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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, Burns and Frost 1979, Burns 1981, 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).

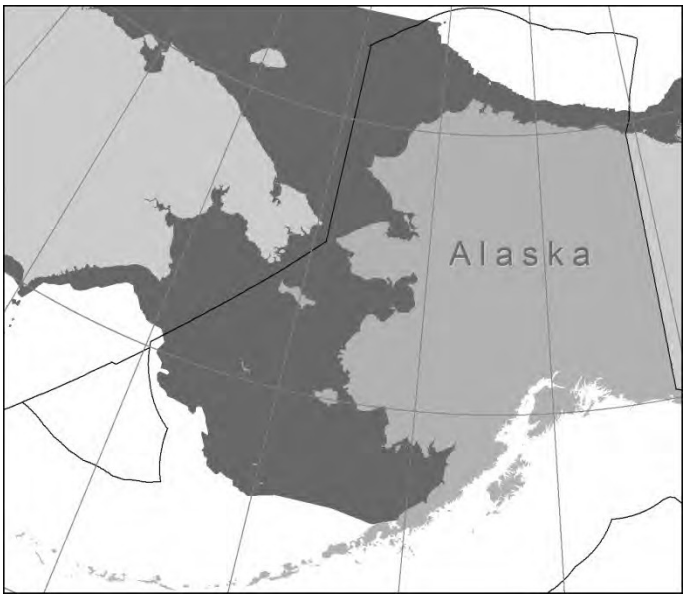

Figure 11. Approximate distribution of bearded seals (shaded area) in Alaska. The combined summer and winter distribution are depicted.

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 112° W in the Canadian Arctic Archipelago as the North American delineation between the two subspecies and 145° E as the Eurasian 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.

Spring surveys conducted in 1999 and 2000 along the Alaskan coast indicate that bearded seals tend to prefer areas of between 70% and 90% sea ice coverage, and 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; Bengtson et al. 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 along the ice edge in the Chukchi Sea (Burns 1967, Burns 1981), although aerial surveys and tagging data suggest they hang out in open water with the loss of ice edge in the Chukchi in summer months. Bearded seals sounds (produced by adult males) have been recorded year-round at multiple locations in the Beaufort Sea and calling behavior is closely related to the presence of sea ice (MacIntyre et al. 2013). 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, Heptner et al. 1976, Burns 1981, 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, Cameron and Boveng 2007, Frost et al. 2008, Cameron and Boveng 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 this stock is currently considered not available. A few regions have been surveyed by various techniques over the past four decades, although only crude estimates for these areas exist and many assumptions used to derive these estimates are conservative (e.g., seals in the water were often not included, some areas were not surveyed or were omitted from the analysis). However, based on studies by Ver Hoef et al. (2010), Fedoseev (2000) and Bengtson et al. (2005), Cameron et al. (2010) estimated about 125,000 bearded seals in the Bering Sea and 27,000 bearded seals in the Chukchi Sea. Cameron et al. (2010) did not present population estimates for the East Siberian and Beaufort Seas, but did estimate that the Beringia DPS contained approximately 155,000 bearded seals. This number is considered a crude estimate based on multiple surveys using various techniques over the past four decades, which involved conservative assumptions. However, given that these numbers are outdated, this estimate cannot necessarily be considered strictly minimum or conservative overall (Cameron et al. 2010).

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

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 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 minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality.*" Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with bearded seals and 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 3 fisheries into 12 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. Between 2007 and 2011, there were incidental serious injuries and mortalities

of bearded seals in the Bering Sea/Aleutian Islands pollock trawl and the Bering Sea/ Aleutian Islands flatfish trawl fisheries (Table 23). The estimated minimum mortality rate incidental to commercial fisheries is 1.8 (CV = 0.05) bearded seals per year, based exclusively on observer data.

Table 23. Summary of incidental mortality of bearded seals (Alaska stock) due to commercial fisheries from 2007 to 2011 and calculation of the mean annual mortality rate (Breiwick 2013). Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. pollock trawl	2007	obs data	85	1	1.0	1.4 (CV = 0.06)
	2008		85	4	4.1	
	2009		86	1	1.0	
	2010		86	0 (+1)*	0 (1)**	
	2011		98	0	0	
Bering Sea/ Aleutian Islands flatfish trawl	2007		72	0	0	0.4 (CV = 0.03)
	2008		100	1	1.0	
	2009		100	0	0	
	2010		100	0	0	
	2011		100	1	1.0	
Total estimated annual mortality						1.8 (CV = 0.05)

*Total mortalities observed in unsampled hauls.
**Total mortalities observed in sampled and unsampled hauls. Since the total known mortality (1) exceeds the estimated mortality (0) for 2010, the sum of actual mortalities observed (1) will be used as a minimum estimate for that year.

Subsistence/Native Harvest Information

Bearded seals are an important species for Alaska subsistence hunters, with estimated annual harvests of 1,784 (SD = 941) from 1966 to 1977 (Burns 1981). Between August 1985 and June 1986, 791 bearded seals were harvested in five villages in the Bering Strait region based on reports from the Alaska Eskimo Walrus Commission (Kelly 1988). Five Alaska Native communities in the Northwest Arctic region of Alaska voluntarily reported a total of 258 bearded seals were harvested during 2012 (Ice Seal Committee 2013).

The Division of Subsistence, Alaska Department of Fish and Game maintained 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 bearded seals was compiled for 129 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 to 1998 were used. As of August 2000, the subsistence harvest database indicated that the estimated number of bearded seals harvested for subsistence use per year was 6,788. Data on overall statewide community subsistence harvests are no longer being collected and no new annual statewide harvest estimates exist.

At this time, there are no efforts to quantify the total statewide level of harvest of bearded 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. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 6,788 bearded seals estimated by the ADFG Division of Subsistence is considerably higher than the previous minimum estimate of 791 per year from five villages in the Bering Strait and the recent report of 258 seals harvested during 2012 by five northwest Alaska Native communities. 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 6,788 bearded seals from 2000 is the best estimate of the total statewide annual harvest level currently available.

Other Mortality

Mortalities 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 2007-2011, there was 1 mortality resulting from research on the Alaska stock of bearded seals (2007), which results in an average of 0.2 mortalities per year from this stock (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910, 11 January 2012).

STATUS OF STOCK

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). 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). Because of its threatened status under the ESA, this stock is designated as "depleted" under the MMPA. As a result, the stock is classified as a strategic stock. Because the PBR 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. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (1.8), recent MMPA permit records, and Alaska Native harvest (6,788) is 6,790. Population trends and status of this stock relative to OSP 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., 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 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 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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