consistent with killer~~

~~whale predation in 2010 (one carcass), 2012 (two), 2013 (three), 2015 (three), 2016 (four), 2017 (one), 2018 (four), and 2019 (six) (Willoughby et al. 2020a, 2020b).~~

Currently, vessel-strike injuries on bowhead whales in Alaska are thought to be uncommon (George et al. 2017, 2019). Only 10 whales harvested between 1990 and 2012 (approximately 2% of the records examined) showed clear evidence of scarring from vessel propellers (George et al. 2017), while only seven whales from the photo-identification catalog from 1985 to 2011 (1% of the sample) had evidence of vessel-inflicted scars (George et al. 2019). One carcass observed in 2019 during the ASAMM surveys had blubber sections with straight wound edges and was likely struck by a vessel (Willoughby et al. 2020b). Two whales landed in the harvest in 2021 had healing wounds that appeared to be vessel-strike injuries (Stimmelmayr et al. 2022).

STATUS OF STOCK

Based on currently available data, the minimum estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries (0 whales) is not known to exceed 10% of the PBR (10% of PBR = 12) and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate. The minimum estimated mean annual level of human-caused mortality and serious injury (~~56~~57 whales) is not known to exceed the PBR (133~~116~~), the IWC annual maximum strike limit (67 + up to 33 previously unused strikes)~~.~~, nor the IWC block-level landing limit (392 whales, or 56 landings per year). By 2011, the Western Arctic bowhead whale stock; had increased to 16,820 whales; this represents between 31% and 168% of the pre-exploitation abundance of 10,000 to 55,000 whales estimated by Brandon and Wade (2004, 2006). The most recent ice-based abundance estimate from 2019 (Givens et al. 2021a, 2021b) and aerial line-transect abundance estimate from 2019 (Ferguson et al. 2022) are~~is~~ not statistically different from the corresponding estimate for 2011; therefore, the abundance is not believed to have decreased. However, the stock is classified as strategic because the bowhead whale is listed as endangered under the U.S. Endangered Species Act and is, therefore, also designated as depleted under the MMPA. Status of this stock relative to its Optimum Sustainable Population size has not been quantified.

There are key uncertainties in the assessment of the Western Arctic stock of bowhead whales. One of t~~T~~he current best estimates of abundance is based on the 2019 ice-based survey, which was negatively affected by disturbance from powered skiffs and anomalies in sea ice conditions that subsequently affected observation effort and the whales' migration route (Givens et al. 2021a). Givens et al. (2021b) derived a correction factor to account for the disturbance from powered skiffs, but the other known sources of negative bias were not accounted for in the best abundance estimate. The aerial line-transect abundance estimate from 2019 did not cover the entire summer range of the Western Arctic stock, and it has not yet been corrected for back-transformation bias (Ferguson et al. 2022), and both of these sources of bias would result in an underestimate of abundance. Although there are few records of bowhead whales being killed or seriously injured incidental to commercial fishing, about 12.2% of harvested bowhead whales examined for scarring (59/485 records) had scars indicating line entanglement wounds (George et al. 2017) and the southern range of the population overlaps with commercial pot fisheries (Citta et al. 2014).

~~HABITAT CONCERNS~~OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Non-Human Caused Mortality and Serious Injury

Transient killer whales are known to prey on bowhead whales. In a study of marks on bowhead whales taken in the subsistence harvest between spring 1976 and fall 1992, 4.1% to 7.9% had scars indicating that they had survived attacks by killer whales (George et al. 1994). Of 377 complete records for killer whale scars collected from 1990 to 2012, 29 whales (7.9%) had scarring "rake marks" consistent with killer whale injuries and another 10 had possible injuries (George et al. 2017). A higher rate of killer whale rake mark scars occurred from 2002 to 2012 than in the previous decade. George et al. (2017) noted this may be due to better reporting and/or sampling bias, an increase in killer whale population size, an increase in occurrence of killer whales at high latitudes (Clarke et al. 2013), or a longer open water period offering more opportunities to attack bowhead whales. The Aerial Surveys of Arctic Marine Mammals (ASAMM) project photo-documented bowhead whale carcasses that had injuries consistent with killer whale predation in 2010 (one carcass), 2012 (two), 2013 (three), 2015 (three), 2016 (four), 2017 (one), 2018 (four), and 2019 (seven; Willoughby et al. 2020, ~~2020~~2022). Scars from interactions with killer whales were also present on landed whales in 2020 (two) and 2021 (three), and on two of three carcasses observed during North Slope Borough autumn aerial surveys conducted in 2021 (Stimmelmayr et al. 2022).

During 2017-2021, 33 stranded bowhead whales were documented within the range of the Western Arctic Stock (Table ~~5~~4; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 29 November 2022). One stranding was determined to have no evidence of human interaction and the remaining carcasses could not be fully evaluated for evidence of human interaction.

Table ~~5~~4. Number of strandings of bowhead whales during 2017-2021, including those for which evidence of human interaction (HI) could not be determined (CBD) or no evidence was determined. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 29 November 2022). Please note "HI Yes" does not necessarily mean the interaction caused the animal's death.

Year	2017			2018			2019			2020			2021		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
Western Arctic Stock	0	0	1	0	0	6	0	0	15	0	0	0	0	1	10
Annual Total	1			6			15			0			11		

Habitat Concerns

Vessel traffic in arctic waters is increasing, largely due to an increase in commercial shipping facilitated by the lack of sea ice (Smith and Stephenson 2013, Reeves et al. 2014, Hauser et al. 2018, USCMTS 2019, George et al. 2020). For example, in January 2021 large vessels carrying liquefied natural gas ~~recently~~ transited through Anadyr Strait (west of Saint Lawrence Island; Smith 2021) and there are plans for consistent year-round shipping through the Strait (Stolyarov 2021), including the wintering area for western Arctic bowhead whales. The increase in vessel traffic could result in an increased number of vessel collisions with bowhead whales (Huntington et al. 2015, Hauser et al. 2018, Halliday et al. 2022) and increased acoustic disturbance (Halliday et al. 2021). Oil and gas development in the Beaufort Sea imposes risks of various forms of pollution, including oil spills, in bowhead whale habitat and the technology for effectively recovering spilled oil in icy conditions is lacking (Wilkinson et al. 2017).

Also of concern is noise produced by seismic surveys and vessel traffic resulting from shipping and offshore energy exploration, development, and production operations (Blackwell and Thode 2021). Evidence indicates that bowhead whales are sensitive to noise from offshore drilling platforms and seismic survey operations (Richardson and Malme 1993, Richardson 1995, Davies 1997, Robertson et al. 2013, Blackwell et al. 2017). Bowhead whales often avoid sound sources associated with active drilling (Schick and Urban 2000) and seismic operations (Miller et al. 1999). Exposure to seismic operations resulted in subtle changes to dive, surfacing, and respiration behaviors (Robertson et al. 2013). Source levels, time of year, and whale behavior (migrating, feeding, etc.) all affect the extent of displacement or changes in behavior, including calling rates (reviewed in Blackwell and Thode 2021).

Global climate model projections for the next 50 to 100 years consistently show pronounced warming over the Arctic, accelerated sea-ice loss, and continued permafrost degradation (USGS 2011, IPCC 2013, Jeffries et al. 2015). Within the Arctic, some of the largest changes are projected to occur in the Bering, Beaufort, and Chukchi seas (Chapman and Walsh 2007, Walsh 2008). Ice-associated animals, including the bowhead whale, may be sensitive to changes in A~~a~~rctic weather, sea surface temperatures, sea-ice extent, and the concomitant effect on prey availability (Moore et al. 2019). Based on an analysis of various life-history features, Laidre et al. (2008) concluded that, on a worldwide basis, bowhead whales were likely to be moderately sensitive to climate change. Using statistical models, Chambault et al. (2018) found that bowhead whales in Baffin Bay, Greenland, targeted a narrow range of temperatures (-0.5 to 2°C) and may be exposed to thermal stress as a result of warming temperatures. However, the Western Arctic stock of bowhead whales commonly feeds in waters ranging from 4° to 6°C near Tuktoyaktuk (Citta et al. 2021); a bowhead was sighted in the relatively warm waters of the Gulf of Maine during summer 2012, 2014, and 2017 (Accardo et al. 2018); and bowhead whales in the Sea of Okhotsk are found in waters with sea surface temperatures up to 16.5°C (Shpak and Paramonov 2018). Therefore, it is possible that bowhead whales' selection of cooler waters in some regions could be primarily due to prey availability as opposed to thermal stress. ~~Additionally, landed Western Arctic bowhead whales had better body condition during years of light ice cover (George et al. 2006). In addition, a positive correlation between body condition of Western Arctic bowhead whales and summer sea-ice loss has been observed over the last 2.5 decades in the Pacific Arctic (George et al. 2015).~~ Ice-free areas along the shelf break are thought to create increased upwelling and likely more feeding opportunities for foraging whales. The movement and foraging behavior of bowhead whales is becoming more variable as feeding areas are altered in response to retreating sea ice. Ashjian et al. (2021) found that interannual variability in sea ice and winds in the Chukchi Sea affect krill population structure in the bowhead whale feeding hotspot near Point Barrow. Hannay et al. (2013) found that a large fraction of bowhead whale acoustic detections in the northeast Chukchi Sea occurred just in advance of the progression of sea ice formation during the fall migration, suggesting that an increase in ice-free days may lead to a delayed migration out of the Chukchi Sea during fall. Stafford et al. (2021) found that bowhead whales delayed their migration out of the Beaufort Sea by 7 days per year from 2008-2018. Insley et al. (2021) used passive acoustic monitoring to document the first known occurrence of bowhead whales overwintering in Amundsen Gulf and the eastern Beaufort Sea. Sheffield and George (2013) presented evidence that the occurrence of fish has become more prevalent in the diets of Western Arctic bowhead whales near Utqiaġvik in the autumn. However, there are insufficient data to make reliable projections about whether A~~a~~rctic climate change will result in negative (thermal stress, habitat loss) or positive (prey abundance) effects on this population. The reduction in sea ice may lead to increased predation of bowhead whales by killer whales. A northward shift of fish stocks and fisheries due to climate change (Morley et al. 2018) will also increase the risk of bowhead whale interactions with fishing gear.

Ocean acidification, driven primarily by the release of carbon dioxide (CO_2) emissions into the atmosphere, is also a concern due to potential effects on prey. Because their primary prey are small crustaceans (especially calanoid copepods, euphausiids, gammarid and hyperid amphipods, and mysids that have exoskeletons composed of chitin and calcium carbonate), bowhead whale survival and recruitment may be impacted by increased ocean acidification (Lowry et al. 2004). The nature and timing of impacts to bowhead whales from ocean acidification are extremely uncertain and will depend partially on the whales' ability to switch to alternate prey species. Ecosystem responses may have very long lags as they propagate through trophic webs.

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Appendix 1. Summary of substantial changes to the text and/or values in the ~~2022~~2023 stock assessments (last revised ~~9/1/2022~~ 8/29~~6/1~~/2023). An 'X' indicates sections where the information presented has been updated since the ~~2021~~2022 stock assessments were released. Stock Assessment Reports for those stocks in boldface were updated in ~~2022~~2023.

Stock	Stock definition	Population size	PBR	Fishery mortality	Subsistence mortality	Status
Steller sea lion (Western ~~U.S.~~)		**X**	**X**	**X**	**X**	**X**
Steller sea lion (Eastern ~~U.S.~~)		**X**	**X**	**X**	**X**	**X**
Northern fur seal (Eastern Pacific)						
Harbor seal (Aleutian Islands)						
Harbor seal (Pribilof Islands)						
Harbor seal (Bristol Bay)						
Harbor seal (North Kodiak)						
Harbor seal (South Kodiak)						
Harbor seal (Prince William Sound)						
Harbor seal (Cook Inlet/Shelikof Strait)						
Harbor seal (Glacier Bay/Icy Strait)						
Harbor seal (Lynn Canal/Stephens Passage)						
Harbor seal (Sitka/Chatham Strait)						
Harbor seal (Dixon/Cape Decision)						
Harbor seal (Clarence Strait)						
Spotted seal (Bering)						
Bearded seal (Beringia)						
Ringed seal (Arctic)						
Ribbon seal						
Beluga whale (Beaufort Sea)						
Beluga whale (Eastern Chukchi Sea)						
Beluga whale (Eastern Bering Sea)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Beluga whale (Bristol Bay)						
Beluga whale (Cook Inlet)						
Narwhal (Unidentified)						
Killer whale (ENP Alaska Resident)	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~
Killer whale (ENP Northern Resident)						
Killer whale (ENP Gulf of Alaska, Aleutian Islands, and Bering Sea Transient)						
Killer whale (AT1 Transient)						
Killer whale (West Coast Transient)						
Pacific white-sided dolphin (North Pacific)						
Harbor porpoise (Northern Southeast Alaska Inland Waters)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Harbor porpoise (Southern Southeast Alaska Inland Waters)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Harbor porpoise (Yakutat/Southeast Alaska Offshore Waters)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Harbor porpoise (Gulf of Alaska)						
Harbor porpoise (Bering Sea)						
Dall's porpoise (Alaska)						
Sperm whale (North Pacific)						
Baird's beaked whale (Alaska)						
Cuvier's beaked whale (Alaska)						
Stejneger's beaked whale (Alaska)						
Sato's beaked whale	**X**	**X**	**X**	**X**	**X**	**X**
Humpback whale (Western North Pacific)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~

Stock	Stock definition	Population size	PBR	Fishery mortality	Subsistence mortality	Status
Humpback whale (Hawai‘i)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Humpback whale (Mexico-North Pacific)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Fin whale (Northeast Pacific)						
Minke whale (Alaska)						
North Pacific right whale (Eastern North Pacific)	**X**	**X**				
Bowhead whale (Western Arctic)		**X**	**X**	**X**	**X**	**X**

Appendix 2. Stock summary table (last revised ~~9/1/2022~~ 8/29/2023). N/A indicates data are unknown. UNDET (undetermined) PBR indicates data are available to calculate a PBR level but a determination has been made that calculating a PBR level using those data is inappropriate (see Stock Assessment Report (SAR) for details). N_{EST} is the AFSC Marine Mammal Laboratory's best estimate of the size of the population; Strategic status: S = Strategic, NS = Not Strategic.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Steller sea lion	Western ~~U.S.~~	~~N~~Y	~~52,932~~ 49,837		~~52,932~~ 73,211 (49,837 in U.S. only)	0.12	0.1	~~318~~ 439 (299 for U.S. only)	~~254~~ 267 (267 in U.S. only)	~~37~~ 39	~~209~~ 218	S	~~2020~~ 2023	~~2018-2019~~ 2021-2022	N_{EST} is best estimate of counts, which have not been corrected for animals at sea during abundance surveys.
Steller sea lion	Eastern ~~U.S.~~	~~N~~Y	~~43,201~~ 36,308		~~43,201~~ 36,308 (U.S. only)	0.12	1.0	~~2,592~~ 2,178 (U.S. only)	~~112~~ 93.2 (U.S. only)	~~24~~ 21.4	11	NS	~~2019~~ 2023	~~2017~~ 2015-2022	N_{EST} is best estimate of counts, which have not been corrected for animals at sea during abundance surveys.
Northern fur seal	Eastern Pacific	N	626,618	0.2	530,376	0.086	0.5	11,403	373	3.5	360	S	2021	2014-2019	Survey years = Sea Lion Rock - 2014; St. Paul and St. George Is. - 2014, 2016, 2018; Bogoslof Is. - 2015, 2019.
Harbor seal	Aleutian Islands	N	5,588		5,366	0.12	0.3	97	90	0.4	90	NS	2019	2018	
Harbor seal	Pribilof Islands	N	229		229	0.12	0.5	7	0	0	0	NS	2019	2018	N_{EST} is best estimate of counts, which have not been corrected for animals at sea during abundance surveys.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Harbor seal	Bristol Bay	N	44,781		38,254	0.12	0.7	1,607	20	3.8	15	NS	2019	2017	
Harbor seal	North Kodiak	N	8,677		7,609	0.12	0.5	228	38	0.3	37	NS	2019	2017	
Harbor seal	South Kodiak	N	26,448		22,351	0.12	0.7	939	127	1.2	126	NS	2019	2017	
Harbor seal	Prince William Sound	N	44,756		41,776	0.12	0.5	1,253	413	24	387	NS	2019	2015	
Harbor seal	Cook Inlet/Shelikof Strait	N	28,411		26,907	0.12	0.5	807	107	2.5	104	NS	2019	2018	
Harbor seal	Glacier Bay/Icy Strait	N	7,455		6,680	0.12	0.3	120	104	0	104	NS	2019	2017	
Harbor seal	Lynn Canal/Stephens Passage	N	13,388		11,867	0.12	0.3	214	50	0	50	NS	2019	2016	
Harbor seal	Sitka/Chatham Strait	N	13,289		11,883	0.12	0.5	356	77	0	77	NS	2019	2015	
Harbor seal	Dixon/Cape Decision	N	23,478		21,453	0.12	0.5	644	69	0	69	NS	2019	2015	
Harbor seal	Clarence Strait	N	27,659		24,854	0.12	0.5	746	40	0	40	NS	2019	2015	
Spotted seal	Bering	N	461,625		423,237	0.12	1.0	25,394	5,254	1	5,253	NS	2020	2012-2013	
Bearded seal	Beringia	N				0.12	0.5		6,709	1.8	6,707	S	2020	2012-2013	N_{EST}, N_{MIN}, and PBR have been calculated, however, important caveats exist; see SAR text for details.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Ringed seal	Arctic	N				0.12	0.5		6,459	5	6,454	S	2020	2012-2013	N_{EST}, N_{MIN}, and PBR have been calculated, however, important caveats exist; see SAR text for details.
Ribbon seal		N	184,697		163,086	0.12	1.0	9,785	163	0.9	162	NS	2020	2012-2013	
Beluga whale	Beaufort Sea	N	39,258	0.229	N/A	0.04	1.0	UNDET	104	0	104	NS	2020	1992	
Beluga whale	Eastern Chukchi Sea	N	13,305	0.51	8,875	0.04	1.0	178	56	0	56	NS	2020	2017	
Beluga whale	Eastern Bering Sea	Y	12,269	0.118	11,112	0.048	1.0	267	227	0	227	NS	2017	2017	
Beluga whale	Bristol Bay	N	2,040	0.26	1,645	0.04	1.0	33	19	0	19	NS	2020	2016	
Beluga whale	Cook Inlet	N	279	0.061	267	0.04	0.1		0	0	0	S	2021	2014-2018	Survey years = 2014, 2016, and 2018. PBR has been calculated, however, important caveats exist; see SAR text for details.
Narwhal	Unidentified	N	N/A	N/A	N/A	0.04	0.5	N/A	0	0	0	NS	2016		
Killer whale	Eastern North Pacific Alaska Resident	Y	1,920	N/A	1,920	0.04	0.5	19	1.3	1.1	0	NS	2016	2005-2019	N_{EST} is based on counts of individuals identified from photo-ID catalogs.
Killer whale	Eastern North Pacific Northern Resident (British Columbia)	N	302	N/A	302	0.029	0.5	2.2	0.2	0	0	NS	2019	2018	N_{EST} is based on counts of individuals identified from photo-ID catalogs.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Killer whale	Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	N	587	N/A	587	0.04	0.5	5.9	0.8	0.8	0	NS	2020	2012	N_{EST} is based on counts of individuals identified from photo-ID catalogs.
Killer whale	AT1 Transient	N	7	N/A	7	0.04	0.1		0	0	0	S	2020	2019	N_{EST} is based on counts of individuals identified from photo-ID catalogs. PBR has been calculated, however, important caveats exist; see SAR text for details.
Killer whale	West Coast Transient	N	349	N/A	349	0.04	0.5	3.5	0.4	0.2	0	NS	2020	2018	N_{EST} is based on counts of individuals identified from photo-ID catalogs in an analysis of a subset of data from 1958 to 2018.
Pacific white-sided dolphin	North Pacific	N	26,880	N/A	N/A	0.04	0.5	UNDET	0	0	0	NS	2018	1990	
Harbor porpoise	Northern Southeast Alaska Inland Waters	Y	1,619	0.26	1,250	0.04	0.5	13	5.6	5.6	0	NS	N/A (New SAR in 2022)	2019	New stock split from Southeast Alaska stock in 2022.
Harbor porpoise	Southern Southeast Alaska Inland Waters	Y	890	0.37	610	0.04	0.5	6.1	7.4	7.4	0	S	N/A (New SAR in 2022)	2019	New stock split from Southeast Alaska stock in 2022.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Harbor porpoise	Yakutat/Southeast Alaska Offshore Waters	Y	N/A		N/A	0.04	0.5	N/A	22.2	22.2	0	NS	N/A (New SAR in 2022)	1997	New stock split from Southeast Alaska stock.
Harbor porpoise	Gulf of Alaska	N	31,046	0.21	N/A	0.04	0.5	UNDET	72	72	0	S	2020	1998	
Harbor porpoise	Bering Sea	N			N/A	0.04	0.5	UNDET	0.4	0	0	S	2020	2008	N_{EST} has been calculated, however, important caveats exist; see SAR text for details.
Dall's porpoise	Alaska	N				0.04	0.5		37	37	0	NS	2021	2015	N_{EST}, N_{MIN}, and PBR have been calculated, however, important caveats exist; see SAR text for details.
Sperm whale	North Pacific	N				0.04	0.1		3.5	3.3	0	S	2020	2015	N_{EST}, N_{MIN}, and PBR have been calculated, however, important caveats exist; see SAR text for details.
Baird's beaked whale	Alaska	N	N/A		N/A	0.04	0.5	N/A	0	0	0	NS	2013		
Cuvier's beaked whale	Alaska	N	N/A		N/A	0.04	0.5	N/A	0	0	0	NS	2013		
Stejneger's beaked whale	Alaska	N	N/A		N/A	0.04	0.5	N/A	0	0	0	NS	2013		
Sato's beaked whale		Y	N/A		N/A	0.04	0.5	N/A	0	0	0	NS	N/A (New SAR in 2023)		

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Humpback whale	Western North Pacific	Y	1,084	0.088	1,007	0.067	0.1	3.4 (0.2 for U.S. waters)	5.82 (0.06 in U.S. waters)	0.012	0.004	S	N/A (New SAR in 2022)	2004-2006	New SAR in 2022 following North Pacific humpback whale stock structure changes
Humpback whale	Hawai'i	Y	11,278	0.56	7,265	0.07	0.5	127	27.09	8.39	0.18	NS	N/A (New SAR in 2022)	2002-2020	New SAR in 2022 following North Pacific humpback whale stock structure changes
Humpback whale	Mexico-North Pacific	Y			N/A	0.066	0.5	UNDET	0.57	0.36	0.01	S	N/A (New SAR in 2022)	2003-2006	New SAR in 2022 following North Pacific humpback whale stock structure changes. N_{EST} has been calculated, however, important caveats exist; see SAR text for details.
Fin whale	Northeast Pacific	N				0.04	0.1		0.6	0	0	S	2020	2013	N_{EST}, N_{MIN}, and PBR have been calculated, however, important caveats exist; see SAR text for details.

Species	Stock name	SAR updated	N_{EST}	CV N_{EST}	N_{MIN}	R_{MAX}	F_R	PBR	Total annual mortality/ serious injury	Annual U.S. commercial fishery mortality/ serious injury	Annual Native subsistence mortality	Strategic status	SAR last revised	Last survey year(s) for estimating abundance	Comments
Minke whale	Alaska	N	N/A		N/A	0.04	0.5	N/A	0	0	0	NS	2018		
North Pacific right whale	Eastern North Pacific	~~N~~Y	31	0.226	26	0.04	0.1		0	0	0	S	~~2020~~ 2023	2008	PBR has been calculated, however, important caveats exist; see SAR text for details.
Bowhead whale	Western Arctic	Y	~~14,025~~ 15,227	~~0.228~~ 0.165	~~11,603~~ 13,264	0.04	0.5	~~116~~ 133	~~56~~ 57	0	~~56~~ 57	S	~~2022~~ 2023	2019	

Appendix 3. Percent observer coverage in Alaska commercial fisheries 1990-~~2020~~ 2021 (last revised ~~9/1/2022~~ 8/29/2023).

Fishery name[a]	Method for calculating observer coverage[b]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gulf of Alaska (GOA) groundfish trawl	% of observed biomass	55	38	41	37	33	44	37	33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
GOA flatfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	39.2	35.8	36.8	40.5	35.9	40.6	76.9	29.2	24.2	31	28	22	26	31	42	46	47	54	39	56	35	39	38	82
GOA Pacific cod trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.6	16.4	13.5	20.3	23.2	27.0	82.5	21.4	22.8	25	24	38	31	41	25	10	12	13	13	11	28	28	100	28
GOA pollock trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37.5	31.7	27.5	17.6	26.0	31.4	96.1	24.2	26.5	27	34	43			27	15	14	23	27	19	20	23	9.5	13
GOA rockfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51.4	49.8	50.2	51.0	37.2	48.4	74.1	51.4	49.1	88	87	91			95	95	96	93	98	98	94	95	93	96
GOA longline	% of observed biomass	21	15	13	13	8	18	16	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
GOA Pacific cod longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.8	5.7	6.1	4.9	11.4	12.6	21.4	3.7	10.2	45	32	43	29	30	13	29	31	36	30	39	28	33	0	30
GOA halibut longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51.3	47.1	51.1	43.0	41.4	9.6	36.4	6.5	2.8	N/A	N/A	N/A		2.3	0.6	4.2	11	2.5	2.9	1.3	2	2.2	1.3	20
GOA rockfish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0	1.4	0.2	1.3	4.9	2.5	0	0	3.1	N/A	N/A	83			0	0	3.2	5	4.4	6.3	0	0.8	6.2	34
GOA sablefish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.9	14.0	15.2	12.4	13.7	9.4	37.7	10.4	11.2	37	35	38	15	14	14	14	19	18	12	10	8.9	12	6.1	11
GOA finfish pots	% of observed biomass	13	9	9	7	7	7	5	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
GOA Pacific cod pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.7	5.7	7.0	5.8	7.0	4.0	40.6	3.8	2.9	14	18	13			9.6	8.4	8.7	14	8.3	2.9	8.8	7.6	0	6
Bering Sea/Aleutian Islands (BSAI) finfish pots	% of observed biomass	43	36	34	41	27	20	17	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
BSAI Pacific cod pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.6	16.2	8.5	14.7	12.1	12.4	33.1	14.4	12.4	30	23	29	21	20	19	18	21	27	21	13	21	16	13	14
BS sablefish pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42.1	44.1	62.6	38.7	40.6	21.4	72.5	44.3	35.3	N/A	N/A	N/A			39	13	11	9	23	19	33	11	18	10
AI sablefish pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100	50.3	68.2	60.6	69.4	47.5	51.2	64.4	18.7	N/A	N/A	N/A			40	0	0	86	88	33	55	23	57	80
BSAI groundfish trawl	% of observed biomass	74	53	63	66	64	67	66	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
BSAI Atka mackerel trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	65.0	77.2	86.3	82.4	98.3	95.4	96.6	97.8	96.7	94	100	99	100	99	100	99	100	100	98	100	100	100	100	99
BSAI flatfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59.4	66.3	64.5	57.6	58.4	63.9	68.2	68.3	67.8	72	100	100	99	99	100	100	100	100	99	100	100	100	100	99
BSAI Pacific cod trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	55.3	50.6	51.7	57.8	47.4	49.9	75.1	52.8	46.8	52	56	64	66	60	68	80	80	72	68	68	73	67	74	58

Fishery name[a]	Method for calculating observer coverage[b]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
BSAI pollock trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	66.9	75.2	76.2	79.0	80.0	82.2	92.8	77.3	73.0	85	85	86	86	98	98	98	98	99	99	99	99	98	91	77
BSAI rockfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	85.4	85.6	85.1	65.3	79.9	82.6	94.1	71.0	80.6	88	98	99	99	99	100	100	100	100	100	100	100	100	100	96
BSAI longline	% of observed biomass	80	54	35	30	27	28	29	33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
BSAI Greenland turbot longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31.6	30.8	52.8	33.5	37.3	40.9	39.3	33.7	36.2	64	74	74	59	59	57	52	56	52	60	56	62	56	52	0
BSAI Pacific cod longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	34.4	31.8	35.2	29.5	29.6	29.8	25.7	24.6	26.3	63	63	61	64	57	51	66	64	62	57	58	55	52	53	55
BSAI halibut longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38.9	48.4	55.3	67.2	57.4	20.3	44.5	27.9	26.4	N/A	N/A	N/A		16	1.8	13	11	3.9	3	1.6	3	2.2	1.4	3.1
BSAI rockfish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	41.5	21.4	53.0	26.9	36.0	74.9	37.9	36.3	46.8	88	N/A	100			34	49	100	71	53	0	82	73	100	55
BSAI sablefish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	19.5	28.4	24.4	18.9	30.3	10.4	50.9	19.3	11.2	48	49	56			27	42	35	34	23	7.1	7.7	9.4	30	19
Prince William Sound salmon drift gillnet	% of estimated sets observed	4	5	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Prince William Sound salmon set gillnet	% of estimated sets observed	3	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Alaska Peninsula/Aleutian Islands salmon drift gillnet (South Unimak area only)	% of estimated sets observed	4	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Cook Inlet salmon drift gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	1.6	3.6	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Cook Inlet salmon set gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	0.16-1.1	0.34-2.7	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Kodiak Island salmon set gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	6.0	not obs.	not obs.	4.9	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Yakutat salmon set gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	5.3	7.6	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Southeast Alaska salmon drift gillnet (Districts 6, 7, and 8)[c]	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	6.4	6.6	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.

[a] From 1990 to 1997, most federally-regulated commercial fisheries in Alaska were named using gear type and fishing location. In 2003, the naming convention changed to define fisheries based on gear type, fishing location, and target fish species. Bycatch data collected from 1998 to present are analyzed using these fishery definitions. The use of "N/A" for either pooled or separated fisheries indicates that we do not have effort data for a particular fishery for that year.

[b] Observer coverage in the groundfish fisheries (trawl, longline, and pots) was determined by the percentage of the total catch that was observed. Observer coverage in the drift gillnet fisheries was calculated as the percentage of the estimated sets that were observed. Observer coverage in the set gillnet fishery was calculated as the percentage of estimated setnet hours (determined by number of permit holders and the available fishing time) that were observed.

[c] Total percent observer coverage levels for the observed areas (Alaska Department of Fish & Game districts 6, 7, and 8) are shown (Manly 2015). Coverage levels varied by sub-district and year. Coverage levels in 2012 and 2013 by sub-district were 7.3% and 6.7% (6A), 5.5% and 6.0% (6B), 6.0% and 7.9% (7A), 6.9% and 8.9% (8A), and 6.3% and 5.7% (8B), respectively.

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