Revised: July 2023

NORTHERN SEA OTTER (*Enhydra lutris kenyoni*): Southeast Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sea otters (*Enhydra lutris*) occur in nearshore coastal waters of the North Pacific Rim from the northern end of Japan to California. The northern sea otter sub-species (*E. lutris kenyoni*) extends from Alaska's Aleutian Islands through British Columbia (Canada) and Washington. Sea otters primarily inhabit nearshore habitats within the 40 meters (m) (~ 130 feet [ft]) depth contour where they forage for benthic invertebrates in shallow subtidal and intertidal zones (Riedman and Estes 1990), though they can forage and will occur at depths over 100 m (~ 328 ft) (Bodkin et al. 2004). Sea otters are not migratory and generally do not disperse over long distances, although movements of tens of kilometers (km) (tens of miles [mi]) are common (Garshelis and Garshelis 1984). Annual home range sizes of adult sea otters are relatively small, with male territories ranging from 4 to 11 square kilometers (km^2) (~ 1.5 to 4.2 square miles [mi^2]) and adult female home ranges from a few to 24 km^2 (~ 9.3 mi^2) (Garshelis and Garshelis 1984, Ralls et al. 1988, Jameson 1989). Sea otter distribution and density can vary at small spatial scales seasonally and across years as sea otters seek refuge from storms (Stewart et al. 2015) and populations recover across their historic range (Larson et al. 2014).

Gorbics and Bodkin (2001) applied the phylogeographic approach of Dizon et al. (1992) and used the best available data at the time to identify three sea otter stocks in Alaska: Southeast, Southcentral, and Southwest. The ranges of these stocks are defined as follows: (1) Southeast Alaska stock extends from Dixon Entrance to Cape Yakataga; (2) Southcentral Alaska stock extends from Cape Yakataga to Cook Inlet including Prince William Sound, the Kenai Peninsula coast, eastern Cook Inlet and Kachemak Bay; and (3) Southwest Alaska stock includes Western Cook Inlet, the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof Islands (Figure 1). This stock assessment report is focused on the Southeast stock of sea otters in Alaska (hereafter, "Southeast stock"). The U.S. Fish and Wildlife Service (Service) recognizes that the inclusion of genetic variation among sea otter populations is important to define stock delineations. Recent genetic analyses support existing stock structure designations indicate that genetic differentiation among northern sea otters is clinal across their range (Larson et al. 2021, Flannery et al. 2021). The Service also acknowledges that range-wide reductions and extirpations during the commercial fur trade of the 18th and 19th centuries occurred not simply because of excessive harvest, but because the harvest was not allocated proportionally to the abundance and distribution of sea otters (Bodkin and Ballachey 2010). This process of serial depletion was facilitated by the relatively sedentary nature of sea otters. To reduce the risk of overexploitation, sea otters must be managed on a spatial scale compatible with their well-known behavioral and reproductive biology (Bodkin and Monson 2002), incorporating traits such as home range and movements.

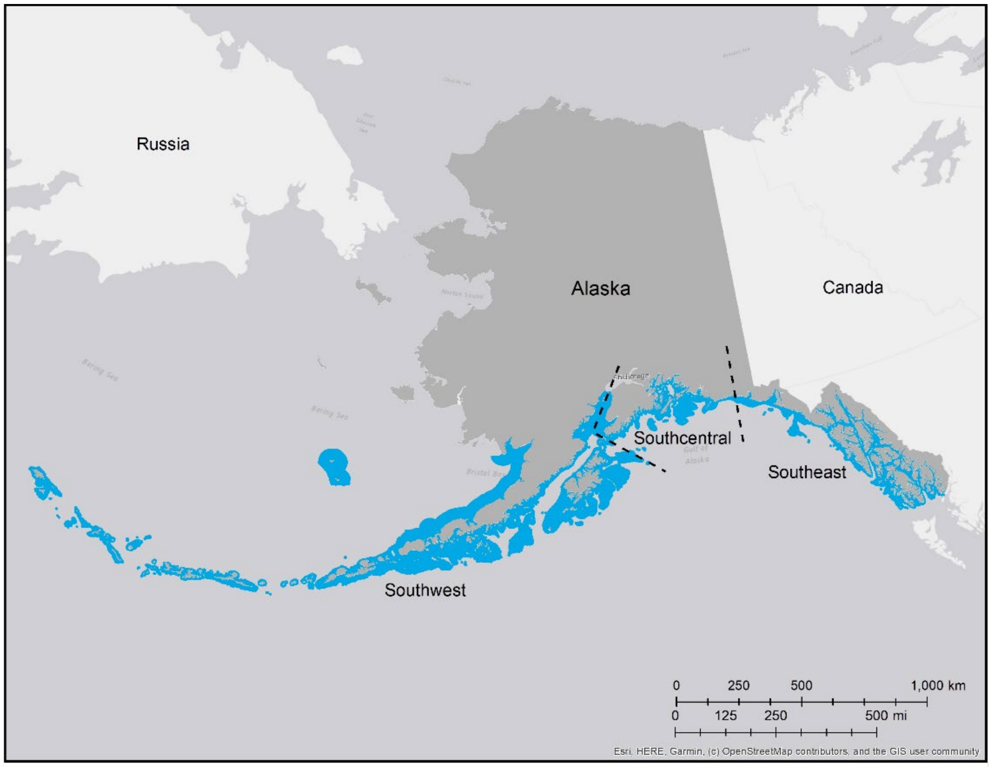

Figure 1. Northern sea otter distribution in Alaska (blue) delineated as ocean waters within the 100 m depth contour, within the median ice extent for the month of March from 2001-2020 and restricted to the 24 nautical mile Contiguous Zone maritime boundary. The boundaries among the three stocks are indicated with a dashed line.

POPULATION SIZE

Historically, sea otters occurred across the North Pacific Rim, ranging from Hokkaido, Japan, through the Kuril Islands, the Kamchatka Peninsula, the Commander Islands, the Aleutian Islands, Alaska Peninsula and southern coasts of Alaska, and south through British Columbia, Canada, into Washington, Oregon, California and Baja California, Mexico (Kenyon 1969). However, commercial exploitation of sea otters extirpated them from much of their range, with probably fewer than 2,000 animals remaining in an estimated thirteen remnant colonies (Kenyon 1969) when they were afforded protection by the International Fur Seal Treaty in 1911. Through both natural population growth and human-assisted translocations, sea otters have since repatriated much of their historical range in Alaska.

Although population recovery began following legal protection, no remnant colonies of sea otters existed in Southeast Alaska. As part of efforts to re-establish sea otters in portions of their historical range to offset costs of nuclear testing in Alaska and reinvigorate fur harvest, animals from Amchitka Island and Prince William Sound were translocated to other areas in the 1960s and 1970s, including to Southeast Alaska, Washington, and Oregon (Jameson et al. 1982). Despite being met with mixed success initially, these translocation efforts yielded one of the greatest success stories for sea otter recovery across their historic range. From 1965 to 1969, 412 otters (89 percent from Amchitka Island in Southwest Alaska, and 11 percent from

Prince William Sound in southcentral Alaska) were translocated to six sites in Southeast Alaska (Jameson et al. 1982). In the first 20 years following translocation, these populations increased in numbers and expanded their range (Pitcher 1989), continuing to do so to present with sustained high population growth rates enabled by the abundant resources and complexity of the shoreline across southeast Alaska (Eisaguirre et al. 2021, Tinker et al. 2019).

Through 2012, the Service's population estimates for the Southeast Alaska stock were developed using the aerial survey methods of Bodkin and Udevitz (1999) plus one survey of the outer coastline from the western boundary of the stock at Cape Yakataga to Cape Spencer conducted by U.S. Geological Survey (USGS) in 2000. Thirty-two sea otters were estimated to be in that outer coastal area (coefficient of variation [CV]=0.378). Tinker et al. (2019) calculated regional population estimates across Southeast Alaska using a state-space model with survey data through 2012, finding the regional population for Yakutat (2005) to be 919 ± 274, for Northern Southeast (2011) (excluding Glacier Bay) to be 3,680 ± 883, for Southern Southeast (2010) to be 13,178 ± 2,355, for Glacier Bay (2012) to be 7,955 ± 1,973, and for all of Southeast Alaska (2011 summed across years/regions) to be 25,584 ± 3,828.

More recent surveys have been conducted by the Glacier Bay National Park Service using an integrated population model-based optimized survey design and photogrammetry to obtain an abundance estimate (Williams et al. 2017, Womble et al. 2018). Synthesizing the historic Southeast-wide survey data gathered in 2010 and 2011 with recent 2019 Glacier Bay data through an applied diffusion model (Eisaguirre et al. 2021) made it possible to calculate a stock-wide population estimate for the Southeast stock in 2019 of 27,285 (CV=0.07). The Service and its partner agencies expanded the photo-based survey methods and integrated population modelling framework from Glacier Bay across Southeast Alaska in 2022, to conduct the first complete survey of the Southeast stock (Schuette et al. 2023). Those data were incorporated with all available historic aerial survey data and analyzed by the same underlying model used in Eisaguirre et al. (2021, 2023) providing the best available contemporary estimate of abundance. The most up-to-date population estimate for the Southeast stock is presented in Table 1, which shows a total estimate of 22,359 (95 percent Bayesian credible interval: 19,595, 25,290, CV = 0.064) sea otters.

Table 1. Abundance estimates for the Southeast Alaska stock of northern sea otters as of 2022 using diffusion model output for that year (Schuette et al. 2023).

Survey Area	Year	Estimate	CV	N_{MIN}
Southeast Stock Estimate	2022	22,359	0.064	21,187

MINIMUM POPULATION ESTIMATE

The Marine Mammal Protection Act (MMPA) defines a N_{MIN} as "an estimate of the number of animals in a stock that: (A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and (B) provides reasonable assurance that the stock size is equal to or greater than the estimate." (MMPA §3(27)).

The N_{MIN} for this stock is calculated using Equation 1 from the Potential Biological

Removal Guidelines (Wade and Angliss 1997; NMFS 2016): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for Southeast Alaska is presented in Table 1. Using the abundance estimate for all of the Southeast Stock from Schuette et al. (2023) as the best available, contemporary stock-wide estimate, N_{MIN} for the Southeast stock is 21,187 sea otters and a CV of 0.064.

CURRENT POPULATION TREND

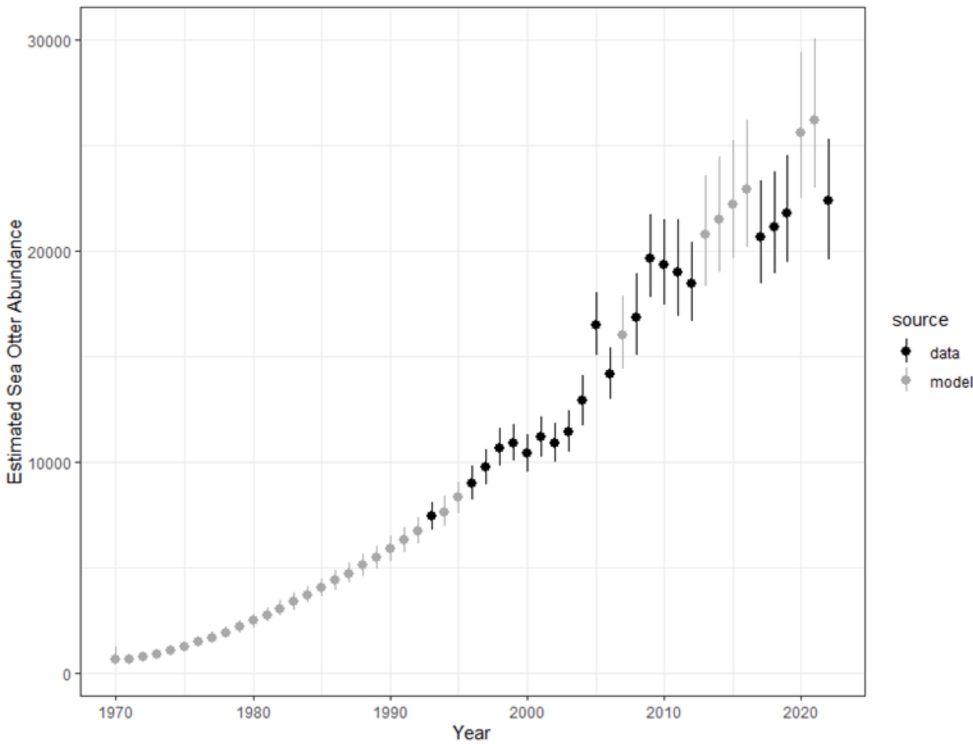

Figure 2. Time series of total abundance estimates from the spatiotemporal model of sea otter population growth and spread in Southeast Alaska since reestablishment (Schuette et al. 2023). Points are posterior means, and segments are 95 percent credible intervals. Note stock-wide surveys were completed over two years for the years 2002-2003 and 2010-2011; whereas other years based on empirical data are from sub-regional surveys at Yakutat (2004) and Glacier Bay (1993, 1995-2006, 2009-2012, and 2017-2019). 2022 was the most recent year of data collection for the entire stock region and is the year used for reporting stock abundance in this SAR. Black points indicate estimates informed by empirical data collection; grey points indicate estimates from model-based predictions.

The trend for this stock of sea otters has generally been one of growth and expansion (Pitcher 1989, Agler et al. 1995, Esslinger and Bodkin 2009, Tinker et al. 2019, Eisaguirre et al. 2021, 2023). The estimated population size (22,359 individuals) of this stock has increased steadily over time (Schuette et al. 2023). While it is important to note that the methodologies and models used to generate population estimates have evolved over time, model predictions and modelling of historical information (or hindcasting) support this increasing population trend for the Southeast stock (Eisaguirre et al. 2021, 2023, Schuette et al. 2023, Figure 2).

MAXIMUM NET PRODUCTIVITY RATE

Eisaguirre et al. (2021) provides the most recent estimate of maximum theoretical net productivity rate (R_{MAX}) for northern sea otter at 0.29 (90 percent Bayesian Credible Interval: 0.28-0.31) based on an assessment of sea otter population dynamics in Southeast Alaska. Given that R_{MAX} is the maximum intrinsic rate of growth achievable by northern sea otters, the value of 0.29 is also applied to calculations used for this Stock Assessment Report. Previously, R_{MAX} values ranging 0.20-0.24 were reported by Estes (1990) were generally accepted to be realistic for northern sea otter (Tinker et al. 2019). Estes (1990) assumed age of first reproduction of 3-4 years and female reproductive rates of 0.43-0.45 per year. However, more recent evidence suggests sea otters are physiologically capable of reproducing, and many do reproduce, at 2 years (von Biela et al. 2009), and female reproductive rates are probably as high as 0.54 (Riedman et al. 1994). Therefore, an R_{MAX} value of 0.29 was used for the Southeast stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the MMPA, the potential biological removal (PBR) is defined as “the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.” (MMPA § 3(20)). Potential biological removal is the product of the minimum population estimate N_{MIN}, one-half the R_{MAX}, and a recovery factor (F_R): PBR = N_{MIN} x $0.5(R_{MAX})$ x F_R.

The F_R value for this stock has been adjusted to account for biases and uncertainties associated with human-caused mortality rates and current and future population trends. There have been no reported rates of incidental mortality and serious injuries associated with commercial fisheries in the U.S. However, this is based on self-reporting and observer programs on vessels that may not overlap with sea otter habitat, and therefore it is difficult to state the full effect of fisheries on the Southeast stock. Reported subsistence harvest rates have declined slightly since 2019, but it is unknown how much underreporting occurs. There is also additional uncertainty to the rate of human-caused mortality associated with oil spills, local boating activity, and increased development in the mariculture industry. Although population levels have been stable or increasing, there is also an unknown degree of error associated with the disparate nature of when these population estimate surveys were conducted.

A F_R value of 0.75 has been adopted for this stock to account for uncertainty and buffer against an underestimate of mortality by approximately 25 percent. Using an $F_R < 1.0$ accounts for the known biases and uncertainties associated with the human-caused mortality rates and future population trends. Thus, the calculated PBR value for the Southeast stock is 2,304 (21,187× 0.5(0.29) × 0.75).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Our best estimate of the average rate of annual human-caused mortality and serious injury for the Southeast stock for the period 2017 through 2021 is 852 sea otters/year, which is below the calculated PBR value of 2,304 sea otters. Self-reported fisheries interactions averaged < 1 sea otter interaction per year. Data for subsistence harvest of sea otters in the Southeast stock are collected by a mandatory Marking, Tagging, and Reporting Program (MTRP) administered by the Service since 1988. Total annual subsistence harvest removals averaged 851 sea otters/year over this same five-year period, which represents approximately 3 percent of N_{MIN}, but is likely an underestimate, as some harvested sea otters are never reported.

The MTRP indicates they have received some anecdotal reports of illegal and unreported harvest around Southeast Alaska, but the extent to which this occurs is unknown. Rates of serious injury and strike and loss are also unknowns not quantified.

Additional factors likely to result in human-caused mortality or serious injury for this stock include oil and gas development and spills, boat strikes, and anthropogenic disturbance-related mortalities associated with fisheries or mariculture farms. Thus, the estimated annual human-caused mortality rate should be considered negatively biased to an unknown degree.

Fisheries Information

A complete list of fisheries and marine mammal interactions is published annually by National Oceanic and Atmospheric Administration (NOAA) Fisheries, the most recent of which was published April 19, 2022 (NOAA Fisheries 2022; 87 FR 23122). Fisheries that have been known to interact with sea otters across their range do occur in Southeast Alaska, including dive-shellfisheries, gillnet fin-fisheries, and pot fisheries for crab, shrimp, and fish. Of those active fisheries in Southeast Alaska with the most overlap and risk to sea otters are the Southeast salmon drift gillnet (474 vessels and/or persons participating), the Yakutat salmon set gillnet (168 vessels and/or persons participating), the Southeast crab pot fishery (375 vessels and/or persons participating), the Southeast shrimp pot fishery (99 vessels and/or persons participating). However, no interactions between sea otters and these fisheries have been self-reported in recent years. Available information suggests that fisheries using other types of gear, such as trawl, longline, and purse seine, are less likely to have interactions with sea otters in Alaska because they operate outside of sea otter habitat, the specific gear used poses little risk to sea otters (e.g., otters are not likely to tangle or get trapped in a longline), or a combination of these factors.

The Marine Mammal Authorization Program database includes self-reported incidences of mortality from fisheries operations. There have been no self-reported interactions with sea otters in Alaska over the past five calendar years (2017–2021). NOAA Fisheries also conducts a marine mammal observer program. Over the last 5 years (2017–2021), there have been no serious sea otter injuries or mortalities in the observed Alaska fisheries. However, there has been no observer effort to document by-catch in the salmon set or drift gillnet fisheries or in the crab or shrimp pot fisheries in Southeast Alaska. Hatfield et al. (2011) suggest that significant sea otter mortality from pot fishery by-catch might easily go undetected, even when seemingly high levels of observer effort exist.

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska is found in fisher self-reports required of vessel owners by NOAA Fisheries. Anecdotal observations have been reported to the Service within the last 5 years, suggesting that sea otters do interact with pot fisheries in Southeast Alaska. Credle et al. (1994) considered fisher self-reports to be a minimum estimate of mortality and serious injury as these data are most likely negatively biased. As sea otters reoccupy portions of their former habitat in Southeast Alaska, co-occurrence with pot fisheries will increase and so will the likelihood of mortalities or serious injury.

In summary, in the last 5-year period (2017-2021) there are few records of mortality and serious injury of sea otters by commercial fisheries within the range of the Southeast stock, no observer records of sea otter mortality or serious injury, and no self-reports of sea otter mortality or serious injury. It is difficult to determine whether these sources of information are comprehensive and to what extent serious injuries to sea otters and mortality goes unreported. Therefore, it is difficult to state the total combined effect of fisheries on the Southeast stock, including whether or not the total fishery mortality and serious injury rate is insignificant and approaching a zero mortality and serious injury rate.

Oil Spills

Activities associated with exploration, development, and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for conserving body heat and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (< 10 percent of body surface), but that greater levels (>25 percent) will lead to death (Costa and Kooyman 1981, Siniff et al. 1982).

There is currently no oil and gas development in Southeast Alaska. Tankers carrying oil south from the Trans-Alaska Pipeline typically travel offshore of Southeast Alaska. Information on oil spills compiled by the Alaska Department of Environmental Conservation from 2010 to 2021 indicates that there were no reported spills of crude oil in Southeast Alaska. In addition to spills that may occur in association with the development, production, and transport of crude oil, each year numerous spills of non-crude oil products in the marine environment occur from ships and shore facilities throughout Southeast Alaska. During that same time period, there was an average of 133 spills each year, ranging in size from less than 1 and up to 17,800 gallons (approximately 4 to 64,600 liters). The vast majority of these spills were small, with a mean size of 46 gallons (1,748 liters), and there is no indication that these small-scale spills have caused mortality or serious injury. Although information is insufficient to estimate an annual rate of mortality and serious injury from oil spills, there is no indication that these small-scale spills have had an impact on the Southeast stock at the population level.

Alaska Native Subsistence Harvest Information

The MMPA exempts Alaska Natives from the prohibition on take of marine mammals, provided such taking is not wasteful and is done for subsistence use or practicing traditional crafts through creation and sale of authentic handicrafts or clothing. It is possible that some harvested sea otters are never reported, and the Service does not currently have a method in place to estimate the amount of unreported harvest that occurs. However, sea otter hides are required to have MTRP tags before they can be commercially tanned, which is thought to help ensure proper reporting. We rely on MTRP as an indication of harvest levels in the Southeast stock.

The mean reported annual subsistence harvest during the past five complete calendar years (2017-2021) was 851 animals (Figure 3). This is a decrease from the previous 5-year mean of 1,218 sea otters/year for 2012-2016. Subsistence harvest reporting should be considered a minimum estimate, as it does not account for underreporting of harvest or correct for struck and lost animals (i.e., attempted to be harvested, but not recovered and tagged). Those factors are known to exist, but since they are not currently monitored in any substantive way, the subsistence harvest data is not corrected to account for them.

Age and sex composition of harvest can influence sea otter population demographics but is not a concern at the current harvest level (Bodkin and Ballachey 2010). Reported age composition of harvested sea otters from 2017 to 2021 was 87 percent adults, 11 percent subadults, 1 percent pups, and 1 percent undetermined. Sex composition during that period was 64 percent males, 35 percent females, and 1 percent of undetermined sex.

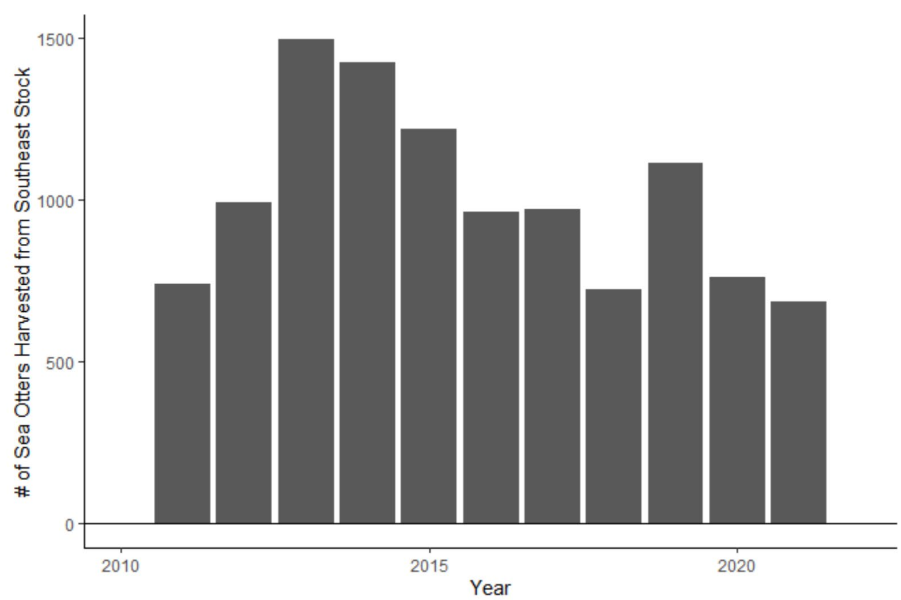

Figure 3. Reported annual subsistence harvest of northern sea otters from the Southeast stock, 2011 to 2021.

Illegal Take

The extent to which sea otters are illegally killed as a result of conflict with fisheries-related activities is unknown. The Service's Law Enforcement office maintains records of the number of prosecutions for unlawful take, possession, transport, or sale of sea otters or sea otter hides. From 2017-2021, there were two illegal instances of take of sea otters, but the origin of the incident, nature of the takes, or the number of sea otters taken in these incidents is unknown. The Service does not currently have a method for quantifying illegal take of northern sea otters.

Research and Public Display

In the past 5 years, no sea otters were removed from the Southeast stock for research or public display.

Boat Strike

The Service maintains a baseline stranding program to determine cause of death, disease incidence, and status of general health parameters. However, the stranding program receives few carcasses from the Southeast stock. Despite the spatial imbalance of stranding reporting, boat strike is considered a recurring potential cause of mortality and serious injury across all three stocks (Burek-Huntington et al. 2021), so it is useful to summarize what is known about boat strikes in Southcentral to assess the potential risk to the Southeast stock. In Kachemak Bay, boat strikes have been the most commonly encountered human-inflicted injury (Burek-Huntington et al. 2021). Necropsies of boat-struck sea otters have revealed that although trauma was the ultimate cause of death, disease or biotoxin exposure likely incapacitated the animal and made it more vulnerable to boat strike (Lefebvre et al. 2016, Burek-Huntington et al. 2021). Due to the limited spatial extent of the stranding program outside of Kachemak Bay in the Southcentral stock, the rate of sea otter mortality and serious injury related to boat strikes is unknown for the Southeast stock.

Mariculture

Mariculture is defined as the farming of aquatic plants, such as kelps and other macro-algae, fish, and shellfish in salt water (Monson and Degange 1988). Aquatic farms specializing in cultivating macro-algae and various shellfish species have been increasing in Alaska since 1988 when the Aquatic Farm Act (Alaska Statutes 16.40.100-199) was passed by the Alaska Legislature (Alaska Mariculture Task Force 2018). Over the next 30 years, Alaska's mariculture industry grew slowly, and annual production was approximately $1 million in 2018 (Alaska Mariculture Task Force 2018). It is unknown how current mariculture activities influence the Southeast stock and how these interactions will change under various scenarios of industry growth. The Service has developed a Mariculture Working Group to better understand mariculture activities and to take a proactive role in helping reduce any potential negative sea otter-farm interactions. A recent review of self-reporting to the State of Alaska revealed conflicts between sea otters and mariculture operations in Kachemak Bay and described measures taken by operators (e.g., maintaining a human physical presence to discourage and mitigate sea otter impacts), which may have disturbed some Southcentral sea otters (Rehberg and Goodglick 2023). Future monitoring of reporting and outreach to mariculture operators about legal and sustainable pathways to resolving sea otter conflicts, in collaboration with state agencies tasked with oversight will be essential to reducing conflict with sea otters.

OTHER MORTALITY SOURCES

Predation

Sea otter predation occurs in all three stocks from killer whales, wolves, bears, and eagles on pups. Where sea otters have recolonized and frequently haul out, they become susceptible to terrestrial predators such as bears and wolves (Monson 2021, Roffler et al. 2021); however, terrestrial predators are unlikely to have stock-wide population impacts (Monson 2021). Eagle predation primarily occurs on pups less than 1 month old, and experienced sea otter mothers will alter behavior to minimize eagle predation risk to pups (Esslinger et al. 2014). While the population-level impacts from predators are generally hard to discern, predation from killer whales was a driver of population dynamics for the Southwest stock (USFWS 2020, Tinker et al. 2021). Killer whales have been observed preying upon sea otters in the Southeast stock (e.g., Glacier Bay National Park); however, the predation does not appear to be impacting the Southeast stock at this time.

Biotoxins

Biotoxins are compounds produced by algae (dinoflagellates and diatoms) that can reach high levels under certain conditions known as harmful algal blooms (HAB). HABs occur most often in warm water conditions, but biotoxins can occur in the environment at high levels at any time, particularly in bivalve mollusks. Biotoxins associated with HABs that cause significant illness and mortality in marine mammal species, including neurotoxins domoic acid and saxitoxin, are an emerging concern in Alaska as sea surface temperatures increase (Burek et al. 2008).

While sea otters are at risk for exposure and uptake of biotoxins as detected in Kachemak Bay (Bowen et al. 2022) and around the State of Alaska (Lefebvre et al. 2016), it is unknown how the concentrations reported in sea otters to date relate to concentrations known to cause clinical signs of toxicity or mortality in other animals. Therefore, the population-level health effects to sea otters are not well understood and while the population shows an increasing trend, it is unknown how the frequency and severity of HABs influence sea otter demographics.

Pathogens

Pathogens (bacteria, fungi, viruses, parasites) can exert population-level effects through increased rates of mortality and reducing fertility or fecundity. Individual health and susceptibility to disease is a complex interaction of several factors such as immune status, body condition, and environmental conditions (Burek et al. 2008). Climate change is also increasing the prevalence of existing pathogens and introducing new pathogens to arctic and sub-arctic animal populations (Harvell et al. 1999, Dudley et al. 2015). However, due to the lack of information on sea otter health statewide in Alaska and the uncertainty in how a changing climate will influence distribution of pathogens and sea otter vulnerability to them, it is difficult to predict the impact pathogens will have at the stock level in the future.

STATUS OF STOCK

The Southeast stock is not designated as depleted under the MMPA, nor is it listed as threatened or endangered under the U.S. Endangered Species Act. Currently the stock is classified as non-strategic, per the MMPA. There is insufficient information to determine if incidental mortality and serious injury related to commercial fisheries is zero or approaching zero, as the information that exists is based on self-reporting. However, the best available information indicates that fishery-related mortality and serious injury is likely low. Current sea otter harvest levels are within a sustainable range. The reported annual human-caused removals average 851 sea otters/year. The total known human-caused removals are below the calculated PBR level of 2,304 sea otters/year. Therefore, the Southeast stock remains classified as non-strategic under the MMPA.

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