

POLAR BEAR (*Ursus maritimus*): Southern Beaufort Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Polar bears are circumpolar in their distribution in the northern hemisphere. They occur in several largely discrete stocks or populations (Harington 1968). Polar bear movements are extensive and individual activity areas are enormous (Garner et al. 1990, Amstrup et al. 2000). The parameters used by Dizon et al. (1992) to classify stocks based on the phylogeographic approach were considered in the determination of stock separation in Alaska. Several polar bear stocks are known to be shared between countries (Amstrup et al. 1986, Amstrup and Demaster 1988). Lentfer hypothesized that two Alaska stocks exist, the Southern Beaufort Sea, and the Chukchi/Bering Seas, based upon: (a) variations in levels of heavy metal contaminants of organ tissues (Lentfer 1976, Lentfer and Galster 1987); (b) morphological characteristics (Manning 1971; Lentfer 1974; Wilson 1976); (c) physical oceanographic features which segregate stocks (Lentfer 1974) and; (d) movement information collected from mark and recapture studies of adult female bears (Lentfer 1983) (Figure 1). Information on contaminants (Woshner et al. 2001, Evans 2004a, Evans 2004b, Kannan et al. 2005, Smithwick et al. 2005, Verreault et al. 2005, Muir et al. 2006, Smithwick et al. 2006, Kannan et al. 2007, Rush et al. 2008) and movement data using satellite collars (Amstrup et al. 2004, Amstrup et al. 2005) continue to support the existence of these two stocks.

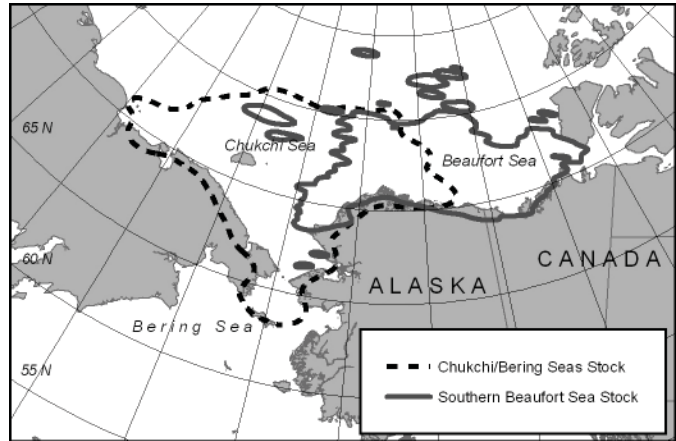


Figure 1. Map of the Southern Beaufort Sea and the Chukchi/Bering seas polar bear stocks.

Amstrup et al. (2000) demonstrated that the eastern boundary of the Southern Beaufort Sea stock occurs south of Banks Island and east of the Baillie Islands, Canada. The bears in the Northern Beaufort Seas and Southern Beaufort Sea populations spend the summer on pack ice and move toward the coast during fall, winter, and spring (Durner et al. 2004). The range of the two populations previously overlapped extensively in the vicinity of the Baillie Islands, Canada (Amstrup 2000) but recent data no longer support this degree of overlap (Amstrup et al. 2005). Recent analysis of polar bear movements using satellite telemetry from 2000 to 2006 (Amstrup et al. 2004, Amstrup et al. 2005), capture and recapture data (Regehr et al. 2006, Stirling et al. 2007), and harvest information suggest that the eastern population boundary has shifted westward to near the village of Tuktoyaktuk, Canada. The assignment of this new boundary could be adjusted somewhat based on local management considerations; however, it will probably necessitate a downward readjustment of the population size of the Southern Beaufort Sea stock to correspond with the smaller geographic area. The proposed boundary change is under consideration and has not been accepted by the parties to the Polar Bear Management Agreement for the Southern Beaufort Sea between the Inuvialuit Game Council of Canada and the North Slope Borough of Alaska. For the purposes of this report, we continue to use the previously published boundaries for the Southern Beaufort Sea population delineated by Bethke et al. (1996). The western boundary is near Point Hope. An extensive area of overlap between the Southern Beaufort Sea stock and the Chukchi/Bering seas stock occurs between Point Barrow and Point Hope, centered near Point Lay (Garner et al. 1990, Garner et al. 1994, Amstrup et al. 2000). Telemetry data indicates that adult female polar bears marked in the Southern Beaufort Sea spend about 25% of their time in the northeastern Chukchi Sea, whereas females captured in the Chukchi Sea spend only 6% of their time in the Southern Beaufort Sea (Amstrup 1995). However, polar bears are not dispersed evenly throughout their range. To access ringed and bearded seals, polar bears in the Southern Beaufort Sea concentrate in shallow waters less than 300 m deep over the continental shelf and in areas with >50% ice cover (Stirling et al. 1999, Durner et al. 2004, Durner et al. 2006a, Durner et al. 2009). Polar bears from this population have historically denned on both the sea ice and land. Thinning of the sea ice in recent years has caused a decline in the number of polar bears denning on the sea ice. Fischbach et al. (2007) found that the proportion of dens on the pack ice declined from 62% from 1985–1994 to 37% in 1998–2004. The main terrestrial denning areas for the Southern Beaufort Sea population in Alaska occur on the barrier islands from Barrow to Kaktovik and along coastal areas up to 25 miles inland including the Arctic National Wildlife Refuge to Peard Bay, west of Barrow (Amstrup and Gardner 1994, Amstrup 2000, Durner et al. 2001, Durner et al. 2006b).

In response to changes in the sea ice characteristics and declines in sea ice habitat over the continental shelf during the summer and late fall, some polar bears have changed distribution to search for seals and to access the remains of subsistence harvested bowhead whales (Schliebe et al. 2008). It is expected that changes in the distribution and movements may occur with increasing frequency in the future (Durner et al. 2009, Schliebe et al. 2008). Polar bears may also become more nutritionally stressed due to global climate changes in the Arctic (Stirling and Parkinson 2006) and, thus, continued monitoring is required to document these changes.

Analysis of mitochondrial DNA and microsatellite DNA loci indicates little differentiation of the Alaska polar bear stocks (Cronin et al. 1991, Scribner et al. 1997, Cronin et al. 2006). Using 16 highly variable micro satellite loci, Paetkau et al. (1999) determined that polar bears throughout the arctic (19 populations) were genetically very similar. Genetically, polar bears in the Southern Beaufort Sea differed more from polar bears in the Chukchi/Bering Seas than from polar bears in the Northern Beaufort Sea (Paetkau et al. 1999, Thiemann et al. 2008). While genetically similar, demographic and movement data indicates a high degree of site fidelity, suggesting that the stocks should be managed separately (Amstrup 2000, Amstrup et al. 2000, Amstrup et al. 2001a, Amstrup et al. 2002, Amstrup et al. 2004, Amstrup et al. 2005).

POPULATION SIZE

Polar bears occur at low densities throughout their circumpolar range (DeMaster and Stirling 1981). They are long lived, mature late, have an extended breeding interval, and have small litters (Lentfer et al. 1980, DeMaster and Stirling 1981, Amstrup 2003). Accurate population estimates for the Alaskan populations have been difficult to obtain because of low population densities, inaccessibility of the habitat, movement of bears across international boundaries, and budget limitations (Amstrup and DeMaster 1988, Garner et al. 1992). Research of the Southern Beaufort Sea population began in 1967 and is one of only four polar bear populations with long term (>20 yrs) data.

Amstrup et al. (1986) estimated the Southern Beaufort Sea stock at 1,778 (S.D. + 803; C.V. = 0.45) during the 1972-83 period. Amstrup (1995) estimated the Southern Beaufort Sea stock near 1,480 animals in 1992. Amstrup (USGS unpublished data) using data for the 1986-98 period (excluding 4 unsampled years), estimated the population at 2,272 in 2001. This total population estimate was based on an estimate of 1,250 females (C.V. = 0.17) and a sex ratio of 55% females (Amstrup et al. 2001b). Regehr et al. 2006 estimated the population to be 1,526 (95% CI = 1211–1841; C.V. = 0.106) based on open population capture-recapture data collected from 2001 to 2006.

Minimum Population Estimate

N_{MIN} is calculated as follows $N/\exp(0.842 * (\ln(1+CV(N)^2))^{1/2})$ and is 1,397 bears for population size of 1,526 and C.V. of 0.106. This population estimate applies to an area that extends from Pt. Barrow in the west, east to the Baillie Islands in Canada.

Current Population Trend

Prior to the 20th century, when Alaska's polar bears were hunted primarily by Natives, both the Chukchi/Bering seas and Southern Beaufort Sea stocks probably existed near carrying capacity (K). Once harvest by non-Natives became common in the Southern Beaufort Sea in the early 1960s, the size of these stocks declined substantially (Amstrup et al. 1986, Amstrup 1995). Since passage of the Marine Mammal Protection Act (MMPA) in 1972, both Alaska polar bear stocks seem to have increased; this is based on: (a) mark and recapture data; (b) observations by Natives and residents of coastal Alaska and Russia; (c) catch per unit effort indices (USGS unpublished data); (d) reports from Russian scientists (Uspenski and Belikov 1991); and (e) harvest statistics on the age structure of the population. Recapture data from the stock indicated a population growth rate of 2.4% from 1981 to 1992 (Amstrup 1995).

The Southern Beaufort Sea stock experienced little or no growth during the 1990's (Amstrup et al. 2001b). Declining survival, recruitment, and body size (Regehr et al. 2006, Regehr et al. 2007), and low growth rates (λ) during years of reduced sea ice during the summer and fall (2004 and 2005), and an overall declining growth rate of 3% per year from 2001-2005 (Hunter et al. 2007) indicates that the Southern Beaufort Sea population is now declining.

MAXIMUM NET PRODUCTIVITY RATES

Population/stock specific data to estimate R_{MAX} are not available for the stock. Taylor et al. (1987) estimated the sustainable yield of the female component of the population at < 1.6% per annum. The following information is used

to understand the R_{MAX} determination. From 1981-92, when the population was increasing, vital rates of polar bears in the Southern Beaufort Sea were as follows: average age of sexual maturity (females) was 6 years; average COY litter size was 1.67; average reproductive interval was 3.68 years; and average annual natural mortality (nM), which varies by age class, ranged from 1-3% for adults (Amstrup 1995).

Amstrup (1995) projected an annual intrinsic growth rate (including natural mortality but not human-caused mortality) of 6.03% for the Southern Beaufort Sea stock using a Leslie type matrix of recapture data. This analysis mimics a life history scenario where environmental resistance is low and survival high.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

Under the 1994 reauthorized MMPA, the potential biological removal (PBR) level is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = (N_{MIN})(\frac{1}{2} R_{MAX})(F_R)$. Wade and Angliss (1997) recommend a default recovery factor (F_R) of 0.5 for a threatened population or when the status of a population is unknown. In the following calculation: $(N_{MIN})(\frac{1}{2} R_{MAX})(F_R) = PBR$ (Wade and Angliss 1997) the minimum population estimate, N_{MIN} was 1,397; the maximum rate of increase R_{MAX} was 6.03%; and the recovery factor F_R was 0.5. Therefore, the PBR level for the Southern Beaufort Sea stock is 22 bears per year.

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities. Consequently, the total fishery mortality and serious injury rate for the Southern Beaufort Sea stock is zero.

Alaska Native Subsistence Harvest

Historically, polar bears have been killed for subsistence, handicrafts, and recreation (sport hunting). Based upon records of skins shipped from Alaska, the estimated annual statewide harvest (both stocks) for 1925–53 averaged 120 bears taken primarily by Native hunters. Sport hunting using aircraft was common from 1951–72, increasing annual harvest in Alaska to 150 during 1951-60 and to 260 during 1960–72 (Amstrup et al. 1986; Schliebe et al. 1995). The annual harvest for the Southern Beaufort Sea stock was 81/year from 1960–1972. Although polar bear hunting was prohibited by the MMPA, an exemption was made for Alaska Natives living in coastal communities to allow them to hunt polar bears for subsistence and making of handicrafts provided that the hunt was not done in a wasteful manner. The cessation of sport hunting in 1972 reduced the mean annual combined harvest for both Alaskan stocks to 98 during 1980–2007 (SD=40; range 48–242) (USFWS unpublished data). The annual harvest from the Southern Beaufort Sea was 39/year in the 1980s, 33/year in the 1990s, and 32/year in the 2000s. More recently, the 2003–2007 average Alaska harvest for the Southern Beaufort Sea in Alaska was 33 and the sex ratio was 67M:33F. During the same time period the average Canadian harvest for the Southern Beaufort Sea was 21.0 and the sex ratio was 45M:55F. The combined average annual Alaska and Canada harvest during the past five years was 53.6. Figure 2 illustrates the annual Alaska polar bear harvest and trend for the Southern Beaufort Sea stock from 1961–2007. No serious injuries, other than the mortalities discussed here, have been reported for the Southern Beaufort Sea stock.

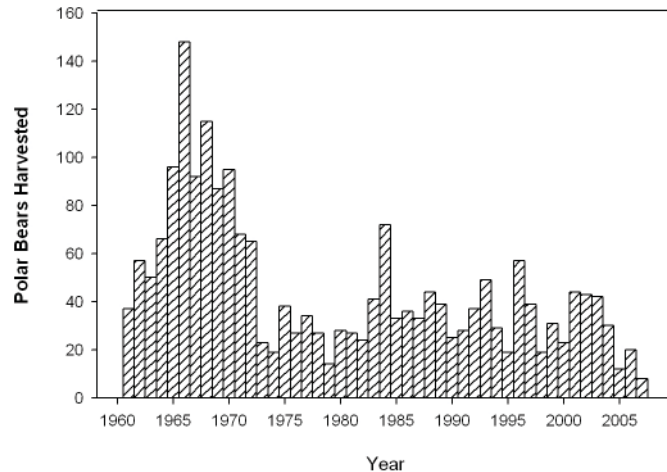


Figure 2. Annual Alaska polar bear harvest from the Southern Beaufort Sea stock, 1961-2007.

During the 1980–2007 period the Alaska harvest from the Southern Beaufort Sea accounted for 34% of the total Alaska kill (annual mean=33 bears) with the remaining 66% occurring in the Chukchi Sea. The sex ratio of the harvest from 1980–2007 in the Southern Beaufort Sea was 69M:31F.

Other Removals

Orphaned cubs are occasionally removed from the wild and placed in zoos; no cubs were placed into public display facilities during the past five years. One bear died as a result of research mortality and two bears were euthanized during the last five years. Activities operating under “incidental take” regulations, associated with the oil and gas industry, have the potential to impact polar bears and their habitat. During the past five years no lethal takes related to industrial activities of polar bears have occurred. Three lethal takes related to oil and gas activities have been documented in the Southern Beaufort Sea: one at an offshore drilling site in the Canadian Beaufort Sea (1968); one bear at the Stinson site in the Alaska Beaufort Sea (1990); and one bear that ingested ethylene glycol stored at an offshore island in the Alaska Beaufort Sea (1988). In 1993, a polar bear was killed at the Oliktok remote radar defense site when it broke into a residence and severely mauled a worker.

STATUS OF STOCK

The Southern Beaufort Sea Stock is currently classified as depleted under the MMPA and listed as threatened under the U.S. Endangered Species Act of 1973 (ESA), as amended.

The primary concerns for this population is loss of the sea ice habitat due in part to climate changes in the Arctic, potential overharvest, and current and proposed human activities including industrial activities occurring in the nearshore and offshore environment. Recent data on the vital rates, population estimate, and growth rates for the Southern Beaufort Sea suggests that this population stock is declining. Because of its status as a threatened species under the ESA, the Southern Beaufort Sea population is designated as a strategic stock.

Conservation Issues and Habitat Concerns

Oil and Gas Exploration

The Minerals Management Service (MMS) (2004) estimated an 11 percent chance of a marine spill greater than 1,000 barrels in the Beaufort Sea from the Beaufort Sea Multiple Lease Sale in Alaska. Amstrup et al. (2006) evaluated the potential effects of a hypothetical 5,912-barrel oil spill (the largest spill thought possible from a pipeline spill) on polar bears from the Northstar offshore oil production facility in the southern Beaufort Sea, and found that there is a low probability that a large number of bears (i.e., 25–60) might be affected by such a spill. For the purposes of this scenario, it was assumed that a polar bear would die if it came in contact with the oil. Amstrup et al. (2006) found that 0–27 bears could potentially be oiled during the open water conditions in September; and from 0–74 bears in mixed ice conditions during October. If such a spill occurred, particularly during the broken ice period, the impact of the spill could be significant to the Southern Beaufort Sea polar bear population (Amstrup et al. 2006, 65 FR 16828; March 30, 2000). At the time that Amstrup did this analysis, the sustainable harvest yield per year for the Southern Beaufort Sea polar bear population, based on a stable population size of 1,800 bears, was estimated to be 81.1 bears (1999–2000 to 2003–2004) (Lunn et al. 2005). For the same time period, the average harvest was 58.2 bears, leaving an additional buffer of 23 bears that could have been removed from the population. Therefore, an oil spill that resulted in the death of greater than 23 bears, which was possible based on the range of oil spill-related mortalities from the previous analysis, could have had population level effects for polar bears in the southern Beaufort Sea. However, the harvest figure of 81 bears may no longer be sustainable for the Southern Beaufort Sea population so, given the average harvest rate cited above, fewer than 23 oil spill-related mortalities could result in a population decline or increase the time required for recovery.

The Fish and Wildlife Service (USFWS) works to monitor and mitigate potential impacts of oil and gas activities on polar bears through incidental take regulations (ITR) as authorized under the Marine Mammal Protection Act. Activities operating under these regulations must adopt measures to: ensure that impacts to polar bears remain negligible; minimize impacts to their habitat; and ensure no unmitigable adverse impact on their availability for Alaska Native subsistence use. ITR also specify monitoring requirements that provide a basis for evaluating potential impacts of current and future activities on marine mammals.

Climate Change

Polar bears evolved over thousands of years to life in a sea ice environment. They depend on the sea ice-dominated ecosystem to support essential life functions. Sea ice provides a platform for hunting and feeding, for seeking mates and breeding, for movement to terrestrial maternity denning areas and occasionally for maternity denning, for resting, and for long-distance movements. The sea ice ecosystem supports ringed seals, the primary prey for polar bears, and other marine mammals that are also part of their prey base.

Sea ice is rapidly diminishing throughout the Arctic and large declines in optimal polar bear habitat have occurred in the Southern Beaufort and Chukchi Seas between the two time periods, 1985–1995 and 1996–2006 (Durner et al. 2009). In addition, it is predicted that the greatest declines in 21st century optimal polar bear habitat will occur in Chukchi and Southern Beaufort Seas (Durner et al. 2009). Patterns of increased temperatures, earlier onset of and longer melting periods, later onset of freeze-up, increased rain-on-snow events, and potential reductions in snowfall are occurring. In addition, positive feedback systems (i.e., the sea-ice albedo feedback mechanism) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can operate to amplify the effects of these phenomena. As a result, there is fragmentation of sea ice, a dramatic increase in the extent of open water areas seasonally, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al 1999, Rothrock et al. 1999, Comiso 2003, Fowler et al. 2004, Lindsay and Zhang 2005, Holland et al. 2006, Comiso 2006, Serreze et al. 2007, Stroeve et al. 2008).

The Chukchi/Bering Seas and the Southern Beaufort Sea population stocks are currently experiencing the initial effects of changes in sea ice conditions (Rode et al. 2007, Regehr et al. 2007, Hunter et al. 2007). These populations are vulnerable to large-scale dramatic seasonal fluctuations in ice movements, decreased abundance and access to prey, and increased energetic costs of hunting. The USFWS is working on measures to protect polar bears and their habitat.

Subsistence Harvest

Recognition that the polar bears in the southern Beaufort Sea were shared between Canada and the Alaska led to the development of the Polar Bear Management Agreement for the Southern Beaufort Sea between the Inuvialuit of the Inuvialuit Game Council (IGC), Canada and the Inupiat of the North Slope Borough (NSB) Alaska in 1988 (Nageak et al. 1991, Treseder and Carpenter 1989, Prestrud and Stirling 1994, Brower et al. 2002). Since initiation of this local user agreement in 1988, the combined Alaska/Canada mean harvest from this stock has been 56.9 bears per year (1988-2007). The harvest in Canada is limited primarily to Native hunters and is regulated by a quota system (Prestrud and Stirling 1994, Brower et al. 2002). Canada has a well regulated and controlled harvest, which has resulted in accurate harvest reporting, strict controls on the harvest, and efficient monitoring and enforcement. The harvest management system in Alaska is voluntary and is less efficient overall than Canadian system (Brower et al 2002).

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