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SPOTTED SEAL (*Phoca largha*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spotted seals are distributed along the continental shelf of the Bering, Chukchi, and Beaufort seas, and the Sea of Okhotsk south to the western Sea of Japan and northern Yellow Sea (Fig. 11). Eight main areas of spotted seal breeding have been reported (Shaughnessy and Fay 1977). On the basis of small samples and preliminary analyses of genetic composition, potential geographic barriers, and significance of breeding groups Boveng et al. (2009) grouped those breeding areas into three Distinct Population Segments (DPSs): The Bering DPS, which includes areas in the Beaufort, Chukchi and East Siberian seas; the Okhotsk DPS; and the Southern DPS, which includes spotted seals breeding in the Yellow Sea and Peter the Great Bay in the Sea of Japan. For the purposes of this stock assessment the Bering DPS is considered the Alaska stock of the spotted seal.

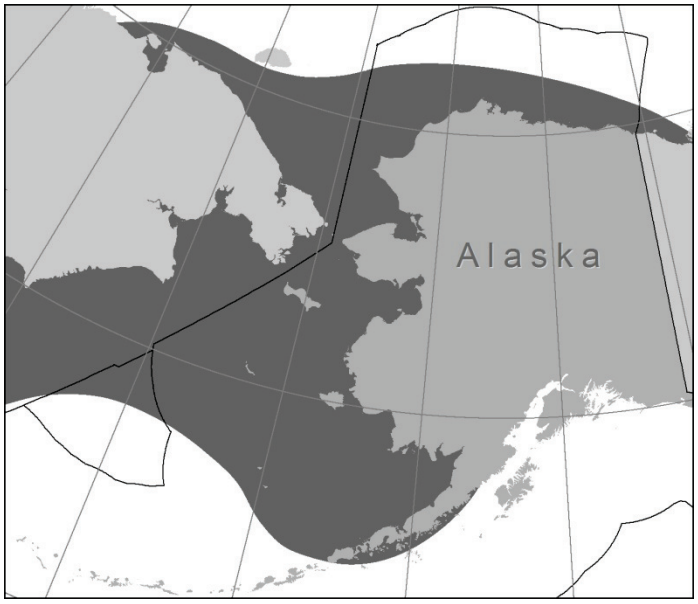

Figure 11. Approximate distribution of spotted seals (shaded area).

Satellite tagging studies showed that seals tagged in the northeastern Chukchi Sea moved south in October and passed through the Bering Strait in November. Seals overwintered in the Bering Sea along the ice edge and made east-west movements along the edge (Lowry et al. 1998). During spring they tend to prefer small floes (i.e., < 20 m in diameter), and inhabit mainly the southern margin of the ice in areas where the water depth does not exceed 200 m, and move to coastal habitats after the retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977, Lowry et al. 2000, Simpkins et al. 2003). In summer and fall, spotted seals use coastal haulouts regularly (Frost et al. 1993, Lowry et al. 1998), and may be found as far north as 69-72°N in the Chukchi and Beaufort Seas (Porsild 1945, Shaughnessy and Fay 1977). To the south, along the west coast of Alaska, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands. Spotted seals are closely related to and often mistaken for Pacific harbor seals (*Phoca vitulina richardsi*). The two species are often seen together and are partially sympatric, as their ranges overlap in the southern part of the Bering Sea (Quakenbush 1988). Yet, spotted seals breed earlier and are less social during the breeding season, and only spotted seals are strongly associated with pack ice (Shaughnessy and Fay 1977). These and other ecological, behavioral, genetic, and morphological differences support their recognition as two separate species (Quakenbush 1988).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of spotted seals into more than one stock. Therefore, only the Alaska stock is recognized in U.S. waters.

POPULATION SIZE

A reliable estimate of the Alaska stock of spotted seal abundance is currently not available (Boveng et al. 2009). A joint U.S.-Soviet effort in 1976 was the most thorough ice seal survey of the southeastern Bering Sea to date (Braham et al. 1984) and produced an unstratified density estimate of spotted seals of 0.37 per nmi^2. Abundance estimates for that region were reported as 10,876 (stratified) and 13,125 (unstratified); however, only seals on the ice were counted, and no adjustment was made for seals in the water. Results were reported primarily in units of seals sighted per unit of surveying time and therefore do not represent abundance estimates.

Based on extensive surveys of the Bering Sea ice in 1987, Fedoseev et al. (1988) reported a minimum estimate of 100,000 spotted seals in the Bering Sea, based on raw counts of 432 spotted seals in April and 179 in May. Four aerial surveys in the western Bering Sea during 1974-1987 produced abundance estimates ranging between 78,000 and 143,000 spotted seals (Fedoseev 2000), with a multi-year average of 140,000 seals. Burkanov et al. (1988) criticized the aerial survey methods used by Fedoseev and others during 1979 and 1987 in the western Bering Sea and argued that significant errors may have resulted from incorrect determinations of the area inhabited by seals.

The Alaska Fisheries Science Center's National Marine Mammal Laboratory (NMML) conducted aerial surveys of the Bering Sea pack ice in 1992 and calculated the density of spotted seals to be 0.28 seals/nmi^2 (Rugh et al. 1995). These surveys were shore based and limited to the areas around Bristol Bay, Nunivak Island, and between Nome and St. Lawrence Island and were not adjusted for seals in the water. More thorough aerial surveys by NMML in 2007 were conducted from U.S. Coast Guard icebreakers that provided greater access to the central and eastern Bering Sea pack ice (Ver Hoef et al. *in review*). Frequencies of sightings data and information on ice distribution and the timings of seal haul-out behavior were analyzed to develop a population estimate of 141,479 (95% CI 92,769-321,882) spotted seals in the areas surveyed within the eastern and central Bering Sea (Ver Hoef et al. *in review*).

Minimum Population Estimate

A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available.

Current Population Trend

Frost et al. (1993) report that counts of spotted seals were relatively stable at Kasegaluk Lagoon from the mid-1970s through 1991. As this represents only a fraction of the stock's range and the likelihood that these data are outdated, reliable data on trends in population abundance for the Alaska stock of spotted seals are considered unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of spotted seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the 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 pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with spotted seals. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Prior to 2004, there were no incidental serious injuries and mortalities of spotted seals in any of the observed fisheries. The Bering Sea/Aleutian Islands flatfish trawl fishery is the only known observed commercial fishery to incur mortalities of spotted seals, with an average of 1.00 (CV = 0.01) seals per year for the period 2007-2009 (Table 15a).

The estimated minimum mortality rate incidental to commercial fisheries is 1.0 animals per year. However, serious injury and mortality of harbor seals incidental to commercial fisheries has occurred within the past five years, and because it is virtually impossible to distinguish between these two species, some of the reported

harbor seal takes may actually have been spotted seals. Further, no observer programs have been done on nearshore Bristol Bay fisheries that are known to interact with this stock, making the total mortality due to fisheries unknown.

Table 15a. Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 2007 through 2009 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Range of Observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea flatfish trawl	2007 2008 2009	obs data	72 100 100	0 2 1	0 2.0 1.0	1.00 (CV = 0.01)
Minimum total annual mortality						1.00 (CV = 0.01)

Subsistence/Native Harvest Information

Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions, with historical estimated annual harvests ranging from 850 to 3,600 seals (averaging about 2,400 annually) taken during 1966-76 (Lowry 1984).

Few studies give a statewide estimate of subsistence take. The Division of Subsistence, Alaska Department of Fish and Game and the Alaska Native Harbor Seal Commission has reported subsistence harvest levels of harbor seals and sea lions annually (e.g., Wolfe et al. 2009b). Harvest data were reported from 63 coastal communities, including 6 communities from north Bristol Bay. Due to seasonal geographic overlap in spotted and harbor seal distribution in northern Bristol Bay in combination with the difficulty in distinguishing the two species from external morphology, reports of harvests of spotted seals were differentiated from harbor seals based on ecological features of the kill, primarily degree of association with seasonal ice (Wolfe et al. 2008). As of 2009, data on community subsistence harvests are no longer being collected, so the estimates from 2004-2008 will be used to estimate the annual harvest for the most recent 5-year period. The estimates given in Table 15b represent the best estimate of the subsistence harvest of spotted seals, although species identifications were not confirmed; therefore, the harvest estimates for spotted seals may include some harbor seals, and some spotted seals may have been recorded as harbor seals (Wolfe et al. 2009b).

The mean annual subsistence harvest in north Bristol Bay from this stock over the 5-year period from 2004 through 2008 was 193 spotted seals per year (Table 15b).

Table 15b. Summary of the subsistence harvest data for spotted seals from six coastal villages in northern Bristol Bay, 2002-2006.

Year	Estimated total number taken	Number harvested	Number struck and lost
2004	170[1]	124	46
2005	201[2]	170	31
2006	170[3]	140	30
2007	153[4]	137	16
2008	271[5]	213	58
Mean annual take (2004-2008)	193	157	36

[1] Wolfe et al. 2005; [2] Wolfe et al. 2006; [3] Wolfe et al. 2008; [4] Wolfe et al. 2009a; [5] Wolfe et al. 2009b.

The Division of Subsistence, Alaska Department of Fish and Game, maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of spotted seals has been compiled for 135 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-98 were used. As of

August 2000; the subsistence harvest database indicated that the estimated number of spotted seals harvested for subsistence use per year is 5,265.

At this time, there are no efforts to quantify the total statewide level of harvest of spotted seals by all Alaska communities.

A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 5,265 spotted seals is the best estimate of harvest level currently available.

STATUS OF STOCK

Spotted seals in Alaska are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Because the PBR for spotted seals is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. Due to a minimal level of interactions between U.S. commercial fisheries and spotted seals, the Alaska stock of spotted seals is not considered a strategic stock.

On 28 March 2008, NMFS initiated a status review of the spotted seal (73 FR 16617). On 28 May 2008, NMFS received a petition to list spotted seals under the ESA, primarily due to concern about threats to this species' habitat from loss of sea ice and climate change in the Arctic. NMFS found that the petition presented sufficient information to consider listing and proceeded with the status review (73 FR 51615, 4 September 2008). After the status review was complete (Boveng et al. 2009), NMFS determined that listing the Bering and Okhotsk DPSs of spotted seals was not warranted at this time. The Southern DPS, however, was proposed for listing as "threatened" under the ESA (74 FR 53683, 20 October 2009). After fully considering comments from peer reviewers and the public, NMFS issued a final rule listing the Southern DPS as "threatened" on 22 October 2010 (75 FR 65239).

Habitat Concerns

The main concern about the conservation status of spotted seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Boveng et al. 2009). Despite the recent dramatic reductions in Arctic Ocean ice extent during summer, the sea ice in the Bering Sea is expected to continue forming annually in winter for the foreseeable future, There will likely be more frequent years in which ice coverage is reduced, resulting in a decline in the long-term average ice extent, but Bering Sea spotted seals will likely continue to encounter sufficient ice to support adequate vital rates. Even if sea ice were to vanish completely from the Bering Sea, there may be prospects for spotted seals to adjust their breeding grounds to follow the northward shift of the annual ice front into the Chukchi Sea. Laidre et al. (2008) concluded that on a worldwide basis spotted seals were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate.

A second major concern, related by the common driver of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased CO_2 in the atmosphere, may impact spotted seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Because of spotted seals' apparent dietary flexibility, this threat should be of less immediate concern than the direct effects of sea-ice degradation (Boveng et al. 2009).

Additional habitat concerns include the potential effects from oil and gas exploration activities, particularly in the outer continental shelf leasing areas, such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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