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BEARDED SEAL (*Erignathus barbatus nauticus*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are a boreoarctic species with a circumpolar distribution (Fedoseev 1965; Johnson et al. 1966; Burns 1967, 1981; Burns and Frost 1979; Smith 1981; Kelly 1988). Their normal range extends from the Arctic Ocean (85°N) south to Sakhalin Island (45°N) in the Pacific and south to Hudson Bay (55°N) in the Atlantic (Allen 1880, Ognev 1935, King 1983). Bearded seals inhabit the seasonally ice-covered seas of the Northern Hemisphere, where they whelp and rear their pups and molt their coats on the ice in the spring and early summer. Bearded seals feed primarily on benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes and so are closely linked to areas where the seafloor is shallow (less than 200 m).

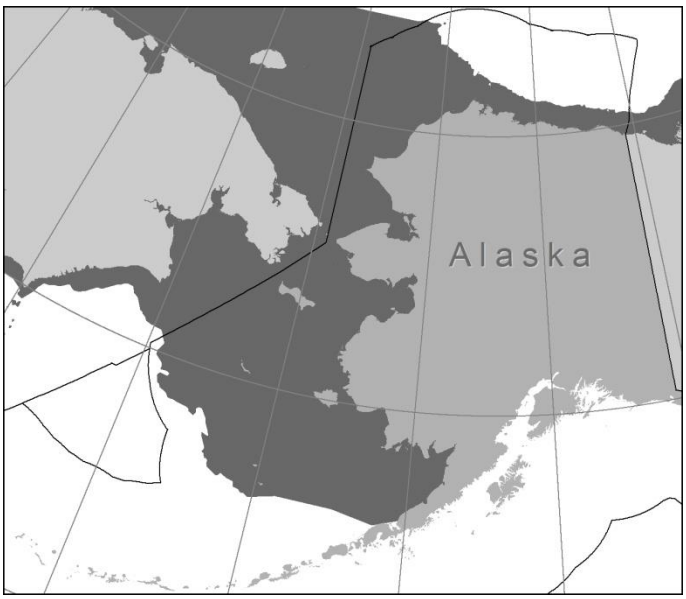

Figure 1. Approximate distribution of bearded seals (dark shaded area) in Alaska. The combined summer and winter distribution are depicted.

Two subspecies have been described: *E. b. barbatus* from the Laptev Sea, Barents Sea, North Atlantic Ocean, and Hudson Bay (Rice 1998); and *E. b. nauticus* from the remaining portions of the Arctic Ocean and the Bering and Okhotsk seas (Ognev 1935, Scheffer 1958, Manning 1974, Heptner et al. 1976). The geographic distributions of these subspecies are not separated by conspicuous gaps, and there are regions of intergrading generally described as somewhere along the northern Russian and central Canadian coasts. As part of a status review of the bearded seal for consideration of listing as "threatened" or "endangered," Cameron et al. (2010) defined longitude 145°E as the Eurasian delineation between the two subspecies and 112°W in the Canadian Arctic Archipelago as the North American delineation between the two subspecies. Based on evidence for discreteness and ecological uniqueness of bearded seals in the Sea of Okhotsk, the *E. b. nauticus* subspecies was further divided into an Okhotsk Distinct Population Segment (DPS) and a Beringia DPS, so named because the continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian seas that are the bearded seals' range in this region overlie much of the land bridge that was exposed during the last glaciation and that has been referred to as Beringia. For the purposes of this stock assessment the Beringia DPS is considered the Alaska stock of the bearded seal (Fig. 1).

Spring surveys conducted in 1999 and 2000 along the Alaskan coast indicate that bearded seals are typically more abundant 20-100 nmi from shore than within 20 nmi of shore, with the exception of high concentrations nearshore to the south of Kivalina (Bengtson et al. 2000, 2005; Simpkins et al. 2003). Many of the seals that winter in the Bering Sea move north through the Bering Strait from late April through June and spend the summer in the Chukchi Sea (Burns 1967, 1981). Bearded seal sounds (produced by adult males) have been recorded nearly year-round (peak occurrence from December to June when sea ice concentrations were >50%) at multiple locations in the Bering, Chukchi, and Beaufort seas, and calling behavior is closely related to the presence of sea ice (MacIntyre et al. 2013, 2015). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals, mostly juveniles, may not follow the ice northward but remain near the coasts of the Bering and Chukchi seas (Burns 1967, 1981; Heptner et al. 1976; Nelson 1981). As the ice forms again in the fall and winter, most seals move south with the advancing ice edge through the Bering Strait into the Bering Sea where they spend the winter (Burns and Frost 1979; Frost et al. 2005, 2008; Cameron and Boveng 2007, 2009). This southward migration is less noticeable and predictable than the northward movements in late spring and early summer (Burns and Frost 1979, Burns 1981, Kelly 1988). During winter, the central and northern parts of the Bering Sea shelf have the highest densities of bearded seals (Fay 1974, Heptner et al. 1976, Burns and Frost 1979, Braham et al. 1981, Burns 1981, Nelson et al. 1984). In late winter and early spring, bearded seals are widely but not uniformly

distributed in the broken, drifting pack ice ranging from the Chukchi Sea south to the ice front in the Bering Sea. In these areas, they tend to avoid the coasts and areas of fast ice (Burns 1967, Burns and Frost 1979).

POPULATION SIZE

A reliable population estimate for the entire stock is not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. In spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 299,174 (95% CI: 245,476-360,544) bearded seals in those waters. These data do not include bearded seals in the Chukchi and Beaufort seas.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for a stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. A reliable N_{MIN} for the entire stock cannot presently be determined because current reliable estimates of abundance are not available for the Chukchi and Beaufort seas. Using the 2012 Bering Sea abundance estimate by Conn et al. (2014), however, provides a partial N_{MIN} of 273,676 bearded seals in the U.S. sector of the Bering Sea.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of bearded seals are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of bearded 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 PBR is defined as the product of the minimum population estimate (N_{MIN}), 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). Using the partial N_{MIN} calculated for bearded seals in the Bering Sea, a partial PBR for bearded seals that overwinter and breed in the U.S. portion of the Bering Sea = 8,210 ($273,676 \times 0.06 \times 0.5$). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available for the entire stock (i.e., N_{MIN} is not available for the Chukchi or Beaufort seas), the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality and serious injury by fisheries observers, 12 fisheries could potentially interact with bearded seals. Between 2009 and 2013, incidental serious injury and mortality of bearded seals occurred in three of these fisheries: the Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands flatfish trawl, and Bering Sea/Aleutian Islands Pacific cod trawl fisheries (Table 1). The estimated minimum mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is 1.2 bearded seals, based exclusively on observer data.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of bearded seals due to U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	1 0 (+1)[a] 0 1 0	1.0 0 (+1)[b] 0 1.0 0	0.6 (CV = N/A)
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 1 1 0	0 0 1.0 1.0 0	0.4 (CV = 0.03)
Bering Sea/Aleutian Is. Pacific cod trawl	2009 2010 2011 2012 2013	obs data	63 66 60 68 80	0 0 0 0 1	0 0 0 0 1	0.2 (CV = 0)
Minimum total estimated annual mortality						1.2 (CV = 0.03)

[a]Total mortality and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul.
[b]Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Alaska Native Subsistence/Harvest Information

Bearded seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2); but more than 50 other communities harvest bearded seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for bearded seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of bearded seals in 2009-2013 is 379 seals. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Bearded seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	Alaska Native population (2013)	Estimated bearded seal harvest				
		2009	2010	2011	2012	2013
Kivalina	352			123		
Noatak	514			65		
Buckland	519			47		
Deering	176			49		
Emmonak	782			106		
Scammon Bay	498			82	51	
Hooper Bay	1,144	332	148	210	212	171
Tununak	342	21	40	42	44	
Quinhagak	694		29	26	44	49
Togiak	842	0	0	2		
Twin Hills	66	0	0			
Total		353	217	752	351	220

Other Mortality

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 2007 and 2011, one mortality resulted from research on the Alaska stock of bearded seals (in 2007), which results in an average annual mortality and serious injury rate of 0.2 bearded seals from this stock (Division of Permits and Conservation, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910, 11 January 2012).

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, walrus, and a few bearded seals, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified.

STATUS OF STOCK

The primary concern for this population is the ongoing and projected loss of sea-ice cover stemming from climate change, which is expected to pose a significant threat to the persistence of these seals in the foreseeable future (based on projections through the end of the 21st century). On December 28, 2012, NMFS listed the Beringia DPS and, thus, the Alaska Stock of bearded seals, as "threatened" under the Endangered Species Act (ESA) (77 FR 76740). Because of its "threatened" status under the ESA, this stock was designated as "depleted" under the MMPA and was classified as a strategic stock. On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The decision vacated NMFS' listing of the Beringia DPS of bearded seals as a "threatened" species. Consequently, it is also no longer designated as "depleted" or classified as a strategic stock. Because the PBR for the entire stock is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. A partial PBR for only those bearded seals that overwinter and breed in the U.S. portion of the Bering Sea, however, is 8,210. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (1.2), the most recent MMPA permit records (0.2), and a minimum estimate of the Alaska Native harvest (379) is 380 bearded seals. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

The main concern about the conservation status of bearded seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific projections are for continued and perhaps accelerated warming in the foreseeable future (Cameron et al. 2010). For bearded seals, the presence of sea ice is considered a requirement for whelping and nursing young. Similarly, the molt is believed to be promoted by elevated skin temperatures that, in polar regions, can only be achieved when seals haul out of the water. Thus, if suitable ice cover is absent from shallow feeding areas during times of peak whelping and nursing (April/May), or molting (May/June and sometimes through August), bearded seals would be forced to seek either sea-ice habitat over deeper waters (perhaps with poor access to food) or coastal regions in the vicinity of haul-out sites on shore (perhaps with increased risks of disturbance, predation, and competition). Both scenarios would require bearded seals to adapt to novel (i.e., potentially suboptimal) conditions, and to exploit habitats to which they may not be well adapted, likely compromising their reproduction and survival rates. A reliable assessment of the future conservation status of each bearded seal species segment requires a focus on projections of specific regional conditions, especially sea ice. End of century projections for the Bering Sea in April-May suggest that there will be sufficient ice only in small zones of the Gulf of Anadyr and in the area between St. Lawrence Island and the Bering Strait. In June in the Bering Sea, suitable ice is predicted to disappear as early as mid-century. To adapt to this regime, bearded seals would likely have to shift their nursing, rearing, and molting areas to the ice-covered seas north of the Bering Strait. Laidre et al. (2008) also concluded that on a worldwide basis bearded seals were likely to be highly sensitive to climate change based on an analysis of various life history features that could be affected by climate.

A second major concern, driven primarily by the production 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 carbon dioxide in the atmosphere, may impact bearded 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. Changes in bearded seal prey, anticipated in response to ocean warming and loss of sea ice, have the potential for negative impacts, but the possibilities are complex. Ecosystem responses may have very long lags as they propagate through trophic webs. Because of bearded seals' apparent dietary flexibility, this threat may be of less immediate concern than the threats from sea-ice degradation.

Additional habitat concerns include the potential effects from increased shipping (particularly in the Bering Strait), and 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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