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Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (Ursus maritimus) Throughout Its Range; Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

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[FWS-R7-ES-2008-0038; 1111 FY07 MO-B2]

RIN 1018-AV19

Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (Ursus maritimus) Throughout Its Range

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine threatened status for the polar bear (*Ursus maritimus*) under the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 et seq.). Polar bears evolved to utilize the Arctic sea ice niche and are distributed throughout most ice-covered seas of the Northern Hemisphere. We find, based upon the best available scientific and commercial information, that polar bear habitat—principally sea ice—is declining throughout the species' range, that this decline is expected to continue for the foreseeable future, and that this loss threatens the species throughout all of its range. Therefore, we find that the polar bear is likely to become an endangered species within the foreseeable future throughout all of its range. This final rule activates the consultation provisions of section 7 of the Act for the polar bear. The special rule for the polar bear, also published in today's edition of the **Federal Register**, sets out the prohibitions and exceptions that apply to this threatened species.

DATES: This rule is effective May 15, 2008. The U.S. District Court order in *Center for Biological Diversity* v. *Kempthorne,* No. C 08–1339 CW (N.D. Cal., April 28, 2008) ordered that the 30-day notice period otherwise required by the Administrative Procedure Act be waived, pursuant to 5 U.S.C. 553(d)(3).

ADDRESSES: Comments and materials received, as well as supporting scientific documentation used in the preparation of this rule, will be available for public inspection, by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Marine Mammals Management Office, 1011 East Tudor Road, Anchorage, AK 99503. Copies of this final rule are also available on the Service's Marine Mammal website: *http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm.*

FOR FURTHER INFORMATION CONTACT: Scott Schliebe, Marine Mammals Management Office (see **ADDRESSES** section) (telephone 907–786–3800). Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8339, 24 hours a day, 7 days a week.

SUPPLEMENTARY INFORMATION:

Background

Information in this section is summarized from the following sources: (1) The Polar Bear Status Review (Schliebe et al. 2006a); (2) information received from public comments in response to our proposal to list the polar bear as a threatened species published in the **Federal Register** on January 9, 2007 (72 FR 1064); (3) new information published since the proposed rule (72 FR 1064), including additional sea ice and climatological studies contained in the Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report* (AR4) and other published papers; and (4) scientific analyses conducted by the U.S. Geological Survey (USGS) and co-investigators at the request of the Secretary of the Department of the Interior specifically for this determination. For more detailed information on the biology of the polar bear, please consult the Status Review and additional references cited throughout this document.

Species Biology

Taxonomy and Evolution

Throughout the Arctic, polar bears are known by a variety of common names, including nanook, nanuq, ice bear, sea bear, isbjørn, white bears, and eisbär. Phipps (1774, p. 174) first proposed and described the polar bear as a species distinct from other bears and provided the scientific name *Ursus maritimus.* A number of alternative names followed, but Harington (1966, pp. 3–7), Manning (1971, p. 9), and Wilson (1976, p. 453) (all three references cited in Amstrup 2003, p. 587) subsequently promoted the name *Ursus maritimus* that has been used since.

The polar bear is usually considered a marine mammal since its primary habitat is the sea ice (Amstrup 2003, p. 587), and it is evolutionarily adapted to life on sea ice (see further discussion under General Description section). The polar bear is included on the list of species covered under the U.S. Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.) (MMPA).

Polar bears diverged from grizzly bears (*Ursus arctos*) somewhere between 200,000 and 400,000 years ago (Talbot and Shields 1996a, p. 490; Talbot and Shields 1996b, p. 574). However, fossil evidence of polar bears does not appear until after the Last Interglacial Period (115,000 to 140,000 years ago) (Kurten 1964, p. 25; Ingolfsson and Wiig 2007). Only in portions of northern Canada, Chukotka, Russia, and northern Alaska do the ranges of polar bears and grizzly bears overlap. Cross-breeding of grizzly bears and polar bears in captivity has produced reproductively viable offspring (Gray 1972, p. 56; Stirling 1988, p. 23). The first documented case of cross-breeding in the wild was reported in the spring of 2006, and Wildlife Genetics International confirmed the cross-breeding of a female polar bear and male grizzly bear (Paetkau, pers. comm. May 2006).

General Description

Polar bears are the largest of the living bear species (DeMaster and Stirling 1981, p. 1; Stirling and Derocher 1990, p. 190). They are characterized by large body size, a stocky form, and fur color that varies from white to yellow. They are sexually dimorphic; females weigh 181 to 317 kilograms (kg) (400 to 700 pounds (lbs)), and males up to 654 kg (1,440 lbs). Polar bears have a longer neck and a proportionally smaller head than other members of the bear family (Ursidae) and are missing the distinct shoulder hump common to grizzly bears. The nose, lips, and skin of polar bears are black (Demaster and Stirling 1981, p. 1; Amstrup 2003, p. 588).

Polar bears evolved in sea ice habitats and as a result are evolutionarily adapted to this habitat. Adaptations unique to polar bears in comparison to other Ursidae include: (1) White pelage with water-repellent guard hairs and dense underfur; (2) a short, furred snout; (3) small ears with reduced surface area; (4) teeth specialized for a carnivorous rather than an omnivorous diet; and (5) feet with tiny papillae on the underside, which increase traction on ice (Stirling 1988, p. 24). Additional adaptations include large, paddle-like feet (Stirling 1988, p. 24), and claws that are shorter and more strongly curved than those of grizzly bears, and larger and heavier than those of black bears (*Ursus americanus*) (Amstrup 2003, p. 589).

Distribution and Movements

Polar bears evolved to utilize the Arctic sea ice niche and are distributed throughout most ice-covered seas of the Northern Hemisphere. They occur throughout the East Siberian, Laptev, Kara, and Barents Seas of Russia; Fram Strait (the narrow strait between northern Greenland and Svalbard), Greenland Sea and Barents Sea of northern Europe (Norway and Greenland (Denmark)); Baffin Bay, which separates Canada and Greenland, through most of the Canadian Arctic archipelago and the Canadian Beaufort Sea; and in the Chukchi and Beaufort Seas located west and north of Alaska.

Over most of their range, polar bears remain on the sea ice year-round or spend only short periods on land. However, some polar bear populations occur in seasonally ice-free environs and use land habitats for varying portions of the year. In the Chukchi Sea and Beaufort Sea areas of Alaska and northwestern Canada, for example, less than 10 percent of the polar bear locations obtained via radio telemetry were on land (Amstrup 2000, p. 137; Amstrup, USGS, unpublished data); the majority of land locations were bears occupying maternal dens during the winter. A similar pattern was found in East Greenland (Wiig et al. 2003, p. 511). In the absence of ice during the summer season, some populations of polar bears in eastern Canada and Hudson Bay remain on land for extended periods of time until ice again forms and provides a platform for them to move to sea. Similarly, in the Barents Sea, a portion of the population is spending greater amounts of time on land.

Although polar bears are generally limited to areas where the sea is ice-covered for much of the year, they are not evenly distributed throughout their range on sea ice. They show a preference for certain sea ice characteristics, concentrations, and specific sea ice features (Stirling et al. 1993, pp. 18–22; Arthur et al. 1996, p. 223; Ferguson et al. 2000a, p. 1,125; Ferguson et al. 2000b, pp. 770–771; Mauritzen et al. 2001, p. 1,711; Durner et al. 2004, pp. 18–19; Durner et al. 2006, p. pp. 34–35; Durner et al. 2007, pp. 17 and 19). Sea-ice habitat quality varies temporally as well as geographically (Ferguson et al. 1997, p. 1,592; Ferguson et al. 1998, pp. 1,088–1,089; Ferguson et al.2000a, p. 1,124; Ferguson et al.2000b, pp. 770–771; Amstrup et al. 2000b, p. 962). Polar bears show a preference for sea ice located over and near the continental shelf (Derocher et al. 2004, p. 164; Durner et al. 2004, p. 18–19; Durner et al. 2007, p. 19), likely due to higher biological productivity in these areas (Dunton et al. 2005, pp. 3,467–3,468) and greater accessibility to prey in near-shore shear zones and polynyas (areas of open sea surrounded by ice) compared to deep-water regions in the central polar basin (Stirling 1997, pp. 12–14). Bears are most abundant near the shore in shallow-water areas, and also in other areas where currents and ocean upwelling increase marine productivity and serve to keep the ice cover from becoming too consolidated in winter (Stirling and Smith 1975, p. 132; Stirling et al. 1981, p. 49; Amstrup and DeMaster 1988, p. 44; Stirling 1990, pp. 226–227; Stirling and Øritsland 1995, p. 2,607; Amstrup et al. 2000b, p. 960).

Polar bear distribution in most areas varies seasonally with the seasonal extent of sea ice cover and availability of prey. The seasonal movement patterns of polar bears emphasize the role of sea ice in their life cycle. In Alaska in the winter, sea ice may extend 400 kilometers (km) (248 miles (mi)) south of the Bering Strait, and polar bears will extend their range to the southernmost proximity of the ice (Ray 1971, p. 13). Sea ice disappears from the Bering Sea and is greatly reduced in the Chukchi Sea in the summer, and polar bears occupying these areas move as much as 1,000 km (621 mi) to stay with the pack ice (Garner et al. 1990, p. 222; Garner et al. 1994, pp. 407–408). Throughout the polar basin during the summer, polar bears generally concentrate along the edge of or into the adjacent persistent pack ice. Significant northerly and southerly movements of polar bears appear to depend on seasonal melting and refreezing of ice (Amstrup 2000, p. 142). In other areas, for example, when the sea ice melts in Hudson Bay, James Bay, Davis Strait, Baffin Bay, and some portions of the Barents Sea, polar bears remain on land for up to 4 or 5 months while they wait for winter and new ice to form (Jonkel et al. 1976, pp. 13–22; Schweinsburg 1979, pp. 165, 167; Prevett and Kolenosky 1982, pp. 934–935; Schweinsburg and Lee 1982, p. 510; Ferguson et al. 1997, p. 1,592; Lunn et al. 1997, p. 235; Mauritzen et al. 2001, p. 1,710).

In areas where sea ice cover and character are seasonally dynamic, a large multi-year home range, of which only a portion may be used in any one season or year, is an important part of the polar bear life history strategy. In other regions, where ice is less dynamic, home ranges are smaller and less variable (Ferguson et al. 2001, pp.51–52). Data from telemetry studies of adult female polar bears show that they do not wander aimlessly on the ice, nor are they carried passively with the ocean currents as previously thought (Pedersen 1945 cited in Amstrup 2003, p. 587). Results show strong fidelity to activity areas that are used over multiple years (Ferguson et al. 1997, p. 1,589). All areas within an activity area are not used each year.

The distribution patterns of some polar bear populations during the open water and early fall seasons have changed in recent years. In the Beaufort Sea, for example, greater numbers of polar bears are being found on shore than recorded at any previous time (Schliebe et al. 2006b, p. 559). In Baffin Bay, Davis Strait, western Hudson Bay and other areas of Canada, Inuit hunters are reporting an increase in the numbers of bears present on land during summer and fall (Dowsley and Taylor 2005, p. 2; Dowsley 2005, p. 2). The exact reasons for these changes may involve a number of factors, including changes in sea ice (Stirling and Parkinson 2006, p. 272).

Food Habits

Polar bears are carnivorous, and a top predator of the Arctic marine ecosystem. Polar bears prey heavily throughout their range on ice-dependent seals (frequently referred to as ‘‘ice seals’’), principally ringed seals (*Phoca hispida*), and, to a lesser extent, bearded seals (*Erignathus barbatus)*. In some locales, other seal species are taken. On average, an adult polar bear needs approximately 2 kg (4.4 lbs) of seal fat per day to survive (Best 1985, p. 1035). Sufficient nutrition is critical and may be obtained and stored as fat when prey is abundant.

Although seals are their primary prey, polar bears occasionally take much larger animals such as walruses (*Odobenus rosmarus*), narwhal (*Monodon monoceros*), and belugas (*Delphinapterus leucas*) (Kiliaan and Stirling 1978, p. 199; Smith 1980, p. 2,206; Smith 1985, pp. 72–73; Lowry et al. 1987, p. 141; Calvert and Stirling 1990, p. 352; Smith and Sjare 1990, p. 99). In some areas and under some conditions, prey other than seals or carrion may be quite important to polar bear sustenance as short-term supplemental forms of nutrition. Stirling and Øritsland (1995, p. 2,609) suggested that in areas where ringed seal populations were reduced, other prey species were being substituted. Like other ursids, polar bears will eat human garbage (Lunn and Stirling 1985, p. 2,295), and when confined to land for long periods, they will consume coastal marine and terrestrial plants and other terrestrial foods (Russell 1975, p. 122; Derocher et al. 1993, p. 252); however the significance of such other terrestrial foods to the long-term welfare of polar bears may be limited (Lunn and Stirling 1985, p. 2,296; Ramsay and Hobson 1991, p. 600; Derocher et al. 2004, p. 169) as further expanded under the section entitled ‘‘Adaptation’’ below.

Reproduction

Polar bears are characterized by late sexual maturity, small litter sizes, and extended parental investment in raising young, all factors that contribute to a low reproductive rate (Amstrup 2003, pp. 599–600). Reproduction in the female polar bear is similar to that in other ursids. Females generally mature and breed for the first time at 4 or 5 years and give birth at 5 or 6 years of age. Litters of two cubs are most common, but litters of three cubs are seen sporadically across the Arctic (Amstrup 2003, p. 599). When foraging conditions are difficult, polar bears may ‘‘defer’’ reproduction in favor of survival (Derocher et al. 1992, p. 564).

Polar bears enter a prolonged estrus between March and June, when breeding occurs. Ovulation is induced by mating (Wimsatt 1963, p. 72), and implantation is delayed until autumn. The total gestation period is 195 to 265 days (Uspenski 1977, cited in Amstrup 2003, p. 599), although active development of the fetus is suspended during most of this period. The timing of implantation, and therefore the timing of birth, is likely dependent on body condition of the female, which depends on a variety of environmental factors. Pregnant females that spend the late summer on land prior to denning may not feed for 8 months (Watts and Hansen 1987, p. 627). This may be the longest period of food deprivation of any mammal, and it occurs at a time when the female gives birth to and then nourishes new cubs.

Newborn polar bears are helpless and have hair, but are blind and weigh only 0.6 kg (1.3 lb) (Blix and Lentfer 1979, p. 68). Cubs grow rapidly, and may weigh 10 to 12 kg (22 to 26 lbs) by the time they emerge from the den in the spring. Young bears will stay with their mothers until weaning, which occurs most commonly in early spring when the cubs are 2.3 years of age. Female polar bears are available to breed again after their cubs are weaned; thus the reproductive interval for polar bears is 3 years.

Polar bears are long-lived mammals not generally susceptible to disease, parasites, or injury. The oldest known female in the wild was 32 years of age and the oldest known male was 28, though few polar bears in the wild live to be older than 20 years (Stirling 1988, p. 139; Stirling 1990, p. 225). Due to extremely low reproductive rates, polar bears require a high survival rate to maintain population levels (Eberhardt 1985, p. 1,010; Amstrup and Durner 1995, pp. 1,313, 1,319). Survival rates increase up to a certain age, with cubs-of-the-year having the lowest rates and prime age adults (between 5 and 20 years of age) having survival rates that can exceed 90 percent. Amstrup and Durner (1995, p. 1,319) report that high survival rates (exceeding 90 percent for adult females) are essential to sustain populations.

Polar Bear—Sea Ice Habitat Relationships

Polar bears are distributed throughout the ice-covered waters of the circumpolar Arctic (Stirling 1988, p. 61), and rely on sea ice as their primary habitat (Amstrup 2003, p. 587). Polar bears depend on sea ice for a number of purposes, including as a platform from which to hunt and feed upon seals; as habitat on which to seek mates and breed; as a platform to move to terrestrial maternity denning areas, and sometimes for maternity denning; and as a substrate on which to make long-distance movements (Stirling and Derocher 1993, p. 241). Mauritzen et al. (2003b, p. 123) indicated that habitat use by polar bears during certain seasons may involve a trade-off between selecting habitats with abundant prey availability versus the use of safer retreat habitats (i.e., habitats where polar bears have lower probability of becoming separated from the main body of the pack ice) of higher ice concentrations with less prey. Their findings indicate that polar bear distribution may not be solely a reflection of prey availability, but other factors such as energetic costs or risk may be involved.

Stirling et al. (1993, p. 15) defined seven types of sea ice habitat and classified polar bear use of these ice types based on the presence of bears or bear tracks in order to determine habitat preferences. The seven types of sea ice are: (1) stable fast ice with drifts; (2) stable fast ice without drifts; (3) floe edge ice; (4) moving ice; (5) continuous stable pressure ridges; (6) coastal low level pressure ridges; and (7) fiords and bays. Polar bears were not evenly distributed over these sea ice habitats, but concentrated on the floe ice edge, on stable fast ice with drifts, and on areas of moving ice (Stirling 1990 p. 226; Stirling et al. 1993, p. 18). In another assessment, categories of ice types included pack ice, shore-fast ice, transition zone ice, polynyas, and leads (linear openings or cracks in the ice) (USFWS 1995, p. 9). Pack ice, which consists of annual and multi-year older ice in constant motion due to winds and currents, is the primary summer habitat for polar bears in Alaska. Shore-fast ice (also known as ‘‘fast ice’’, it is defined by the *Arctic Climate Impact Assessment* (2005, p. 190) as ice that grows seaward from a coast and remains in place throughout the winter; typically it is stabilized by grounded pressure ridges at its outer edge) is used for feeding on seal pups, for movement, and occasionally for maternity denning. Open water at leads and polynyas attracts seals and other marine mammals and provides preferred hunting habitats during winter and spring. Durner et al. (2004, pp. 18–19; Durner et al. 2007, pp. 17–18) found that polar bears in the Arctic basin prefer sea ice concentrations greater than 50 percent located over the continental shelf with water depths less than 300 m (984 feet (ft)).

Polar bears must move throughout the year to adjust to the changing distribution of sea ice and seals (Stirling 1988, p. 63; USFWS 1995, p. 4). In some areas, such as Hudson Bay and James Bay, polar bears remain on land when the sea ice retreats in the spring and they fast for several months (up to 8 months for pregnant females) before fall freeze-up (Stirling 1988, p. 63; Derocher et al. 2004, p. 163; Amstrup et al. 2007, p. 4). Some populations unconstrained by land masses, such as those in the Barents, Chukchi, and Beaufort Seas, spend each summer on the multi-year ice of the polar basin (Derocher et al. 2004, p. 163; Amstrup et al. 2007, p. 4). In intermediate areas such as the Canadian Arctic, Svalbard, and Franz Josef Land archipelagos, bears stay on the sea ice most of the time, but in some years they may spend up to a few months on land (Mauritizen et al. 2001, p. 1,710). Most populations use terrestrial habitat partially or exclusively for maternity denning; therefore, females must adjust their movements in order to access land at the appropriate time (Stirling 1988, p. 64; Derocher et al. 2004, p. 166).

Sea ice changes between years in response to environmental factors may have consequences for the distribution and productivity of polar bears as well as their prey. In the southern Beaufort Sea, anomalous heavy sea ice conditions in the mid-1970s and mid-1980s (thought to be roughly in phase with a similar variation in runoff from the Mackenzie River) caused significant declines in productivity of ringed seals (Stirling 2002, p. 68). Each event lasted approximately 3 years and caused similar declines in the birth rate of polar bears and survival of subadults, after which reproductive success and survival of both species increased again.

Maternal Denning Habitat

Throughout the species' range, most pregnant female polar bears excavate dens in snow located on land in the fall-early winter period (Harington 1968, p. 6; Lentfer and Hensel 1980, p. 102; Ramsay and Stirling 1990, p. 233; Amstrup and Gardner 1994, p. 5). The only known exceptions are in western and southern Hudson Bay, where polar bears first excavate earthen dens and later reposition into adjacent snow drifts (Jonkel et al. 1972, p. 146; Ramsay and Stirling 1990, p. 233), and in the southern Beaufort Sea, where a portion of the population dens in snow caves located on pack and shore-fast ice. Successful denning by polar bears requires accumulation of sufficient snow for den construction and maintenance. Adequate and timely snowfall combined with winds that cause snow accumulation leeward of topographic features create denning habitat (Harington 1968, p. 12).

A great amount of polar bear denning occurs in core areas (Harington 1968, pp. 7–8), which show high use over time (see Figure 8). In some portions of the species' range, polar bears den in a more diffuse pattern, with dens scattered over larger areas at lower density (Lentfer and Hensel 1980, p. 102; Stirling and Andriashek 1992, p. 363; Amstrup 1993, p. 247; Amstrup and Gardner 1994, p. 5; Messier et al. 1994, p. 425; Born 1995, p. 81; Ferguson et al. 2000a, p. 1125; Durner et al. 2001, p. 117; Durner et al. 2003, p. 57).

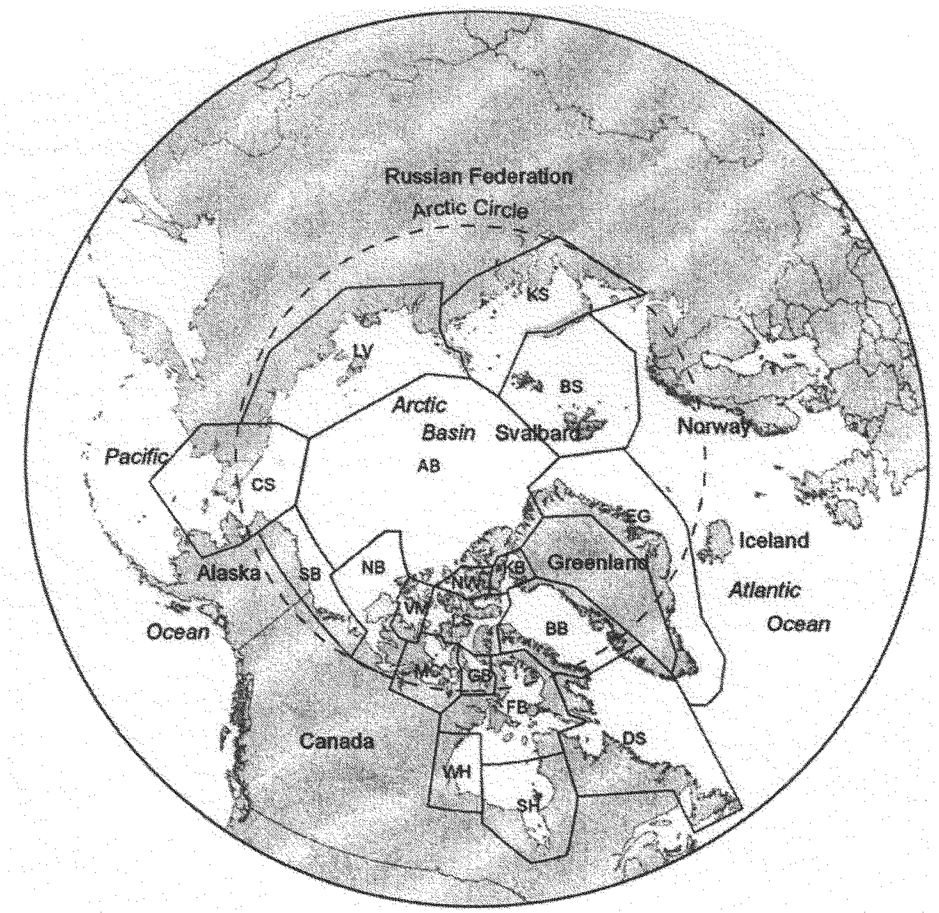
Habitat characteristics of denning areas vary substantially from the rugged mountains and fjordlands of the Svalbard archipelago and the large islands north of the Russian coast (Lønø 1970, p. 77; Uspenski and Kistchinski 1972, p. 182; Larsen 1985, pp. 321–322), to the relatively flat topography of areas such as the west coast of Hudson Bay (Ramsay and Andriashek 1986, p. 9; Ramsay and Stirling 1990, p. 233) and north slope of Alaska (Amstrup 1993, p. 247; Amstrup and Gardner 1994, p. 7; Durner et al. 2001, p. 119; Durner et al. 2003, p. 61), to offshore pack ice-pressure ridge habitat (Amstrup and Gardner 1994, p. 4; Fischbach et al. 2007, p. 1,400). The key characteristic of all denning habitat is topographic features that catch snow in the autumn and early winter (Durner et al. 2003, p. 61). Across the range, most polar bear dens occur relatively near the coast. The main exception to coastal denning occurs in the western Hudson Bay area, where bears den farther inland in traditional denning areas (Kolenosky and Prevett 1983, pp. 243–244; Stirling and Ramsay 1986, p. 349).

Current Population Status and Trend

The total number of polar bears worldwide is estimated to be 20,000–25,000 (Aars et al. 2006, p. 33). Polar bears are not evenly distributed throughout the Arctic, nor do they comprise a single nomadic cosmopolitan population, but rather occur in 19 relatively discrete populations (Aars et al. 2006, p. 33). The use of the term ''relatively discrete population'' in this context is not intended to equate to the Act's term ''distinct population segments'' (Figure 1). Boundaries of the 19 polar bear populations have evolved over time and are based on intensive study of movement patterns, tag returns from harvested animals, and, to a lesser degree, genetic analysis (Aars et al. 2006, pp. 33–47). The scientific studies regarding population bounds began in the early 1970s and continue today. Within this final rule we have adopted the use of the term ''population'' to describe polar bear management units consistent with their designation by the World Conservation Union-International Union for Conservation of Nature and Natural Resources (IUCN), Species Survival Commission (SSC) Polar Bear Specialist Group (PBSG) with information available as of October 2006 (Aars et al. 2006, p. 33), and to describe a combination of two or more of these populations into ''ecoregions,'' as discussed in following sections. Although movements of individual polar bears overlap extensively, telemetry studies demonstrate spatial segregation among groups or stocks of polar bears in different regions of their circumpolar range (Schweinsburg and Lee 1982, p. 509; Amstrup et al. 1986, p. 252; Amstrup et al., 2000b, pp. 957–958.; Garner et al. 1990, p. 224; Garner et al. 1994, pp.112–115; Amstrup and Gardner 1994, p. 7; Ferguson et al. 1999, pp. 313–314; Lunn et al. 2002, p. 41). These patterns, along with information obtained from survey and reconnaissance, marking and tagging studies, and traditional knowledge, have resulted in recognition of 19 relatively discrete polar bear populations (Aars et al. 2006, p. 33). Genetic analysis reinforces the boundaries between some designated populations (Paetkau et al. 1999, p. 1,571; Amstrup 2003, p. 590) while confirming the existence of overlap and mixing among others (Paetkau et al. 1999, p. 1,571; Cronin et al. 2006, p. 655). There is considerable overlap in areas occupied by members of these groups (Amstrup et al. 2004, p. 676; Amstrup et al. 2005, p. 252), and boundaries separating the groups are adjusted as new data are collected. These boundaries, however, are thought to be ecologically meaningful, and the 19 units they describe are managed as populations, with the exception of the Arctic Basin population where few bears are believed to be year-round residents.

Figure 1. Distribution of Polar Bear Populations

Throughout the Arctic Circumpolar Basin



Legend: CS = Chukchi Sea; SB = Southern Beaufort Sea; NB = Northern Beaufort Sea; VM = Viscount Melville Sound, NW = Norwegian Bay; LS = Lancaster Sound; MC = M'Clintock Channel; GB = Gulf of Boothia; FB = Foxe Basin; WH = Western Hudson Bay; SH = Southern Hudson Bay; KB = Kane Basin; BB = Baffin Bay; DS = Davis Strait; EG = East Greenland; BS = Barents Sea; KS = Kara Sea; LV = Laptev Sea; AB = Arctic Basin

Population size estimates and qualitative categories of current trend and status for each of the 19 polar bear populations are discussed below. This discussion was derived from information presented at the IUCN/SSC PBSG meeting held in Seattle, Washington, in June 2005, and updated with results that became available in October 2006 (Aars et al. 2006, p. 33). The following narrative incorporates results from two recent publications (Stirling et al. 2007; Obbard et al. 2007). The remainder of the information on each population is based on the available status reports and revisions given by each nation, as reported in Aars et al. (2006).

Status categories include an assessment of whether a population is believed to be not reduced, reduced, or severely reduced from historic levels of abundance, or if insufficient data are available to estimate status. Trend categories include an assessment of whether the population is currently increasing, stable, or declining, or if insufficient data are available to estimate trend. In general, an assessment of trend requires a monitoring program or data to allow population size to be estimated at more than one point in time. Information on the date of the current population estimate and information on previous population estimates and the basis for those estimates is detailed in Aars et al. (2006, pp. 34–35). In some instances a subjective assessment of trend has been provided in the absence of either a monitoring program or estimates of population size developed for more than one point in time. This status and trend analysis only reflects information about the past and present polar bear populations. Later in this final rule a discussion will be presented about the scientific information on threats that will affect the species within the foreseeable future. The Act establishes a five-factor analysis for using this information in making listing decisions.

Populations are discussed in a counterclockwise order from Figure 1, beginning with East Greenland. There is no population size estimate for the East Greenland polar bear population because no population surveys have been conducted there. Thus, the status and trend of this population have not been determined. The Barents Sea population was estimated to comprise 3,000 animals based on the only population survey conducted in 2004. Because only one abundance estimate is available, the status and trend of this population cannot yet be determined. There is no population size estimate for the Kara Sea population because population surveys have not been conducted; thus status and trend of this population cannot yet be determined. The Laptev Sea population was estimated to comprise 800 to 1,200 animals, on the basis of an extrapolation of historical aerial den survey data (1993). Status and trend cannot yet be determined for this population.

The Chukchi Sea population is estimated to comprise 2,000 animals, based on extrapolation of aerial den surveys (2002). Status and trend cannot yet be determined for this population. The Southern Beaufort Sea population is comprised of 1,500 animals, based on a recent population inventory (2006). The predicted trend is declining (Aars et al. 2006, p.33), and the status is designated as reduced. The Northern Beaufort Sea population was estimated to number 1,200 animals (1986). The trend is designated as stable, and status is believed to be not reduced. Stirling et al. (2007, pp. 12–14) estimated long-term trends in population size for the Northern Beaufort Sea population. The model-averaged estimate of population size from 2004 to 2006 was 980 bears, and did not differ in a statistically significantly way from estimates for the periods of 1972 to 1975 (745 bears) and 1985 to 1987 (867 bears), and thus the trend is stable. Stirling et al. (2007, p. 13) indicated that, based on a number of indications and separate annual abundance estimates for the study period, the population estimate may be slightly biased low (i.e., might be an underestimate) due to sampling issues.

The Viscount Melville Sound population was estimated to number 215 animals (1992). The observed or predicted trend based on management action is listed as increasing (Aars et al. 2006, p. 33), although the status is designated as severely reduced from prior excessive harvest. The Norwegian Bay population estimate was 190 animals (1998); the trend, based on computer simulations, is noted as declining, while the status is listed as not reduced. The Lancaster Sound population estimate was 2,541 animals (1998); the trend is thought to be stable, and status is not reduced. The M'Clintock Channel population is estimated at 284 animals (2000); the observed or predicted trend based on management actions is listed as increasing although the status is severely reduced from excessive harvest. The Gulf of Boothia population estimate is 1,523 animals (2000); the trend is thought to be stable, and status is designated as not reduced. The Foxe Basin population was estimated to number 2,197 animals in 1994; the population trend is thought to be stable, and the status is not reduced. The Western Hudson Bay population estimate is 935 animals (2004); the trend is declining, and the status is reduced. The Southern Hudson Bay population was estimated to be 1,000 animals in 1988 (Aars et al. 2006, p. 35); the trend is thought to be stable, and status is not reduced. In a more recent analysis, Obbard et al. (2007) applied open population capture-recapture models to data collected from 1984–86 and 1999–2005 to estimate population size, trend, and survival for the Southern Hudson Bay population. Their results indicate that the size of the Southern Hudson Bay population appears to be unchanged from the mid-1980s. From 1984–1986, the population was estimated at 641 bears; from 2003–2005, the population was estimated at 681 bears. Thus, the trend for this population is stable. The Kane Basin population was estimated to be comprised of 164 animals (1998); its trend is declining, and status is reduced. The Baffin Bay population was estimated to be 2,074 animals (1998); the trend is declining, and status is reduced. The Davis Strait population was estimated to number 1,650 animals based on traditional ecological knowledge (TEK) (2004); data were unavailable to assess trends or status. Preliminary information from the second of a 3-year population assessment estimates the population number to be 2,375 bears (Peacock et al. 2007, p. 7). The Arctic Basin population estimate, trend, and status are unknown (Aars et al. 2006, p. 35).

On the basis of information presented above, two polar bear populations are designated as increasing (Viscount Melville Sound and M'Clintock Channel-both were severely reduced in the past and are recovering under conservative harvest limits); six populations are stable (Northern Beaufort Sea, Southern Hudson Bay, Davis Strait, Lancaster Sound, Gulf of Bothia, Foxe Basin); five populations are declining (Southern Beaufort Sea, Norwegian Bay, Western Hudson Bay, Kane Basin, Baffin Bay); and six populations are designated as data deficient (Barents Sea, Kara Sea, Laptev Sea, Chukchi Sea, Arctic Basin, East Greenland) with no estimate of trend. The two populations with the most extensive time series of data, Western Hudson Bay and Southern Beaufort Sea, are both considered to be declining.

As previously noted, scientific information assessing this species in the foreseeable future is provided later in this final rule.

Polar Bear Ecoregions

Amstrup et al. (2007, pp. 6–8) grouped the 19 IUCN-recognized polar bear populations (Aars et al. 2006, p. 33) into four physiographically different functional groups or ''ecoregions'' (Figure 2) in order to forecast future polar bear population status on the basis of current knowledge of polar bear populations, their relationships to sea ice habitat, and predicted changes in sea ice and other environmental variables. Amstrup et al. (2007, p. 7) defined the ecoregions ''on the basis of observed temporal and spatial patterns of ice formation and ablation (melting or evaporation), observations of how polar bears respond to those patterns, and how general circulation models (GCMs) forecast future ice patterns.''

The *Seasonal Ice Ecoregion* includes the Western and Southern Hudson Bay populations, as well as the Foxe Basin, Baffin Bay, and Davis Strait populations. These 5 IUCN-recognized populations are thought to include a total of about 7,200 polar bears (Aars et al. 2006, p. 34–35). The 5 populations experience sea ice that melts entirely in summer, and bears spend extended periods of time on shore.

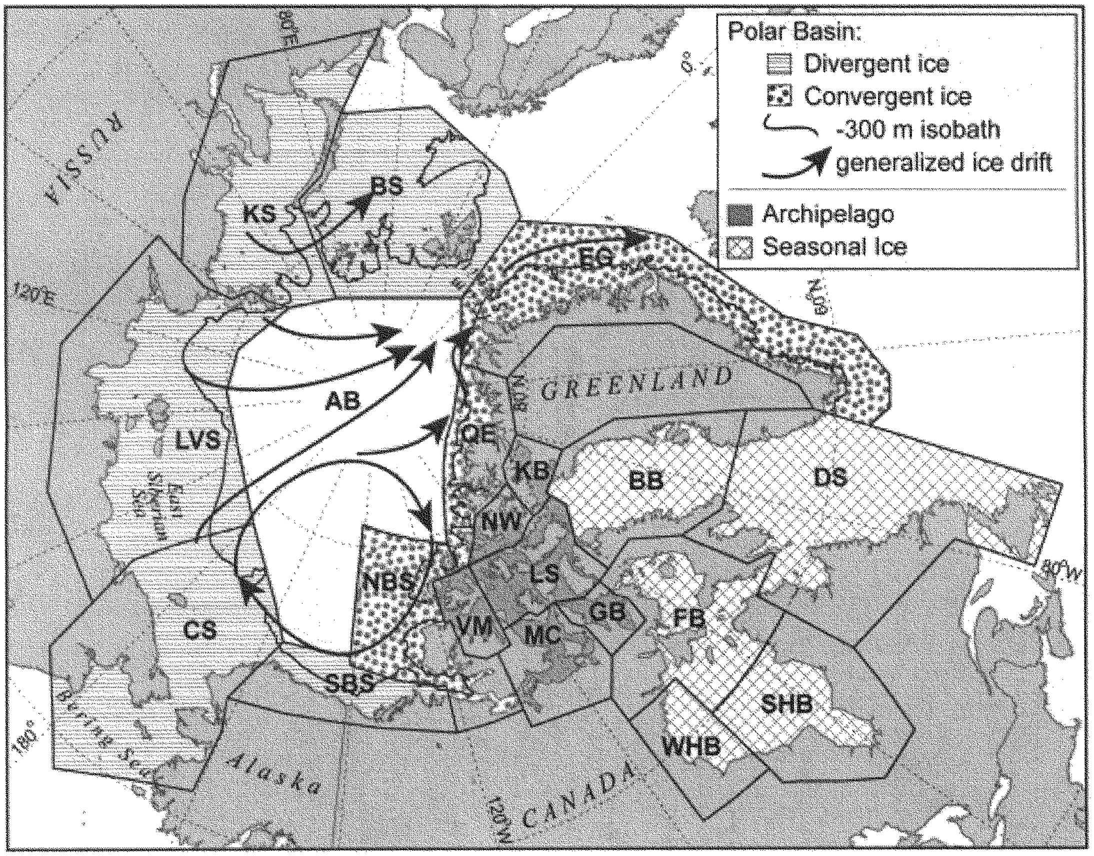


Figure 2. Map of four polar bear ecoregions in Amstrup et al. (2007)(used with permission).

The *Archipelago Ecoregion,* islands and channels of the Canadian Arctic, has approximately 5,000 polar bears representing 6 populations recognized by the IUCN (Aars et al. 2006, p. 34–35). These populations are Kane Basin, Norwegian Bay, Viscount Melville Sound, Lancaster Sound, M'Clintock Channel, and the Gulf of Boothia. Much of this region is characterized by heavy annual and multi-year ice that fills the inter-island channels year round and polar bears remain on the sea ice throughout the year.

The polar basin was split into a *Convergent Ecoregion* and a *Divergent Ecoregion,* based upon the different patterns of sea ice formation, loss (via melt and transport) (Rigor et al. 2002, p. 2,658; Rigor and Wallace 2004, p. 4; Maslanik et al. 2007, pp. 1–3; Meier et al. 2007, pp. 428–434; Ogi and Wallace 2007, pp. 2–3).

The *Divergent Ecoregion* is characterized by extensive formation of annual sea ice that is transported toward the Canadian Arctic islands and Greenland, or out of the polar basin through Fram Strait. The Divergent ecoregion includes the Southern Beaufort, Chukchi, Laptev, Kara, and Barents Seas populations, and is thought to contain up to 9,500 polar bears. In the Divergent Ecoregion, as in the Archipelago Ecoregion, polar bears mainly stay on the sea ice year-round.

The *Convergent Ecoregion,* composed of the Northern Beaufort Sea, Queen Elizabeth Islands (see below), and East Greenland populations, is thought to contain approximately 2,200 polar bears. Amstrup et al. (2007, p. 7) modified the IUCN-recognized population boundaries (Aars et al. 2006, pp. 33,36) of this ecoregion by redefining a Queen Elizabeth Islands population and extending the original boundary of that population to include northwestern Greenland (see Figure 2). The area contained within this boundary is characterized by heavy multi-year ice, except for a recurring lead system that runs along the Queen Elizabeth Islands from the northeastern Beaufort Sea to northern Greenland (Stirling 1980, pp. 307–308). The area may contain over 200 polar bears and some bears from other regions have been recorded moving through the area (Durner and Amstrup 1995, p. 339; Lunn et al. 1995, pp. 12–13). The Northern Beaufort Sea and Queen Elizabeth Islands populations occur in a region of the polar basin that accumulates ice (hence, the Convergent Ecoregion) as it is moved from the polar basin Divergent Ecoregion, while the East Greenland population occurs in area where ice is transported out of the polar basin through the Fram Strait (Comiso 2002, pp. 17–18; Rigor and Wallace 2004, p. 3; Belchansky et al. 2005, pp. 1–2; Holland et al. 2006, pp. 1–5; Durner et al. 2007, p. 3; Ogi and Wallace 2007, p. 2; Serreze et al. 2007, pp. 1,533–1536).

Amstrup et al. (2007) do not incorporate the central Arctic Basin population into an ecoregion. This population was defined by the IUCN in 2001 (Lunn et al. 2002, p.29) to recognize polar bears that may reside outside the territorial jurisdictions of the polar nations. The Arctic Basin region is characterized by very deep water, which is known to be unproductive (Pomeroy 1997, pp. 6–7). Available data indicate that polar bears prefer sea ice over shallow water (less then 300 m (984 ft) deep) (Amstrup et al. 2000b, p. 962; Amstrup et al. 2004, p. 675; Durner et al. 2007, pp. 18–19), and it is thought that this preference reflects increased hunting opportunities over more productive waters. Also, tracking studies indicate that few if any bears are year-round residents of the central Arctic Basin, and therefore this relatively unpopulated portion of the Arctic was not designated as an ecoregion.

Sea Ice Environment

As described in detail in the ''Species Biology'' section of this rule, above, polar bears are evolutionarily adapted to life on sea ice (Stirling 1988, p. 24; Amstrup 2003, p. 587). They need sea ice as a platform for hunting, for seasonal movements, for travel to terrestrial denning areas, for resting, and for mating (Stirling and Derocher 1993, p. 241). Moore and Huntington (in press) classify the polar bear as an ''ice-obligate'' species because of its reliance on sea ice as a platform for resting, breeding, and hunting, while Laidre et al. (in press) similarly describe the polar bear as a species that principally relies on annual sea ice over the continental shelf and areas toward the southern edge of sea ice for foraging. Some polar bears use terrestrial habitats seasonally (e.g., for denning or for resting during open water periods). Open water is not considered to be an essential habitat type for polar bears, because life functions such as feeding, reproduction, or resting do not occur in open water. However, open water is a fundamental part of the marine system that supports seal species, the principal prey of polar bears, and seasonally refreezes to form the ice needed by the bears (see ''Open Water Habitat'' section for more information). Further, the open water interface with sea ice is an important habitat used to a great extent by polar bears. In addition, the extent of open water is important because vast areas of open water may limit a bear's ability to access sea ice or land (see ''Open Water Swimming'' section for more detail). Snow cover, both on land and on sea ice, is an important component of polar bear habitat in that it provides insulation and cover for young polar bears and ringed seals in snow dens or lairs (see ''Maternal Denning Habitat'' section for more detail).

Sea Ice Habitat

Overview of Arctic Sea Ice

According to the *Arctic Climate Impact Assessment* (ACIA 2005), approximately two-thirds of the Arctic is ocean, including the Arctic Ocean and its shelf seas plus the Nordic, Labrador, and Bering Seas (ACIA 2005, p. 454). Sea ice is the defining characteristic of the marine Arctic (ACIA 2005, p. 30). The Arctic sea ice environment is highly dynamic and follows annual patterns of expansion and contraction. Sea ice is typically at its maximum extent (the term ''extent'' is formally defined in the ''Observed Changes in Arctic Sea Ice'' section) in March and at its minimum extent in September (Parkinson et al. 1999, p. 20,840). The two primary forms of sea ice are seasonal (or first year) ice and perennial (or multi-year) ice (ACIA 2005, p. 30). Seasonal ice is in its first autumn/winter of growth or first spring/summer of melt (ACIA 2005, p. 30). It has been documented to vary in thickness from a few tenths of a meter near the southern margin of the sea ice to 2.5 m (8.2 ft) in the high Arctic at the end of winter (ACIA 2005, p. 30), with some ice also that is thinner and some limited amount of ice that can be much thicker, especially in areas with ridging (C. Parkinson, NASA, in litt. to the Service, November 2007). If first-year ice survives the summer melt, it becomes multi-year ice. This ice tends to develop a distinctive hummocky appearance through thermal weathering, becoming harder and almost salt-free over several years (ACIA 2005, p. 30). Sea ice near the shore thickens in shallow waters during the winter, and portions become grounded. Such ice is known as shore-fast ice, land-fast ice, or simply fast ice (ACIA 2005, p. 30). Fast ice is found along much of the Siberian coast, the White Sea (an inlet of the Barents Sea), north of Greenland, the Canadian Archipelago, Hudson Bay, and north of Alaska (ACIA 2005, p. 457).

Pack ice consists of seasonal (or first-year) and multi-year ice that is in constant motion caused by winds and currents (USFWS 1995, pp. 7–9). Pack ice is used by polar bears for traveling, feeding, and denning, and it is the primary summer habitat for polar bears, including the Southern Beaufort Sea and Chukchi Sea populations, as first year ice retreats and melts with the onset of spring (see ''Polar Bear-Sea Ice Habitat Relationships'' section for more detail on ice types used by polar bears). Movements of sea ice are related to winds, currents, and seasonal temperature fluctuations that in turn promote its formation and degradation. Ice flow in the Arctic often includes a clockwise circulation of sea ice within the Canada Basin and a transpolar drift stream that carries sea ice from the Siberian shelves to the Barents Sea and Fram Strait.

Sea ice is an important component of the Arctic climate system (ACIA 2005, p. 456). It is an effective insulator between the oceans and the atmosphere. It also strongly reduces the ocean-atmosphere heat exchange and reduces wind stirring of the ocean. In contrast to the dark ocean, pond-free sea ice (i.e., sea ice that has no meltwater ponds on the surface) reflects most of the solar radiation back into space. Together with snow cover, sea ice greatly restricts the penetration of light into the sea, and it also provides a surface for particle and snow deposition (ACIA 2005, p. 456). Its effects can extend far south of the Arctic, perhaps globally, e.g., through impacting deepwater formation that influences global ocean circulation (ACIA 2005, p. 32).

Sea ice is also an important environmental factor in Arctic marine ecosystems. ''Several physical factors combine to make arctic marine systems unique including: a very high proportion of continental shelves and shallow water; a dramatic seasonality and overall low level of sunlight; extremely low water temperatures; presence of extensive areas of multi-year and seasonal sea-ice cover; and a strong influence from freshwater, coming from rivers and ice melt'' (ACIA 2005, p. 454). Ice cover is an important physical characteristic, affecting heat exchange between water and atmosphere, and light penetration to organisms in the water below. It also helps determine the depth of the mixed layer, and provides a biological habitat above, within, and beneath the ice. The marginal ice zone, at the edge of the pack ice, is important for plankton production and plankton-feeding fish (ACIA 2005, p. 456)

Observed Changes in Arctic Sea Ice

Sea ice is the defining physical characteristic of the marine Arctic environment and has a strong seasonal cycle (ACIA 2005, p. 30). There is considerable inter-annual variability both in the maximum and minimum extent of sea ice, but it is typically at its maximum extent in March and minimum extent in September (Parkinson et al. 1999, p. 20, 840). In addition, there are decadal and inter-decadal fluctuations to sea ice extent due to changes in atmospheric pressure patterns and their associated winds, river runoff, and influx of Atlantic and Pacific waters (Gloersen 1995, p. 505; Mysak and Manak 1989, p. 402; Kwok 2000, p. 776; Parkinson 2000b, p. 10; Polyakov et al. 2003, p. 2,080; Rigor et al. 2002, p. 2,660; Zakharov 1994, p. 42). Sea ice ''extent'' is normally defined as the area of the ocean with at least 15 percent ice coverage, and sea ice ''area'' is normally defined as the integral sum of areas actually covered by sea ice

(Parkinson et al. 1999). ''Area'' is a more precise measure of the areal extent of the ice itself, since it takes into account the fraction of leads (linear openings or cracks in the ice) within the ice, but ''extent'' is more reliably observed (Zhang and Walsh 2006). The following sections discuss specific aspects of observed sea ice changes of relevance to polar bears.

Summer Sea Ice

Summer sea ice area and sea ice extent are important factors for polar bear survival (see ''Polar Bear-Sea Ice Habitat Relationships'' section). Seasonal or first-year ice that remains at the end of the summer melt becomes multi-year (or perennial) ice. The amount and thickness of perennial ice is an important determinant of future sea ice conditions (i.e., gain or loss of ice) (Holland and Bitz 2003; Bitz and Roe 2004). Much of the following discussion focuses on summer sea ice extent (rather than area).

Prior to the early 1970s, ice extent was measured with visible-band satellite imagery and aircraft and ship reports. With the advent of passive microwave (PM) satellite observations, beginning in December 1972 with a single channel instrument and then more reliably in October 1978 with a multi-channel instrument, we have a more accurate, 3-decade record of changes in summer sea ice extent and area. Over the period since October 1978, successive papers have documented an overall downward trend in Arctic sea ice extent and area. For example, Parkinson et al. (1999) calculated Arctic sea ice extents, areas, and trends for late 1978 through the end of 1996, and documented a decrease in summer sea ice extent of 4.5 percent per decade. Comiso (2002) documented a decline of September minimum sea ice extent of 6.7 percent plus or minus 2.4 percent per decade from 1981 through 2000. Stroeve et al. (2005) analyzed data from 1978 through 2004, and calculated a decline in minimum sea ice extent of 7.7 percent plus or minus 3 percent per decade. Comiso (2006, p. 72) included observations for 2005, and calculated a per-decade decline in minimum sea ice extent of up to 9.8 percent plus or minus 1.5 percent. Most recently, Stroeve et al. (2007, pp. 1–5) estimated a 9.1 percent per-decade decline in September sea ice extent for 1979–2006, while Serreze et al. (2007, pp. 1,533–1,536) calculated a per-decade decline of 8.6 percent plus or minus 2.9 percent for the same parameter over the same time period. These estimates differ only because Serreze et al. (2007, pp. 1,533–1,536) normalized the trend by the 1979–2000 mean, in order to be consistent with how the National Snow and Ice Data Center[1] calculates its estimates (J. Stroeve, in litt. to the Service, November 2007). This decline translates to a decrease of 60,421 sq km (23,328 sq mi) per year (NSIDC Press Release, October 3, 2006).

The rate of decrease in September sea ice extent appears to have accelerated in recent years, although the acceleration to date has not been shown to be statistically significant (C. Bitz, in litt. to the Service, November 2007). The years 2002 through 2007 all exceeded previous record lows (Stroeve et al. 2005; Comiso 2006; Stroeve et al. 2007, pp. 1–5; Serreze et al. 2007, pp. 1,533–1,536; NSIDC Press Release, October 1, 2007), and 2002, 2005, and 2007 had successively lower record-breaking minimum extent values (*http://www.nsidc.org*). The 2005 absolute minimum sea ice extent of 5.32 million sq km (2.05 million sq mi) for the entire Arctic Ocean was a 21 percent reduction compared to the mean for 1979 to 2000 (Serreze et al. 2007, pp. 1,533–1,536). Nghiem et al. (2006) documented an almost 50 percent reduction in perennial (multi-year) sea ice extent in the East Arctic Ocean (0 to 180 degrees east longitude) between 2004 and 2005, while the West Arctic Ocean (0 and 180 degrees west longitude) had a slight gain during the same period, followed by an almost 70 percent decline from October 2005 to April 2006. Nghiem et al. (2007) found that the extent of perennial sea ice was significantly reduced by 23 percent between March 2005 and March 2007 as observed by the QuikSCAT/SeaWinds satellite scatterometer. Nghiem et al. (2006) presaged the extensive decline in September sea ice extent in 2007 when they stated: ''With the East Arctic Ocean dominated by seasonal ice, a strong summer melt may open a vast ice-free region with a possible record minimum ice extent largely confined to the West Arctic Ocean.''

Arctic sea ice declined rapidly to unprecedented low extents in summer 2007 (Stroeve et al. 2008). On August 16–17, 2007, Arctic sea ice surpassed the previous single-day (absolute minimum) record for the lowest extent ever measured by satellite (set in 2005), and the sea ice was still melting (NSIDC Arctic Sea Ice News, August 17, 2007). On September 16, 2007 (the end of the melt season), the 5-day running mean sea ice extent reported by NSIDC was 4.13 million sq km (1.59 million sq mi), an all-time record low. This was 23 percent lower than the previous record minimum reported in 2005 (see Figure 3) (Stroeve et al. 2008) and 39 percent below the long-term average from 1979 to 2000 (see Figure 4) (NSIDC Press Release, October 1, 2007). Arctic sea ice receded so much in 2007 that the so-called ''Northwest Passage'' through the straits of the Canadian Arctic Archipelago completely opened for the first time in recorded history (NSIDC Press Release, October 1, 2007). Based on a time-series of data from the Hadley Centre, extending back before the advent of the PM satellite era, sea ice extent in mid-September 2007 may have fallen by as much as 50 percent from the 1950s to 1970s (Stroeve et al. 2008). The minimum September Arctic sea ice extent since 1979 is now declining at a rate of approximately 10.7 percent per decade (Stroeve et al. 2008), or approximately 72,000 sq km (28,000 sq mi) per year (see Figure 3 below) (NSIDC Press Release, October 1, 2007).

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[1] The NSIDC is part of the University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES), is funded largely by the National Aeronautics and Space Administration (NASA), and is affiliated with the National Oceanic and Atmospheric Administration (NOAA) National Geophysical Data Center through a cooperative agreement. A large part of NSIDC is the Polar Distributed Active Archive Center, which is funded by NASA.

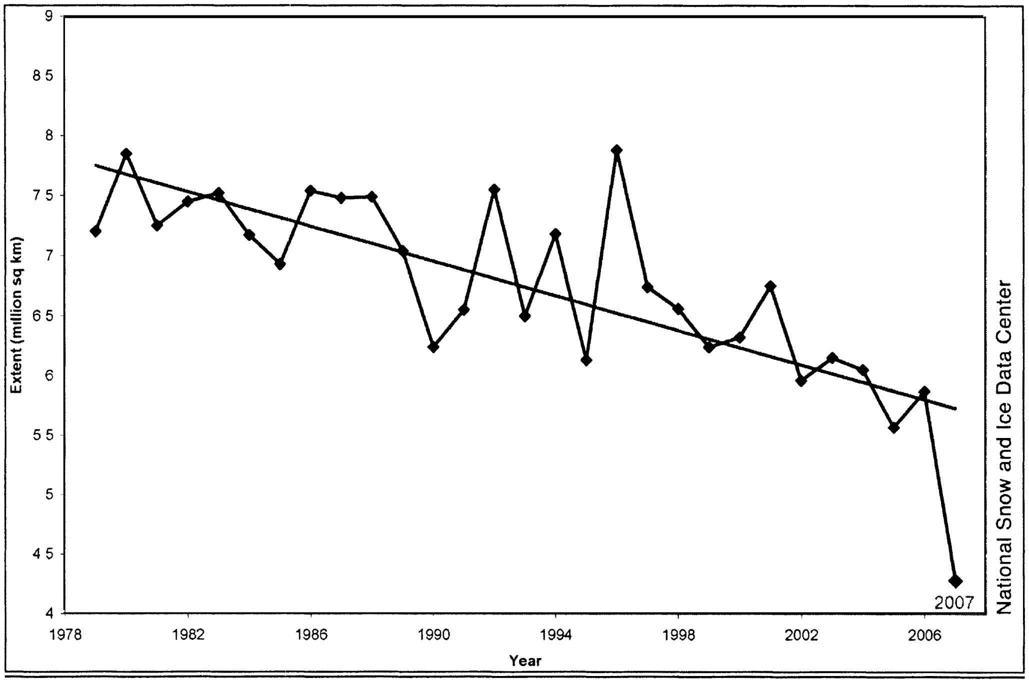


Figure 3. Trends in sea ice cover in the Arctic in September, 1978-2007 (NSIDC Press Release, October 1, 2007).

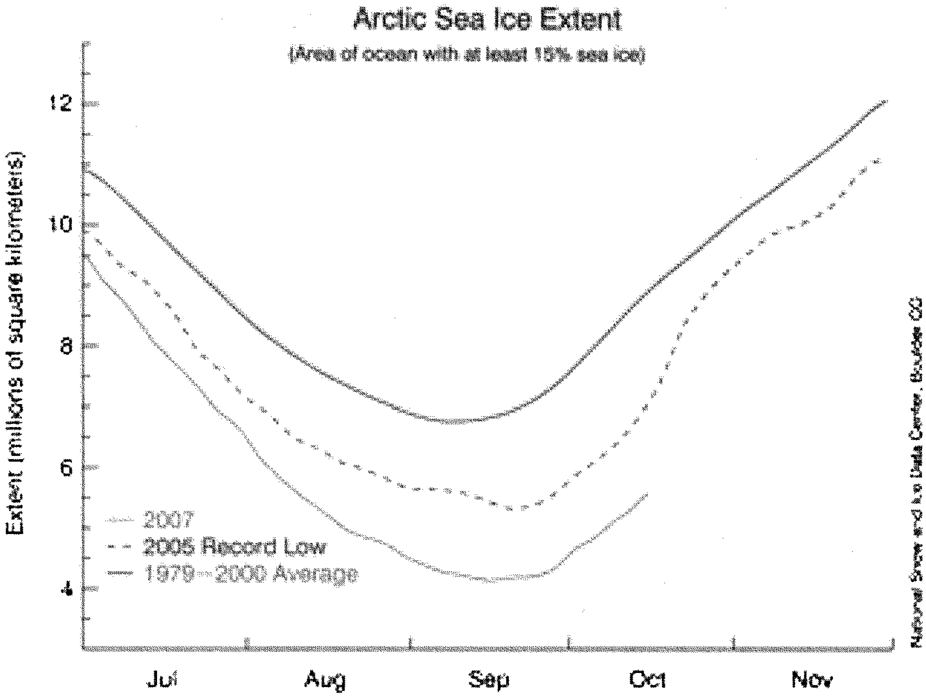


Figure 4. Time series plots showing 2007 minimum Arctic sea ice extent compared with other years. The times series for 2007 (bottom line) is far below the previous record year of 2005, shown as a dashed line. The 1979-2000 average is the top line (NSIDC Arctic Sea Ice News, October 17, 2007).

In August 2007, Arctic sea ice area (recall that ''area'' is a different metric than ''extent'' used in the preceding paragraphs) also broke the record for the minimum Arctic sea ice area in the period since the satellite PM record began in the 1970s (University of Illinois Polar Research Group 2007 web site; *http://arctic.atmos.uiuc.edu/cryosphere/*). The new record was set a full month before the historic summer minimum typically occurs, and the record minimum continued to decrease over the next several weeks (University of Illinois Polar Research Group 2007 web site). The Arctic sea ice area reached an historic minimum of 2.92 million sq km (1.13 million sq mi) on September 16, 2007, which was 27 percent lower than the previous (2005) record Arctic ice minimum area (University of Illinois Polar Research Group 2007 web site). In previous record sea ice minimum years, ice area anomalies were confined to certain sectors (North Atlantic, Beaufort/Bering Sea, etc.), but the character of the 2007 summer sea ice melt was unique in that it was both dramatic and covered the entire Arctic Basin. Atlantic, Pacific, and the central Arctic sectors all showed large negative sea ice area anomalies (University of Illinois Polar Research Group 2007 web site).

Two key factors contributed to the September 2007 extreme sea ice minimum: thinning of the pack ice in recent decades and an unusual pattern of atmospheric circulation (Stroeve et al. 2008). Spring 2007 started out with less ice and thinner ice than normal. Ice thickness estimates from the ICESat satellite laser altimeter instrument indicated ice thicknesses over the Arctic Basin in March 2007 of only 1 to 2 m (3.3 to 6.6 ft) (J. Stroeve, in litt. to the Service, November 2007). Thinner ice takes less energy to melt than thicker ice, so the stage was set for low levels of sea ice in summer 2007 (J. Stroeve, quoted in NSIDC Press Release, October 1, 2007). In general, older sea ice is thicker than younger ice. Maslanik et al. (2007) used an ice-tracking computer algorithm to estimate changes in the distribution of multi-year sea ice of various ages. They estimated: that the area of sea ice at least 5 years old decreased by 56 percent between 1985 and 2007; that ice at least 7 years old decreased from 21 percent of the ice cover in 1988 to 5 percent in 2007; and that sea ice at least 9 years old essentially disappeared from the central Arctic Basin. Maslanik et al. (2007) attributed thinning in recent decades to both ocean-atmospheric circulation patterns and warmer temperatures. Loss of older ice in the late 1980s to mid-1990s was accentuated by the positive phase of the Arctic Oscillation during that period, leading to increased ice export through the Fram Strait (Stroeve et al. 2008). Another significant change since the late 1990s has been the role of the Beaufort Gyre, ''the dominant wind and ice drift regime in the central Arctic'' (Maslanik et al. 2007). ''Since the late 1990s * * * ice typically has not survived the transit through the southern portion of the Beaufort Gyre,'' thus not allowing the ice to circulate in its formerly typical clockwise pattern for years while it aged and thickened (Maslanik et al. 2007). Temperature changes in the Arctic are discussed in detail in the section entitled ''Air and Sea Temperatures.''

Another factor that contributed to the sea ice loss in the summer of 2007 was an unusual atmospheric pattern, with persistent high atmospheric pressures over the central Arctic Ocean and lower pressures over Siberia (Stroeve et al. 2008). The skies were fairly clear under the high-pressure cell, promoting strong melt. At the same time, the pattern of winds pumped warm air into the region. While the warm winds fostered further melt, they also helped push ice away from the Siberian shore.

Winter Sea Ice

The maximum extent of Arctic winter sea ice cover, as documented with PM satellite data, has been declining at a lower rate than summer sea ice (Parkinson et al. 1999, p. 20,840; Richter-Menge et al. 2006, p. 16), but that rate appears to have accelerated in recent years. Parkinson and Cavalieri (2002, p. 441) reported that winter sea ice cover declined at a rate of 1.8 percent plus or minus 0.6 percent per decade for the period 1979 through 1999. More recently, Richter-Menge et al. (2006, p. 16) reported that March sea ice extent was declining at a rate of 2 percent per decade based on data from 1979–2005, Comiso (2006) calculated a decline of 1.9 plus or minus 0.5 percent per decade for 1979–2006, and J. Stroeve (in litt. to the Service, November 2007) calculated a decline of 2.5 percent per decade, also for 1979–2005.

In 2005 and 2006, winter maximum sea ice extent set record lows for the era of PM satellite monitoring (October 1978 to present). The 2005 record low winter maximum preceded the then-record low summer minimum during the same year, while winter sea ice extent in 2006 was even lower than that of 2005 (Comiso 2006). The winter 2007 Arctic sea ice maximum was the second-lowest in the satellite record, narrowly missing the March 2006 record (NSIDC Press Release, April 4, 2007). J. Stroeve (in litt. to the Service, November 2007) calculated a rate of decline of 3.0 plus or minus 0.8 percent per decade for 1979–2007.

Cumulative Annual Sea Ice

Parkinson et al. (1999) documented that Arctic sea ice extent for all seasons (i.e., annual sea ice extent) declined at a rate of 2.8 percent per decade for the period November 1978 through December 1996, with considerable regional variation (the greatest absolute declines were documented for the Kara and Barents Sea, followed by the Seas of Okhotsk and Japan, the Arctic Ocean, Greenland Sea, Hudson Bay, and Canadian Archipelago; percentage declines were greatest in the Seas of Okhotsk and Japan, at 20.1 percent per decade, and the Kara and Barents Seas, at 10.5 percent per decade). More recently, Comiso and Nishio (2008) utilized satellite data gathered from late 1978 into 2006, and estimated an annual rate decline of 3.4 percent plus or minus 0.2 percent per decade. They also found regions where higher negative trends were apparent, including the Greenland Sea (8.0 percent per decade), the Kara/Barents Seas (7.2 percent per decade), the Okhotsk Sea (8.7 percent per decade), and Baffin Bay/Labrador Sea (8.6 percent per decade). Comiso et al. (2008) included satellite data from 1979 through early September 2007 in their analyses. They found that the trend of the entire sea ice cover (seasonal and perennial sea ice) has accelerated from a decline of about 3 percent per decade in 1979–1996 to a decline of about 10 percent per decade in the last 10 years. Statistically significant negative trends in Arctic sea ice extent now occur n all calendar months (Serreze et al. 2007, pp. 1,533–1,536).

Sea Ice Thickness

Sea ice thickness is an important element of the Arctic climate system. The sea ice thickness distribution influences the sea ice mass budget and ice/ocean/atmosphere exchange (Holland et al. 2006a). Sea ice thickness has primarily been measured with upward-looking sonar on submarines and on moored buoys; this sonar provides information on ice draft, the component of the total ice thickness (about 90 percent) that projects below the water surface (Serreze et al. 2007, pp. 1,533–1,536). Rothrock et al. (1999, p. 3,469) compared sea-ice draft data acquired on submarine cruises between 1993 and 1997 with similar data acquired between 1958 and 1976, and concluded that the mean sea-ice draft at the end of the melt season (i.e., perennial or multi-year ice) had decreased by about 1.3 m (4.3 ft) in most of the deep water portion of the Arctic Ocean. One limitation of submarine sonar data is sparse sampling, which complicates interpretation of the results (Serreze et al. 2007, pp. 1,533–1,536). Holloway and Sou (2002) noted concerns regarding the temporal and spatial sampling of ice thickness data used in Rothrock et al. (1999), and concluded from their modeling exercise that ''a robust characterization over the half-century time series consists of increasing volume to the mid-1960s, decadal variability without significant trend from the mid-1960s to the mid-1980s, then a loss of volume from the mid-1980s to the mid-1990s.'' Rothrock et al. (2003, p. 28) conducted further analysis of the submarine-acquired data in conjunction with model simulations and review of other modeling studies, and concluded that all models agree that sea ice thickness decreased between 0.6 and 0.9 m (2 and 3 ft) from 1987 to 1996. Their model showed a modest recovery in thickness from 1996 to 1999. Yu et al. (2004, p. 11) further analyzed submarine sonar data and concluded that total ice volume decreased by 32 percent from the 1960s and 1970s to the 1990s in the central Arctic Basin.

Fowler et al. (2004) utilized a new technique for combining remotely-sensed sea ice motion and sea ice extent to ''track'' the evolution of sea ice in the Arctic region from October 1978 through March 2003. Their analysis revealed that the area of the oldest sea ice (i.e., sea ice older than 4 years) was decreasing in the Arctic Basin and being replaced by younger (first-year) ice. The extent of the older ice was retreating to a relatively small area north of the Canadian Archipelago, with narrow bands spreading out across the central Arctic (Fowler et al. 2004, pp. 71–74). More recently, Maslanik et al. (2007) documented a substantial decline in the percent coverage of old ice within the central Arctic Basin. In 1987, 57 percent of the ice pack in this area was 5 or more years old, with 25 percent of this ice at least 9 years old. By 2007, only 7 percent of the ice pack in this area was 5 or more years old, and ice at least 9 years old had completely disappeared. This is significant because older ice is thicker than younger ice, and therefore requires more energy to melt. The reduction in the older ice types in the Arctic Basin translates into a reduction in mean ice thickness from 2.6 m in March 1987 to 2.0 m in March 2007 (Stroeve et al. 2008).

Kwok (2007, p. 1) studied six annual cycles of perennial (multi-year) Arctic sea ice coverage, from 2000 to 2006, and found that after the 2005 summer melt, only about four percent of the thin, first-year ice that formed the previous winter survived to replenish the multi-year sea ice area (NASA/JPL News Release, April 3, 2007). That was the smallest amount of multi-year ice replenishment documented in the study, and resulted in perennial ice coverage in January 2006 that was 14 percent smaller than in January 2005. Kwok (2007, p. 1) attributed the decline to unusually high amounts of ice exported from the Arctic in the summer of 2005, and also to an unusually warm winter and summer prior to September 2005.

Length of the Melt Period

The length of the melt period (or season) affects sea ice cover (extent and area) and sea ice thickness (Hakkinen and Mellor 1990; Laxon et al. 2003). In general terms, earlier onset of melt and lengthening of the melt season result in decreased total sea ice cover at the end of summer (i.e., the end of the melt season) (Stroeve et al. 2005, p. 3). Belchansky et al. (2004, p. 1) found that changes in multi-year ice area measured in January were significantly correlated with duration of the intervening melt season. Kwok found a correlation between the number of freezing and melting temperature days and area of multi-year sea ice replenished in a year (NASA/JPL News Release, April 3, 2007).

Comiso (2003, p. 3,506), using data for the period 1981–2001, calculated that the Arctic sea ice melt season was increasing at a rate of 10 to 17 days per decade during that period. Including additional years in his analyses, Comiso (2005, p. 50) subsequently found that the length of the melt season was increasing at a rate of approximately 13.1 days per decade. Stroeve et al. (2006 pp. 367–374) analyzed melt season duration and melt onset and freeze-up dates from satellite passive microwave data for the period 1979 through 2005, and found that the Arctic is experiencing an overall lengthening of the melt season at a rate of about 2 weeks per decade.

The NSIDC documented a trend of earlier onset of the melt season for the years 2002 through 2005; the melt season arrived earliest in 2005, occurring approximately 17 days before the mean date of onset of the melt season (NSIDC 2005, p. 6). In 2007, in addition to the record-breaking September minimum sea ice extent, NSIDC scientists noted that the date of the lowest sea ice extent shifted to later in the year (NSIDC Press Release, October 1, 2007). The minimum sea ice extent occurred on September 16, 2007; from 1979 to 2000, the minimum usually occurred on September 12. This is consistent with a lengthening of the melt season.

Parkinson (2000) documented a clear decrease in the length of the sea ice season throughout the Greenland Sea, Kara and Barents Seas, Sea of Okhotsk, and most of the central Arctic Basin. On the basis of observational data, Stirling et al. (cited in Derocher et al. 2004) calculated that break-up of the annual ice in Western Hudson Bay is occurring approximately 2.5 weeks earlier than it did 30 years ago. Consistent with these results, Stirling and Parkinson (2006) analyzed satellite data for Western Hudson Bay for November 1978 through 2004 and found that, on average, ice break-up has been occurring about 7 to 8 days earlier per decade. Stirling and Parkinson (2006) also investigated ice break-up in Foxe Basin, Baffin Bay, Davis Strait, and Eastern Hudson Bay in Canada. They found that ice break-up in Foxe Basin has been occurring about 6 days earlier each decade and ice break-up in Baffin Bay has been occurring 6 to 7 days earlier per decade. Long-term results from Davis Strait were not conclusive, particularly because the maximum percentage of ice cover in Davis Strait varies considerably more between years than in western Hudson Bay, Foxe Basin, or Baffin Bay. Conversely, Stirling and Parkinson (2006) documented a negative short-term trend from 1991 to 2004 in Davis Strait. In eastern Hudson Bay, there was not a statistically significant trend toward earlier break-up.

Understanding Observed Declines in Arctic Sea Ice

The observed declines in the extent of Arctic sea ice are well documented, and more pronounced in the summer than in the winter. There is also evidence that the rate of sea ice decline is increasing. This decline in sea ice is of great importance to our determination regarding the status of the polar bear. Understanding the causes of the decline is also of great importance in assessing what the future might hold for Arctic sea ice, and, thus, considerable effort has been devoted to enhancing our understanding. This understanding will inform our determination regarding the status of the polar bear within the foreseeable future as determined in this rule.

In general terms, sea ice declines can be attributed to three conflated factors: warming, atmospheric changes (including circulation and clouds), and changes in oceanic circulation (Stroeve and Maslowski 2007). Serreze et al.

(2007, pp. 1,533–1,536) characterize the decline of sea ice as a conflation of thermodynamic and dynamic processes: ''Thermodynamic processes involve changes in surface air temperature (SAT), radiative fluxes, and ocean conditions. Dynamic processes involve changes in ice circulation in response to winds and ocean currents.'' In the following paragraphs we discuss warming, changes in the atmosphere, and changes in oceanic circulation, followed by a synthesis. It is critically important that we understand the dynamic forces that govern all aspects of sea ice given the polar bear's almost exclusive reliance on this habitat.

Air and Sea Temperatures

Estimated rates of change in surface air temperature (SAT) over the Arctic Ocean over the past 100 or more years vary depending on the time period, season, and data source used (Serreze et al. 2007, pp. 1,533–1,536). Serreze et al. (2007, pp. 1,533–1,536) note that, although natural variability plays a large role in SAT variations, the overall pattern has been one of recent warming.

Polyakov et al. (2003) compiled SAT trends for the maritime Arctic for the period 1875 through 2000 (as measured by coastal land stations, drifting ice stations, and Russian North Pole stations) and found that, since 1875, the Arctic has warmed by 1.2 degrees Celsius (C), an average warming of 0.095 degree C per decade over the entire period, and an average warming of 0.05 ± 0.04 degree C per decade during the 20th century. The increases were greatest in winter and spring, and there were two relative maxima during the century (the late 1930s and the 1990s). The ACIA analyzed land-surface air temperature trends as recorded in the Global Historical Climatology Network (GHCN) database, and documented a statistically significant warming trend of 0.09 degree C per decade during the period 1900–2003 (ACIA 2005, p. 35). For periods since 1950, the rate of temperature increase in the marine Arctic documented in the GHCN (ACIA 2005, p. 35) is similar to the increase noted by Polyakov et al. (2003).

Rigor et al. (2000) documented positive trends in SAT for 1979 to 1997; the trends were greatest and most widespread in spring. Comiso (2006) analyzed data from the Advanced Very High Resolution Radiometer (AVHRR) for 1981 to 2005, and documented an overall warming trend of 0.54 ± 0.11 degrees C per decade over sea ice. Comiso noted that ''it is apparent that significant warming has been occurring in the Arctic but not uniformly from one region to another.'' The Serreze et al. (2007, pp. 1,533–1,536) assessment of data sets from the National Centers for Environmental Prediction and the National Center for Atmospheric Research indicated strong surface and low-level warming for the period 2000 to 2006 relative to 1979 to 1999, consistent with the observed sea ice losses.

Stroeve and Maslowski (2007) noted that anomalously high temperatures have been consistent throughout the Arctic since 2002. Further support for warming comes from studies indicating earlier onset of spring melt and lengthening of the melt season (e.g., Stroeve et al. 2006, pp. 367–374), and data that point to increased downward radiation toward the surface, which is linked to increased cloud cover and water vapor (Francis and Hunter 2006, cited in Serreze et al. 2007, pp. 1,533–1,536).

According to the IPCC AR4 (IPCC 2007, p. 36), 11 of 12 years from 1995 to 2006 (the exception being 1996) were among the 12 warmest years on record since 1850; 2005 and 1998 were the warmest two years in the instrumental global surface air temperature record since 1850. Surface temperatures in 1998 were enhanced by the major 1997–1998 El Niño but no such large-scale atmospheric anomaly was present in 2005. The IPCC AR4 concludes that the ''warming in the last 30 years is widespread over the globe, and is greatest at higher northern latitudes (IPCC 2007, p. 37).'' Further, the IPCC AR4 states that greatest warming has occurred in the northern hemisphere winter (December, January, February) and spring (March, April, May). Average Arctic temperatures have been increasing at almost twice the rate of the rest of the world in the past 100 years. However, Arctic temperatures are highly variable. A slightly longer Arctic warm period, almost as warm as the present, was observed from 1925 to 1945, but its geographical distribution appears to have been different from the recent warming since its extent was not global.

Finally, Comiso (2005, p. 43) determined that for each 1 degree C increase in surface temperature (global average) there is a corresponding decrease in perennial sea ice cover of about 1.48 million sq km (0.57 million sq mi).

Changes in Atmospheric Circulation

Links have also been established between sea ice loss and changes in sea ice circulation associated with the behavior of key atmospheric patterns, including the Arctic Oscillation (AO; also called the Northern Annular Mode (NAM)) (e.g., Thompson and Wallace 2000; Limpasuvan and Hartmann 2000) and the more regional, but closely related North Atlantic Oscillation (NAO; e.g., Hurrell 1995). First described in 1998 by atmospheric scientists David Thompson and John Wallace, the Arctic Oscillation is a measure of air-pressure and wind patterns in the Arctic. In the so-called ''positive phase'' (or high phase), air pressure over the Arctic is lower than normal and strong westerly winds occur in the upper atmosphere at high latitudes. In the so-called ''negative phase'' (or low phase), air pressure over the Arctic is higher than normal, and the westerly winds are weaker.

Rigor et al. (2002, cited in Stroeve and Maslowski 2007) showed that when the AO is positive in winter, altered wind patterns result in more offshore ice motion and ice divergence along the Siberian and Alaskan coastlines; this leads to the production of more extensive areas of thinner, first-year ice that requires less energy to melt. Rigor and Wallace (2004, cited in Deweaver 2007) suggested that the recent reduction in September ice extent is a delayed reaction to the export of multi-year ice during the high-AO winters of 1989 through 1995. They estimated that the recovery of sea ice to its normal extent should take between 10 and 15 years. However, Rigor and Wallace (2004) estimated that the combined winter and summer AO-indices can explain less than 20 percent of the variance in summer sea ice extent in the western Arctic Ocean where most of the recent reductions in sea ice cover have occurred. The notion that AO-related export of multi-year ice from the Arctic is the principal cause of observed declines in Arctic sea ice extent has been questioned by several authors, including Overland and Wang (2005), Comiso (2006), Stroeve and Maslowski (2007), Serreze et al. (2007, pp. 1,533–1,536), and Stroeve et al. (2008) who note that sea ice extent has not recovered despite the return of the AO to a more neutral state since the late 1990s. Overland and Wang (2005) noted that the return of the AO to a more neutral state was accompanied by southerly wind anomalies from 2000–2005 which contributed to reducing the ice cover over time and ''conditioning'' the Arctic for the extensive summer sea ice reduction in 2007 (J. Overland NOAA, pers. comm. to FWS, 2007). Maslanik et al. (2007) reached a similar conclusion that despite the return of the AO to a more neutral state, wind and ice transport patterns that favor reduced ice cover in the western and central Arctic continued to play a role in the loss of sea ice in those regions. Maslanik et al.

(2007) believe that circulation patterns such as the Beaufort Gyre, which in the past helped to maintain old ice in the Arctic Basin, are now acting to export ice, as the multi-year ice is no longer surviving the transport through the Chukchi and East Siberian Seas.

According to DeWeaver (2007): ''Recognizing the need to incorporate AO variability into considerations of recent sea ice decline, Lindsay and Zhang (2005) used an ocean-sea ice model to reconstruct the sea ice behavior of the satellite era and identify separate contributions from ice motion and thermodynamics. Similar experiments with similar results were also reported by Rothrock and Zhang (2005) and Koberle and Gerdes (2003).'' Rothrock and Zhang (2005, cited in Serreze et al. 2007, pp. 1,533–1,536), using a coupled ice-ocean model, argued that although wind forcing was the dominant driver of declining ice thickness and volume from the late 1980s through the mid-1990s, the ice response to generally rising air temperatures was more steadily downward over the study period (1948 to 1999). ''In other words, without wind forcing, there would still have been a downward trend in ice extent, albeit smaller than that observed'' (Serreze et al. 2007, pp. 1,533–1,536). Lindsay and Zhang (2005, cited in Serreze et al. 2007, pp. 1,533–1,536) came to similar conclusions in their modeling study: ''Rising air temperature reduced ice thickness, but changes in circulation also flushed some of the thicker ice out of the Arctic, leading to more open water in summer and stronger absorption of solar radiation in the upper (shallower depths of the) ocean. With more heat in the ocean, thinner ice grows in autumn and winter.''

Changes in Oceanic Circulation

According to Serreze et al. (2007, pp. 1,533–1,536), it appears that changes in ocean heat transport have played a role in declining Arctic sea ice extent in recent years. Warm Atlantic waters enter the Arctic Ocean through the Fram Strait and Barents Sea (Serreze et al. 2007, pp. 1,533–1,536). This water is denser than colder, fresher (less dense) Arctic surface waters, and sinks (subducts) to form an intermediate layer between depths of 100 and 800 m (328 and 2,624 ft) (Quadfasel et al. 1991) with a core temperature significantly above freezing (DeWeaver 2007; Serreze et al. 2007, pp. 1,533–1,536). Hydrographic data show increased import of Atlantic-derived waters in the early to mid-1990s and warming of this inflow (Dickson et al. 2000; Visbeck et al. 2002). This trend has continued, characterized by pronounced pulses of warm inflow (Serreze et al. 2007, pp. 1,533–1,536). For example, strong ocean warming in the Eurasian Basin of the Arctic Ocean in 2004 can be traced to a pulse entering the Norwegian Sea in 1997–1998 and passing through Fram Strait in 1999 (Polyakov et al. 2007). The anomaly found in 2004 was tracked through the Arctic system and took about 1.5 years to travel from the Norwegian Sea to the Fram Strait region, and an additional 4.5–5 years to reach the Laptev Sea slope (Polyakov et al. 2007).

Polyakov et al. (2007) reported that mooring-based records and oceanographic surveys suggest that a new pulse of anomalously warm water entered the Arctic Ocean in 2004. Further Polyakov et al. (2007) stated that: ''combined with data from the previous warm anomaly * * * this information provides evidence that the Nansen Basin of the Arctic Ocean entered a new warm state. These two warm anomalies are progressing towards the Arctic Ocean interior * * * but still have not reached the North Pole observational site. Thus, observations suggest that the new anomalies will soon enter the central Arctic Ocean, leading to further warming of the polar basin. More recent data, from summer 2005, showed another warm anomaly set to enter the Arctic Ocean through the Fram Strait (Walczowski and Piechura 2006). These inflows may promote ice melt and discourage ice growth along the Atlantic ice margin (Serreze et al. 2007, pp. 1,533–1,536).

Once Atlantic water enters the Arctic Ocean, the cold halocline layer (CHL) separating the Atlantic and surface waters largely insulates the ice from the heat of the Atlantic layer. Observations suggest a retreat of the CHL in the Eurasian basin in the 1990s (Steele and Boyd 1998, cited in Serreze et al. 2007, pp. 1,533–1,536). This likely increased Atlantic layer heat loss and ice-ocean heat exchange (Serreze et al. 2007, pp. 1,533–1,536), which would serve to erode the edge of the sea ice on a year-round basis (C. Bitz, in litt. to the Service, November 2007). Partial recovery of the CHL has been observed since 1998 (Boyd et al. 2002, cited in Serreze et al. 2007, pp. 1,533–1,536), and future behavior of the CHL is an uncertainty in projections of future sea ice loss (Serreze et al. 2007, pp. 1,533–1,536).

Synthesis

From the previous discussion, surface air temperature warming, changes in atmospheric circulation, and changes in oceanic circulation have all played a role in observed declines of Arctic sea ice extent in recent years.

According to DeWeaver (2007): ''Lindsay and Zhang (2005) propose a three-part explanation of sea ice decline,'' which incorporates both natural AO variability and warming climate. In their explanation, a warming climate preconditions the ice for decline as warmer winters thin the ice, but the loss of ice extent is triggered by natural variability such as flushing by the AO. Sea ice loss continues after the flushing because of the sea-ice albedo feedback mechanism which warms the sea even further. In recent years, flushing of sea ice has continued through other mechanisms despite a relaxation of the AO since the late 1990s. The sea-ice albedo feedback effect is the result of a reduction in the extent of brighter, more reflective sea ice or snow, which reflects solar energy back into the atmosphere, and a corresponding increase in the extent of darker, more absorbing water or land that absorbs more of the sun's energy. This greater absorption of energy causes faster melting, which in turn causes more warming, and thus creates a self-reinforcing cycle or feedback loop that becomes amplified and accelerates with time. Lindsay and Zhang (2005, p. 4,892) suggest that the sea-ice albedo feedback mechanism caused a tipping point in Arctic sea ice thinning in the late 1980s, sustaining a continual decline in sea ice cover that cannot easily be reversed. DeWeaver (2007) believes that the work of Lindsay and Zhang (2005) suggests that the observed record of sea ice decline is best interpreted as a combination of internal variability and external forcing (via GHGs), and raises the possibility that the two factors may act in concert rather than as independent agents.

Evidence that warming resulting from GHG forcing has contributed to sea ice declines comes largely from model simulations of the late 20th century climate. Serreze et al. (2007, pp. 1,533–1,536) summarized results from Holland et al. (2006, pp. 1–5) and Stroeve et al. (2007, pp. 1–5), and concluded that the qualitative agreement between model results and actual observations of sea ice declines over the PM satellite era is strong evidence that there is a forced component to the decline. This is because each of these models would be in its own phase of natural variability and thus could show an increase or decrease in sea ice, but the fact that they all show a decrease indicates that more than natural variability is involved, i.e., that external forcing by GHGs is a factor. In addition, the model results do not show a decline if they are not forced with the observed GHGs. Serreze et al.

(2007, pp. 1,533–1,536) concluded: ''These results provide strong evidence that, despite prominent contributions of natural variability in the observed record, GHG loading has played a role.''

Hegerl et al. (2007) used a new approach to reconstruct and attribute a 1,500-year temperature record for the Northern Hemisphere. Based on their analysis to detect and attribute temperature change over that period, they estimated that about a third of the warming in the first half of the 20th century can be attributed to anthropogenic GHG emissions. In addition, they estimated that the magnitude of the anthropogenic signal is consistent with most of the warming in the second half of the 20th century being anthropogenic.

Observed Changes in Other Key Parameters

Snow Cover on Ice

Northern Hemisphere snow cover, as documented by satellite over the 1966 to 2005 period, decreased in every month except November and December, with a step like drop of 5 percent in the annual mean in the late 1980s (IPCC 2007, p. 43). April snow cover extent in the Northern Hemisphere is strongly correlated with temperature in the region between 40 and 60 degrees N Latitude; this reflects the feedback between snow and temperature (IPCC 2007, p. 43).

The presence of snow on sea ice plays an important role in the Arctic climate system (Powell et al. 2006). Arctic sea ice is covered by snow most of the year, except when the ice first forms and during the summer after the snow has melted (Sturm et al. 2006). Warren et al. (1999, cited in IPCC 2007 Chapter 4) analyzed 37 years (1954–1991) of snow depth and density measurements made at Soviet drifting stations on multi-year Arctic sea ice. They found a weak negative trend for all months, with the largest being a decrease of 8 cm (3.2 in) (23 percent) in May.

Precipitation

The Arctic Climate Impact Assessment (2005) concluded that ''overall, it is probable that there was an increase in arctic precipitation over the past century.'' An analysis of data in the Global Historical Climatology Network (GHCN) database indicated a significant positive trend of 1.4 percent per decade (ACIA 2005) for the period 1900 through 2003. New et al. (2001, cited in ACIA 2005)) used uncorrected records and found that terrestrial precipitation averaged over the 60 degree to 80 degree N latitude band exhibited an increase of 0.8 percent per decade over the period from 1900 to 1998. In general, the greatest increases were observed in autumn and winter (Serreze et al. 2000). According to the ACIA (2005) calculations: (1) during the Arctic warming in the first half of the 20th century (1900–1945), precipitation increased by about 2 percent per decade, with significant positive trends in Alaska and the Nordic region; (2) during the two decades of Arctic cooling (1946–1965), the high-latitude precipitation increase was roughly 1 percent per decade, but there were large regional contrasts with strongly decreasing values in western Alaska, the North Atlantic region, and parts of Russia; and (3) since 1966, annual precipitation has increased at about the same rate as during the first half of the 20th century. The ACIA report (2005) notes that these trends are in general agreement with results from a number of regional studies (e.g., Karl et al. 1993; Mekis and Hogg 1999; Groisman and Rankova 2001; Hanssen-Bauer et al. 1997; Førland et al. 1997; Hanssen-Bauer and Førland 1998). In addition to the increase, changes in the characteristics of precipitation have also been observed (ACIA 2005). Much of the precipitation increase appears to be coming as rain, mostly in winter and to a lesser extent in autumn and spring. The increasing winter rains, which fall on top of existing snow, cause faster snowmelt. Increased rain in late winter and early spring could affect the thermal properties of polar bear dens (Derocher et al. 2004), thereby negatively impacting cub survival. Increased rain in late winter and early spring may even cause den collapse (Stirling and Smith 2004).

According to the IPCC AR4 (2007, pp. 256–258), distinct upward trends in precipitation are evident in many regions at higher latitudes, especially from 30 to 85 degrees N latitude. Winter precipitation has increased at high latitudes, although uncertainties exist because of changes in undercatch, especially as snow changes to rain (IPCC 2007, p. 258). Annual precipitation for the circumpolar region north of 50 degrees N has increased during the past 50 years by approximately 4 percent but this increase has not been homogeneous in time and space (Groisman et al. 2003, 2005, both cited in IPCC 2007, p. 258). According to the IPCC AR4: ''Statistically significant increases were documented over Fennoscandia, coastal regions of northern North America (Groisman et al. 2005), most of Canada (particularly northern regions) up until at least 1995 when the analysis ended (Stone et al. 2000), the permafrost-free zone of Russia (Groisman and Rankova 2001) and the entire Great Russian Plain (Groisman et al. 2005, 2007).'' That these trends are real, extending from North America to Europe across the North Atlantic, is also supported by evidence of ocean freshening caused by increased freshwater run-off (IPCC 2007, p. 258).

Rain-on-snow events have increased across much of the Arctic. For example, over the past 50 years in western Russia, rain-on-snow events have increased by 50 percent (ACIA 2005). Groisman et al. (2003) considered rain-on-snow trends over a 50-year period (1950–2000) in high latitudes in the northern hemisphere and found an increasing trend in western Russia and decreases in western Canada (the decreasing Canadian trend was attributed to decreasing snow pack). Putkonen and Roe (2003), working on Spitsbergen Island, where the occurrence of winter rain-on-snow events is controlled by the North Atlantic Oscillation, demonstrated that these events are capable of influencing mean winter soil temperatures and affecting ungulate survival. These authors include the results of a climate modeling effort (using the earlier-generation Geophysical Fluid Dynamics Laboratory climate model and a 1 percent per year increase in CO_2 forcing scenario) that predicted a 40 percent increase in the worldwide area of land affected by rain-on-snow events from 1980–1989 to 2080–2089. Rennert et al. (2008) discussed the significance of rain-on-snow events to ungulate survival in the Arctic, and used the dataset European Center for Medium-range Weather Forecasting (ECMWF) European 40 Year (ERA40) Reanalysis (Uppala et al. 2005) to create a climatology of rain-on-snow events for thresholds that impact ungulate populations and permafrost. In addition to contributing to increased incidence of polar bear den collapse, increased rain-on-snow events during the late winter or early spring could also damage or eliminate snow-covered pupping lairs of ringed seals (the polar bear's principal prey), thereby increasing pup exposure and the risk of hypothermia, and facilitating predation by polar bears and Arctic foxes. This could negatively impact ringed seal recruitment.

Projected Changes in Arctic Sea Ice

Background

To make projections about future ecosystem effects that could result from climate change, one must first make projections of changes in physical climate parameters based on changes in external factors that can affect the physical climate (ACIA 2005). Climate models use the laws of physics to simulate the main components of the climate system (the atmosphere, ocean, land surface, and sea ice) (DeWeaver 2007), and make projections of future climate scenarios-plausible representations of future climate-that are consistent with assumptions about future emissions of GHGs and other pollutants (these assumptions are called ''emissions scenarios'') and with present understanding of the effects of increased atmospheric concentrations of these components on the climate (ACIA 2005).

Virtually all climate models use emissions scenarios developed as part of the IPCC effort; specifically the IPCC's *Special Report on Emissions Scenarios* (SRES) (IPCC 2000) details a number of plausible future emissions scenarios based on assumptions on how societies, economies, and energy technologies are likely to evolve. The SRES emissions scenarios were built around four narrative storylines that describe the possible evolution of the world in the 21st century (ACIA 2005, p.119). Around these four narrative storylines the SRES constructed six scenario groups and 40 different emissions scenarios. Six scenarios (A1B, A1T, A1FI, A2, B1, and B2) were then chosen as illustrative ''marker'' scenarios. These scenarios have been used to estimate a range of future GHG emissions that affect the climate. The scenarios are described on page 18 of the *AR4 Working Group I: Summary for Policymakers* (IPCC 2007), and in greater detail in the SRES Report (IPCC 2000).

The most commonly-used scenarios for current-generation climate modeling are the B1, A1B, and A2 scenarios. In the B1 scenario, CO_2 concentration is around 549 parts per million (ppm) by 2100; this is often termed a 'low' scenario. In the A1B scenario, CO_2 concentration is around 717 ppm by the end of the century; this is a 'medium' or 'middle-of-the-road' scenario. In the A2 scenario, CO_2 concentration is around 856 ppm at the end of the 21st century; this is considered a 'high' scenario with respect to GHG concentrations. It is important to note that the SRES scenarios include no additional mitigation initiatives, which means that no scenarios are included that explicitly assume the implementation of the United Nations Framework Convention on Climate Change (UNFCC) or the emission targets of the Kyoto Protocol.

Of the various types of climate models, the Atmosphere-Ocean General Circulation Models (AOGCMs, also known as General Circulation Models (GCMs)) are acknowledged as the principal and most rapidly-developing tools for simulating the response of the global climate system to various GHG and aerosol emission scenarios. The climates simulated by these models have been verified against observations in several model intercomparison programs (e.g., Achuta Rao et al. 2004; Randall et al. 2007) and have been found to be generally realistic (DeWeaver 2007). Additional confidence in model simulations comes from experiments with a hierarchy of simpler models, in which the dominant processes represented by climate models (e.g., heat and momentum transport by mid-latitude weather systems) can be isolated and studied (DeWeaver 2007).

For projected changes in climate and Arctic sea ice conditions, our proposed rule (72 FR 1064) relied primarily on results in the IPCC's *Third Assessment Report* (TAR) (IPCC 2001b), the *Arctic Climate Impact Assessment* (ACIA 2005, p. 99), and selected peer-reviewed papers (e.g., Johannessen et al. 2004; Holland et al. 2006, pp. 1–5). The IPCC TAR used results derived from 9-AOGCM ensemble (i.e, averaged results from 9 AOGCMs) and three SRES emissions scenarios (A2, B2, and IS92a). The ACIA (2005, p. 99) used a 5-AOGCM ensemble under two SRES emissions scenarios (A2 and B2); however, the B2 emissions scenario was chosen as the primary scenario for use in ACIA analyses (ACIA 2005). These reports relied on ensembles rather than single models, because ''no one model can be chosen as 'best' and it is important to use results from a range of models'' (IPCC 2001, Chapter 8). The other peer-reviewed papers used in the proposed rule (72 FR 1064) tend to report more-detailed results from a one or two model simulations using one SRES scenario.

After the proposed rule was published (72 FR 1064), the IPCC released its *Fourth Assessment Report* (AR4) (IPCC 2007), a detailed assessment of current and predicted future climates around the globe. Projected changes in climate and Arctic sea ice conditions presented in the IPCC AR4 have been used extensively in this final rule. The IPCC AR4 used results from state-of-the-art climate models that have been substantially improved over the models used in the IPCC TAR and ACIA reports (M. Holland, NCAR, in litt. to the Service, 2007; DeWeaver 2007). In addition, the IPCC AR4 used results from a greater number of models (23) than either the IPCC TAR or ACIA reports. ''This larger number of models running the same experiments allows better quantification of the multi-model signal as well as uncertainty regarding spread across the models, and also points the way to probabilistic estimates of future climate change'' (IPCC 2007, p. 761). Finally, the IPCC AR4 used a greater number of emissions scenarios (4) than either the IPCC TAR or ACIA reports. The emission scenarios considered in the AR4 include A2, A1B, and B1, as well as a ''year 2000 constant concentration'' scenario; this choice was made solely due to the limited computational resources for multi-model simulations using comprehensive AOGCMs, and ''does not imply any preference or qualification of these three scenarios over the others'' (IPCC 2007, p.761). For all of these reasons, there is considerable confidence that the AOGCMs used in the IPCC AR4 provide credible quantitative estimates of future climate change, particularly at continental scales and above (IPCC 2007, p. 591), and we have determined that these results are rightly included in the category of best available scientific information upon which to base a listing decision for the polar bear.

In addition to the IPCC AR4 results, this final rule utilizes results from a large number of peer-reviewed papers (e.g., Parkinson et al. 2006; Zhang and Walsh 2006; Arzel et al. 2006; Stroeve et al. 2007, pp. 1–5; Holland et al. 2006, pp. 1–5; Wang et al. 2007, pp. 1,093–1,107; Overland and Wang 2007a, pp. 1–7; Chapman and Walsh 2007) that provide more detailed information on climate change projections for the Arctic.

Uncertainty in Climate Models

The fundamental physical laws reflected in climate models are well established, and the models are broadly successful in simulating present-day climate and recent climate change (IPCC 2007, cited in DeWeaver 2007). For Arctic sea ice, model simulations unanimously project declines in areal coverage and thickness due to increased GHG concentrations (DeWeaver 2007). They also agree that GHG-induced warming will be largest in the high northern latitudes and that the loss of sea ice will be much larger in summer than in winter (Meehl et al. 2007, cited in DeWeaver 2007). However, despite the qualitative agreement among climate model projections, individual model results for Arctic sea ice decline span a considerable range (DeWeaver 2007). Thus, projections from models are often expressed in terms of the typical behavior of a group (ensemble) of simulations (e.g., Arzel et al. 2006; Flato et al. 2004; Holland et al. 2006, pp. 1–5).

DeWeaver (2007) presents a detailed analysis of uncertainty associated with climate models and their projections for Arctic sea ice conditions. He concludes that two main sources of uncertainty should be considered in assessing Arctic sea ice simulations: uncertainties in the construction of climate models and unpredictable natural variability of the climate system. DeWeaver (2007) states that while most aspects of climate simulations have some degree of uncertainty, projections of Arctic climate change have relatively higher uncertainty. This higher level of uncertainty is, to some extent, a consequence of the smaller spatial scale of the Arctic, since climate simulations are believed to be more reliable at continental and larger scales (Meehl et al. 2007, IPCC 2007, both cited in DeWeaver 2007). The uncertainty is also a consequence of the complex processes that control the sea ice, and the difficulty of representing these processes in climate models. The same processes which make Arctic sea ice highly sensitive to climate change, the ice-albedo feedback in particular, also make sea ice simulations sensitive to any uncertainties in model physics (e.g., the representation of Arctic clouds) (DeWeaver 2007).

DeWeaver (2007) also discusses natural variability of the climate system. He states that the atmosphere, ocean, and sea ice comprise a ‘‘nonlinear chaotic system’’ with a high level of natural variability unrelated to external climate forcing. Thus, even if climate models perfectly represented all climate system physics and dynamics, inherent climate unpredictability would limit our ability to issue highly, detailed forecasts of climate change, particularly at regional and local spatial scales, into the middle and distant future (DeWeaver 2007).

DeWeaver (2007) states that the uncertainty in model simulations should be assessed through detailed model-to-model and model-to-observation comparisons of sea ice properties like thickness and coverage. In principle, inter-model sea ice variations are attributable to differences in model construction, but attempts to relate simulation differences to specific model differences generally have not been successful (e.g., Flato et al. 2004, cited in DeWeaver 2007). A practical consequence of uncertainty in climate model simulations of sea ice is that a mean and spread of an ensemble of simulations should be considered in deciding the likely fate of Arctic sea ice. Some model-to-model variation (or spread) in future sea ice behaviors is expected even among high-quality simulations due to natural variability, but spread that is a consequence of poor simulation quality should be avoided. Thus, it is desirable to define a selection criterion for membership in the ensemble, so that only those models that demonstrate sufficient credibility in present-day sea ice simulation are included. Fidelity in sea ice hindcasts (i.e., the ability of models to accurately simulate past to present-day sea ice conditions) is an important consideration. This same perspective is shared by other researchers, including Overland and Wang (2007a, p. 1), who state: ‘‘Our experience (Overland and Wang 2007b) as well as others (Knutti et al. 2006) suggest that one method to increase confidence in climate projections is to constrain the number of models by removal of major outliers through validating historical simulations against observations. This requirement is especially important for the Arctic.’’

Projection Results in the IPCC TAR and ACIA

This section briefly summarizes the climate model projections of the IPCC TAR and the ACIA, the principal reports used in the proposed rule (72 FR 1064), while the following section presents detailed results published subsequent to those reports, including in the IPCC AR4.

All models in the IPCC TAR predicted continued Arctic warming and continued decreases in the Arctic sea ice cover in the 21st century due to increasing global temperatures, although the level of increase varied between models. The TAR projected a global mean temperature increase of 1.4 degree C by the mid-21st century compared to the present climate for both the A2 and B2 scenarios (IPCC 2001b). Toward the end of the 21st century (2071 to 2100), the mean change in global average surface air temperature, relative to the period 1961–1990, was projected to be 3.0 degrees C (with a range of 1.3 to 4.5 degrees C) for the A2 scenario, and 2.2 degrees C (with a range of 0.9 to 3.4 degrees C) for the B2 scenario. Relative to glacier and sea ice change, the TAR reported that ‘‘The representation of sea-ice processes continues to improve, with several climate models now incorporating physically based treatments of ice dynamics * * *. Glaciers and ice caps will continue their widespread retreat during the 21st century and Northern Hemisphere snow cover and sea ice are projected to decrease further.’’

The ACIA concluded that, for both the A2 and B2 emissions scenarios, models projected mean temperature increases of 2.5 degrees C for the region north of 60 degrees N latitude by the mid-21st century (ACIA 2005, p. 100). By the end of the 21st century, Arctic temperature increases were projected to be 7 degrees C and 5 degrees C for the A2 and B2 scenarios, respectively, compared to the present climate (ACIA 2005, p. 100). Greater warming was projected for the autumn and winter than for the summer (ACIA 2005, p. 100).

The ACIA utilized projections from the five ACIA-designated AOGCMs to evaluate changes in sea ice conditions for three points in time (2020, 2050, and 2080) relative to the climatological baseline (2000) (ACIA 2005, p. 192). In 2020, the duration of the sea ice freezing period was projected to be shorter by 10 days; winter sea ice extent was expected to decline by 6 to 10 percent from baseline conditions; summer sea ice extent was expected to decline such that continental shelves were likely to be ice free; and there would be some reduction in multi-year ice, especially on shelves (ACIA 2005, Table 9.4). In 2050, the duration of the sea ice freezing period was projected to be shorter by 15 to 20 days; winter sea ice extent was expected to decline by 15 to 20 percent; summer sea ice extent was expected to decline 30 to 50 percent from baseline conditions; and there would be significant loss of multi-year ice, with no multi-year ice on shelves. In 2080, the duration of the sea ice freezing period was projected to be shorter by 20 to 30 days; winter sea ice extent was expected to decline such that there probably would be open areas in the high Arctic (Barents Sea and possibly Nansen Basin); summer sea ice extent was expected to decline 50 to 100 percent from baseline conditions; and there would be little or no multi-year ice.

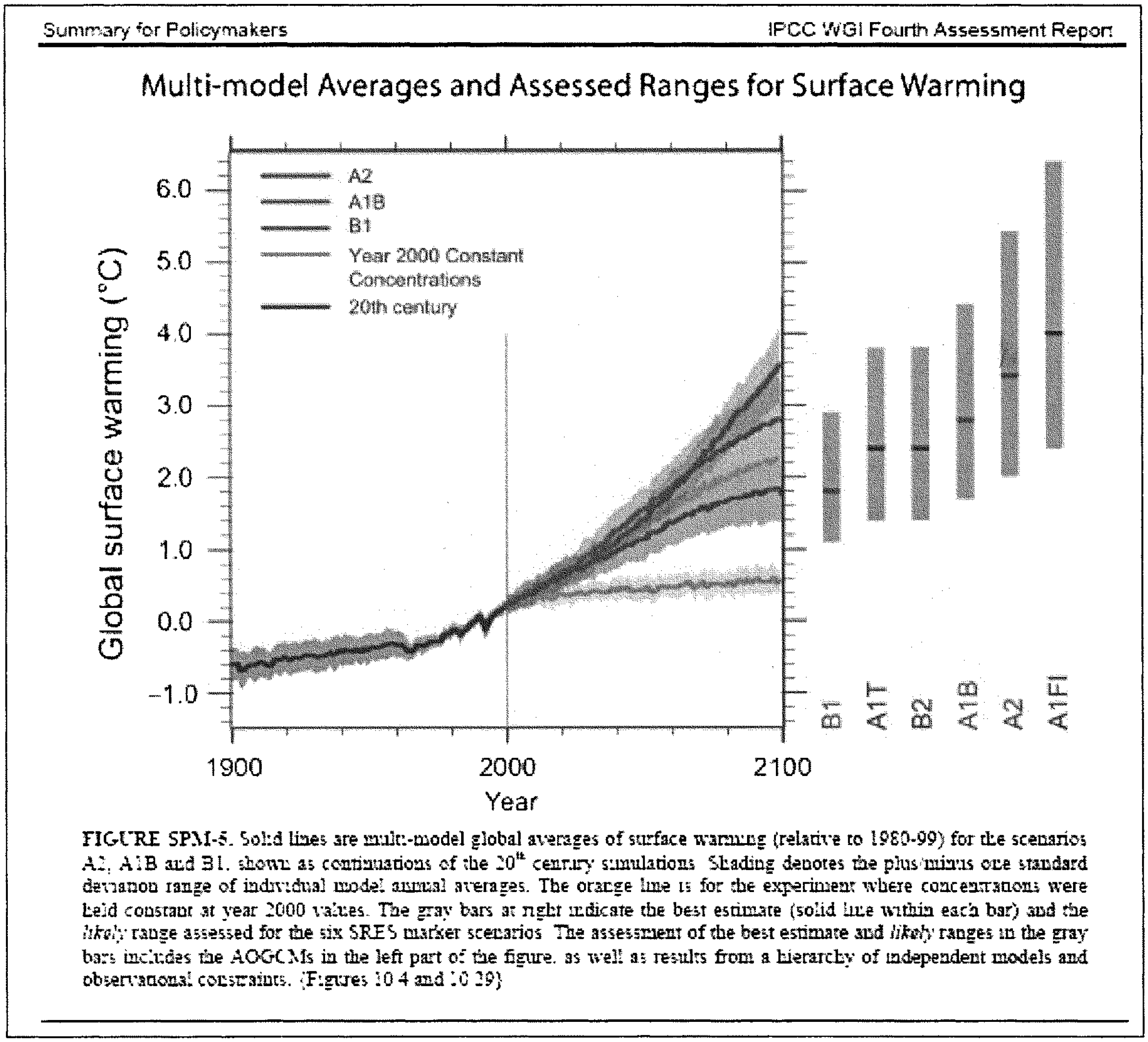
According to ACIA (2005, p. 193), one model indicated an ice-free Arctic during September by the mid-21st century, but this model simulated less than half of the observed September sea-ice extent at the start of the 21st century. None of the other models projected ice-free summers in the Arctic by 2100, although the sea-ice extent projected by two models decreased to about one-third of initial (2000) and observed September values by 2100.

Projection Results in the IPCC AR4 and Additional Projections

The IPCC AR4, released a few months after publication of our proposed listing rule for the polar bear (72 FR 1064), presents results from state-of-the-art climate models that are substantially improved over models used in the IPCC TAR and ACIA reports (M. Holland, NCAR, in litt. to the Service FWS, 2007; DeWeaver 2007). Results of the AR4 are presented in this section, followed by discussion of several key, peer-reviewed articles that discuss results presented in the AR4 in greater detail or use AR4 simulations to conduct additional, in-depth analyses.

In regard to surface air temperature changes, the IPCC AR4 states that the range of expected globally averaged surface air temperature warming shows limited sensitivity to the choice of SRES emissions scenarios for the early 21st century (between 0.64 and 0.69 degrees C for 2011 to 2030 compared to 1980 to 1999, a range of only 0.05 °C), largely due to climate change that is already committed (IPCC 2007, p. 749). By the mid-21st century (2046–2065), the choice of SRES scenario becomes more important for globally averaged surface air temperature warming (with increases of 1.3 degree C for the B1 scenario, 1.8 degree C for A1B, and 1.7 degree C for A2). During this time period, about a third of that warming is projected to be due to climate change that is already committed (IPCC 2007, p. 749).

The ''limited sensitivity'' of the results is because the state-of-the-art climate models used in the AR4 have known physics in connecting increases in GHGs to temperature increases through radiation processes (Overland and Wang 2007a, pp. 1–7, cited in J. Overland, NOAA, in litt. to the Service, 2007), and the GHG levels used in the SRES emissions scenarios are relatively similar until around 2040–2050 (see Figure 5). Because increases in GHGs have lag effects on climate and projections of GHG emissions can be extrapolated with greater confidence over the next few decades, model results projecting out for the next 40 to 50 years (near-term climate change estimates) have greater credibility than results projected much further into the future (long-term climate change) (J. Overland, NOAA, in litt. to the Service, 2007). Thus, the uncertainty associated with emissions is relatively smaller for the 45-year ''foreseeable future'' for the polar bear listing. After 2050, uncertainty associated with various climate mechanisms and policy/societal changes begins to increase, as reflected in the larger confidence intervals around the trend lines in Figure 5 beyond 2050.



Summary for Policymakers IPCC WGI Fourth Assessment Report

Multi-model Averages and Assessed Ranges for Surface Warming

FIGURE SPM-5. Solid lines are multi-model global averages of surface warming (relative to 1980-99) for the scenarios A2, A1B and B1, shown as continuations of the 20^{th} century simulations. Shading denotes the plus/minus one standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The gray bars at right indicate the best estimate (solid line within each bar) and the *likely* range assessed for the six SRES marker scenarios. The assessment of the best estimate and *likely* ranges in the gray bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints. {Figures 10.4 and 10.29}

Figure 5. Average projected global surface warming for SRES emissions scenarios in a multiple model ensemble (from IPCC 2007, p. 14).

However, even if GHG emissions had stabilized at 2000 levels, the global climate system would already be committed to a warming trend of about 0.1 degree C per decade over the next two decades, in the absence of large changes in volcanic or solar forcing. Meehl et al. (2006) conducted climate change scenario simulations using the Community Climate System Model, version 3 (CCSM3, National Center for Atmospheric Research), with all GHG emissions stabilized at 2000 levels, and found that the global climate system would already be committed to 0.40 degree C more warming by the end of the 21st century.

With respect to warming in the Arctic itself, the AR4 concludes: ''At the end of the 21st century, the projected annual warming in the Arctic is 5 degrees C, estimated by the multi-model A1B ensemble mean projection'' (see IPCC 2007, p. 908, Fig. 11.21). The across-model range for the A1B scenario varied from 2.8 to 7.8 degrees C. Larger mean warming was found for the A2 scenario (5.9 degrees C), and smaller mean warming was found for the B1 scenario (3.4 degrees C); both with proportional across-model ranges. Chapman and Walsh (2007, cited IPCC 2007, p. 904) concluded that the across-model and across-scenario variability in the projected temperatures are both considerable and of comparable amplitude.

In regard to changes in sea ice, the IPCC AR4 concludes that, under the A1B, A2, and B1 SRES emissions scenarios, large parts of the Arctic Ocean are expected to be seasonally ice free by the end of the 21st century (IPCC 2007, p. 73). Some projections using the A2 and A1B scenarios achieve a seasonally ice-free Arctic by as early as 2080–2090 (IPCC 2007, p.771, Figure 10.13a, b). Sea ice reductions are greater in summer than winter, thus it is summer sea ice cover that is projected to be lost in some models by 2080–2090, not winter sea ice cover. The reduction in sea ice cover is accelerated by positive feedbacks in the climate system, including the ice-albedo feedback (which allows open water to receive more heat from the sun during summer, the insulating effect of sea ice is reduced and the increase in ocean heat transport to the Arctic further reduces ice cover) (IPCC 2007, p. 73).

While the conclusions of the IPCC TAR and AR4 are similar with respect to the Arctic, the confidence level associated with independent reviews of AR4 is greater, owing to improvements in the models used and the greater number of models and emissions scenarios considered (J. Overland, NOAA, in litt. to the Service, 2007). Climate models still have challenges modeling some of the regional differences caused by changing decadal climate patterns (e.g., Arctic Oscillation). To help improve the models further, the evaluation of AR4 models has been on-going both for how well they represent conditions in the 20th century and how their predicted results for the 21st century compare (Parkinson et al. 2006; Zhang and Walsh 2006; Arzel et al. 2006; Stroeve et al. 2007, pp. 1–5; Holland et al. 2006, pp. 1–5; Wang et al. 2007, pp. 1,093–1,107; Chapman and Walsh 2007).

Arzel et al. (2006) and Zhang and Walsh (2006) evaluate the sea ice results from the IPCC AR4 models in more detail. Arzel et al. (2006) investigated projected changes in sea ice extent and volume simulated by 13 AOGCMs (also known as GCMs) driven by the SRES A1B emissions scenario. They found that the models projected an average relative decrease in sea ice extent of 15.4 percent in March, 61.7 percent in September, and 27.7 percent on an annual basis when comparing the periods 1981–2000 and 2081–2100; the average relative decrease in sea ice volume was 47.8 percent in March, 78.9 percent in September, and 58.8 percent on an annual basis when comparing the periods 1981–2000 and 2081–2100. More than half the models (7 of 13) reach ice-free September conditions by 2100, as reported in some previous studies (Gregory et al. 2002, Johannessen et al. 2004, both cited in Arzel et al. 2006).

Zhang and Walsh (2006) investigated changes in sea ice area simulated by 14 AOGCMs driven by the SRES A1B, A2, and B1 emissions scenarios. They found that the annual mean sea ice area during the period 2080–2100 would be decreased by 31.1 percent in the A1B scenario, 33.4 percent in the A2 scenario, and 21.6 percent in the B1 scenario relative to the observed sea ice area during the period 1979–1999. They further determined that the area of multi-year sea ice during the period 2080–2100 would be decreased by 59.7 percent in the A1B scenario, 65.0 percent in the A2 scenario, and 45.8 percent in the B1 scenario relative to the ensemble mean multi-year sea ice area during the period 1979–1999.

Dumas et al. (2006) generated projections of future landfast ice thickness and duration for nine sites in the Canadian Arctic and one site on the Labrador coast using the Canadian Centre for Climate Modelling and Analysis global climate model (CGCM2). For the Canadian Arctic sites the mean maximum ice thickness is projected to decrease by roughly 30 cm (11.8 in) from 1970–1989 to 2041–2060 and by roughly 50–55 cm (19.7–21.7 in) from 1970–1989 to 2081–2100. Further, they projected a reduction in the duration of sea ice cover of 1 and 2 months by 2041–2060 and 2081–2100, respectively, from the baseline period of 1970–1989. In addition simulated changes in freeze-up and break-up revealed a 52-day later freeze-up and 30-day earlier break-up by 2081–2100.

Holland et al. (2006, pp. 1–5) analyzed an ensemble of seven projections of Arctic summer sea ice from the Community Climate System Model, version 3 (CCSM3; National Center for Atmospheric Research, USA) utilizing the SRES A1B emissions scenario. CCSM3 is the model that performed best in simulating the actual observations for Arctic ice extent over the PM satellite era (Stroeve et al. 2007, pp. 1–5). Holland et al. (2006, pp. 1–5) found that the CCSM3 simulations compared well to actual observations for Arctic ice extent over the PM satellite era, including the rate of its recent retreat. They also found that the simulations did not project that sea ice retreat would continue at a constant rate into the future. Instead, the CCSM3 simulations indicate abrupt shifts in the ice cover, with one CCSM3 simulation showing an abrupt transition starting around 2024 with continued rapid retreat for around 5 years. Every CCSM3 run had at least one abrupt event (an abrupt event being defined as a time when a 5-year running mean exceeded three times the 2001–2005 observed retreat) in the 21st century, indicating that near ice-free Septembers could be reached within 30–50 years from now.

Holland et al. (2006, pp. 1–5) also discussed results from 15 additional models used in the IPCC AR4, and concluded that 6 of 15 other models ''exhibit abrupt September ice retreat in the A1B scenario runs.'' The length of the transition varied from 3 to 8 years among the models. Thus, in these model simulations, it was found that once the Arctic ice pack thins to a vulnerable state, natural variability can trigger an abrupt loss of the ice cover so that seasonally ice-free conditions can happen within a decade's time (J. Stroeve, in litt. to the Service, November 2007).

Finally, Holland et al. (2006, pp. 1–5) noted that the emissions scenario used in the model affected the likelihood of future abrupt transitions. In models using the SRES B1 scenario (i.e., with GHG levels increasing at a slower rate), only 3 of 15 models show abrupt declines lasting from 3 to 5 years. In models using the A2 scenario (i.e., with

GHG levels increasing at a faster rate), 7 of 11 models with available data obtain an abrupt retreat in the ice cover; the abrupt events last from 3 to 10 years (Holland et al. 2006, pp. 1–5).

In order to increase confidence in climate model projections, several studies have sought to constrain the number of models used by validating climate change in the models simulations against actual observations (Knutti et al. 2006; Hall and Ou 2006). The concept is to create a shorter list of ''higher confidence'' models by removing outlier model projections that do not perform well when compared to 20th century observational data (Overland and Wang 2007a, pp. 1–7). This has been done for temperatures (Wang et al. 2007, pp. 1,093–1,107), sea ice (Overland and Wang 2007a, pp. 1–7; Stroeve et al. 2007, pp. 1–5), and sea level pressure (SLP; defined as atmospheric pressure at sea level) and precipitation (Walsh and Chapman, pers. comm. with J. Overland, NOAA, cited in litt. to the Service, 2007).

Overland and Wang (2007a, pp. 1–7) investigated future regional reductions in September sea ice area utilizing a subset of AR4 models that closely simulate observed regional ice concentrations for 1979–1999 and were driven by the A1B emissions scenario. They used a selection criterion, similar to Stroeve et al. (2007, pp. 1–5), to constrain the number of models used by removing outliers so as to increase confidence in the projections used. Out of an initial set of 20 potential models, 11 models were retained for the Arctic-wide area, 4 were retained for the Kara/Laptev Sea area, 8 were retained for the East Siberian/Chukchi Sea, and 11 were retained for the Beaufort Sea (Overland and Wang 2007a, pp. 1–7). Using these constrained subsets, Overland and Wang (2007a, pp. 1–7) found that there is: ''considerable evidence for loss of sea ice area of greater than 40 percent by 2050 in summer for the marginal seas of the Arctic basin. This conclusion is supported by consistency in the selection of the same models across different regions, and the importance of thinning ice and increased open water at mid-century to the rate of ice loss.'' More specifically, Overland and Wang (2007a, pp. 1–7) found that ''By 2050, 7 of 11 models estimate a loss of 40 percent or greater of summer Arctic ice area. Six of 8 models show a greater than 40 percent ice loss in the East Siberian/Chukchi Seas and 7 of 11 models show this loss for the Beaufort Sea. The percentage of models with major ice loss could be considered higher, as two of the models that retain sea ice are from the same Canadian source and thus cannot be considered to be completely independent. These results present a consistent picture: there is a substantial loss of sea ice for most models and regions by 2050'' (see Figure 6). With less confidence, they found that the Bering, Okhotsk, and Barents seas have a similar 40 percent loss of sea ice area by 2050 in winter; Baffin Bay/Labrador shows little change compared to current conditions (Overland and Wang 2007a, pp. 1–7). Overland and Wang (2007a, pp. 1–7) also note that the CCSM3 model (Holland et al. 2006, pp. 1–5) is one of the models with the most rapid ice loss in the 21st century; this model is also one of the best at simulating historical 20th century observations (also see Figure 12 in DeWeaver (2007)).

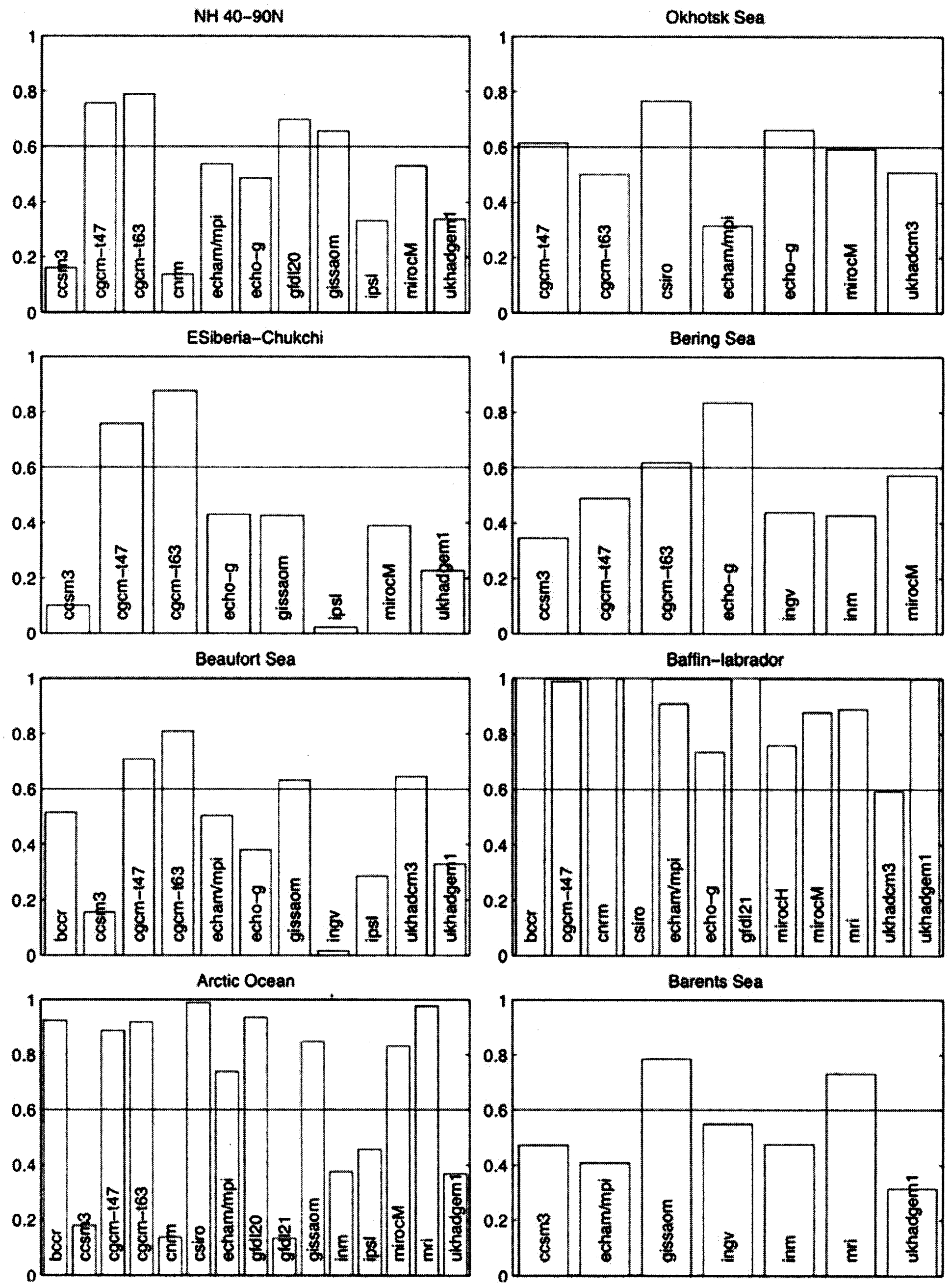


Figure 6. Change of summer sea ice area between 1979–1999 and 2045–2054, given as a fraction of ice remaining in various water bodies, and the northern hemisphere as a whole (NH 40-90N). The models that passed the selection criteria are shown for each water body. The line in each plot indicates a 40 percent reduction in the area of summer sea ice at 2050 versus the baseline period of 1979-1999 (figure from Overland and Wang 2007a, pp. 1-7, used with permission).

DeWeaver (2007), applying a similar conceptual approach as Overland and Wang (2007a, pp. 1–7) and Stroeve et al. (2007, pp. 1–5), used a selection criterion to construct an ensemble of 10 climate models that most accurately depicted sea-ice extent, from the 20 models that contributed sea ice data to the AR4. This 10-model ensemble was used by the USGS for assessing potential polar bear habitat loss (Durner et al. 2007). DeWeaver's selection criterion was to include only those models for which the mean 1953–1995 simulated September sea ice extent is within 20 percent of its actual observed value (as taken from the Hadley Center Sea Ice and Sea Surface Temperature (HadISST) data set (Raynor et al. 2003)). DeWeaver (2007) then investigated the future performance of his 10-model ensemble driven by the SRES A1B emissions scenario. He found that: all 10 models projected declines of September sea ice extent of over 30 percent by the middle of the 21st century (i.e., 2045–2055); 4 of 10 models projected declines September sea ice in excess of 80 percent by mid-21st century; and 7 of 10 models lose over 97 percent of their September sea ice by the end of the 21st century (i.e., 2090–2099) (DeWeaver 2007).

Stroeve et al. (2007, pp. 1–5) compared observed Arctic sea ice extent from 1953–2006 with 20th and 21st century simulation results from an ensemble of 18 AR4 models forced with the SRES A1B emission scenario. Like Overland and Wang (2007a) and DeWeaver (2007), Stroeve et al. (2007, pp. 1–5) applied a selection criterion to limit the number of models used for comparison. Of the original 18 models in the ensemble, 13 were selected because their performance simulating 20th century September sea ice extent satisfied the selection criterion established by the authors (i.e., model simulations for the the period 1953–1995 had to be within 20 percent of observations). The observational record for the Arctic by Stroeve et al. (2007, pp. 1–5) made use of a blended record of PM satellite-era (post November 1978) and pre-PM satellite era data (early satellite observation, aircraft and ship reports) described by Meier et al. (2007, pp. 428–434) and spanning the years 1953–2006 (Stroeve et al. 2007, pp. 1–5).

Stroeve et al.'s (2007, pp. 1–5) results revealed that the observed trend of September sea ice from 1953–2006 (a decline of 7.8 ± 0.6 percent per decade) is three times larger than the 13-model mean trend (a decline of 2.5 ± 0.2 percent per decade). In addition, none of the 13 models or their individual ensemble members has trends in September sea ice as large as the observed trend for the entire observation period (1953–2006) or the 11-year period 1995–2006 (Stroeve et al. 2007, pp. 1–5) (see Figure 7). March sea ice trends are not as dramatic, but the modeled decreases are still smaller than observed (Stroeve et al. 2007, pp. 1–5). Stroeve et al. (2007, pp. 1–5) offer two alternative interpretations to explain the discrepancies between the modeled results and the observational record. The first is that the ''observed September trend is a statistically rare event and imprints of natural variability strongly dominate over any effect of GHG loading'' (Stroeve et al. 2007, pp. 1–5). The second is that, if one accepts that the suite of simulations is a representative sample, ''the models are deficient in their response to anthropogenic forcing'' (Stroeve et al. 2007, pp. 1–5). Although there is some evidence that natural variability is influencing the sea ice decrease, Stroeve et al. (2007, pp. 1–5) believe that ''while IPCC AR4 models incorporate many improvements compared to their predecessors, shortcomings remain'' (Stroeve et al. 2007, pp. 1–5) when they are applied to the Arctic climate system, particularly in modeling Arctic Oscillation variability and accurately parameterizing sea ice thickness.

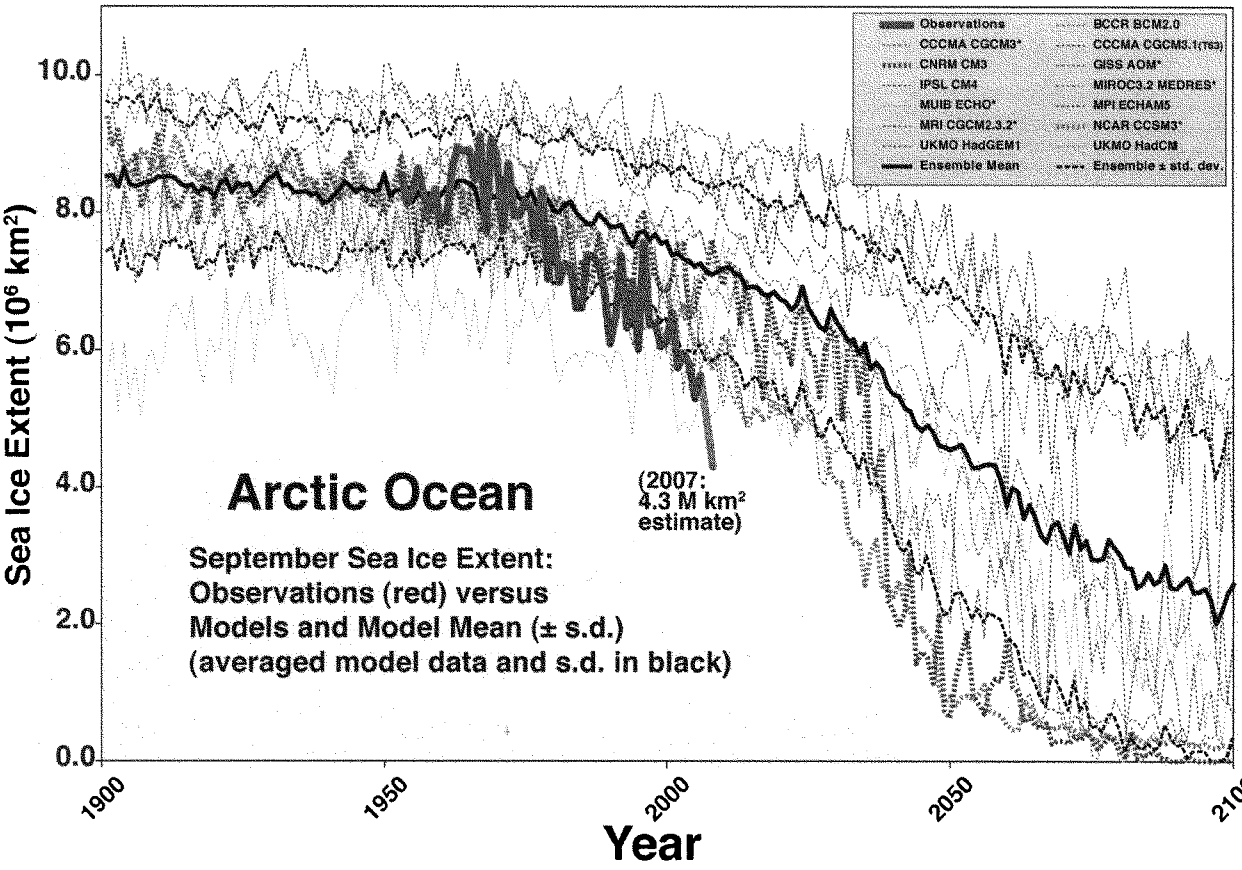


Figure 7. Arctic September sea ice extent. Comparison of observations with results of model runs (updated from Stroeve et al. 2007, pp. 1-5, used with permission).

The observational record indicates that current summer sea ice losses appear to be about 30 years ahead of the ensemble of modeled values, which suggests that a transition towards a seasonally ice-free Arctic might occur sooner than the models indicate (J. Stroeve, in litt. to the Service, November 2007). However, Stroeve et al. (2007, pp. 1–5) note that the two models that best match observations over the PM satellite era-CCSM3 and UKMO_HADGEM1 (Hadley Center for Climate Prediction and Research, UK)-incorporate relatively sophisticated sea ice models (McLaren et al. 2006 and Meehl et al. 2006, both cited in Stroeve et al. 2007, pp. 1–5). The same two models were mentioned by Gerdes and Koberle (2007) as having the most realistic sea ice thickness simulations. If only the results of CCSM3 are considered, as in Holland et al. (2006, pp. 1–5), model simulations compare well to actual observations for Arctic ice extent over the PM satellite era, including the rate of its recent retreat, and simulations of future conditions indicate that near ice-free Septembers could be reached within 30–50 years from now. If the record ice losses from the summer of 2007 are considered, it appears more likely the transition towards a seasonal ice cover will occur during the first half of this century (Stroeve et al. 2007, pp. 1–5) (see Figure 7). DeWeaver (2007) cautions that reliance on a multi-model ensemble is preferred to a single model, because the ensemble represents a balance between the desire to focus on the most credible models and the competing desire to retain a large enough sample to assess the spread of possible outcomes.

Projected Changes in Other Parameters

Air Temperature

As previously noted, IPCC AR4 simulations using a multi-model ensemble and the A1B emissions scenario project that, at the end of the 21st century (i.e., the period 2080–2099), the Arctic will be approximately 5 degrees C warmer, on an annual basis, than in the earlier part of 20th century (i.e., the period 1980–1999) (IPCC 2007, p. 904). Larger mean warming of 5.9 degrees C is projected for the A2 scenario, while smaller mean warming of 3.4 degrees C is projected for the B1 scenario. J. Overland (NOAA, in litt. to the Service, 2007) and associates recently estimated Arctic land temperatures north of 60 degrees N latitude out to 2050 for the 12 models selected in Wang et al. (2007, pp. 1,093–1,107). The average warming from this reduced set of models is an increase of 3 degrees C in surface temperatures; the range of model projections is 2–4 degrees C, which is an estimate of the range of uncertainly in scientists' ability to model Arctic climate. An increase in surface temperatures of 3 degrees C by 2050 will have a major impact on the timing of snowmelt timing (i.e., will lead to earlier snowmelt) (J. Overland, NOAA, in litt. to the Service, 2007).

Precipitation

The IPCC AR4 simulations show a general increase in precipitation over the Arctic at the end of the 21st century (i.e., the period 2080–2099) in comparison to the 20th century (i.e., the period 1980–1999) (IPCC 2007, p. 906). According to the AR4 report (IPCC 2007, p. 906), ‘‘the precipitation increase is robust among the models and qualitatively well understood, attributed to the projected warming and related increased moisture convergence.'' Differences between the projections for different emissions scenarios are small in the first half of the 21st century but increase later. ‘‘The spatial pattern of the projected change shows the greatest percentage increase over the Arctic Ocean (30 to 40 percent) and smallest (and even slight decrease) over the northern North Atlantic (less then 5 percent). By the end of the 21st century, the projected change in the annual mean arctic precipitation varies from 10 to 28 percent, with an ensemble median of 18 percent in the A1B scenario'' (IPCC 2007, p. 906). Larger mean precipitation increases are found for the A2 scenario with 22 percent; smaller mean precipitation increases are found for the B1 scenario with 13 percent. The percentage precipitation increase is largest in winter and smallest in summer, consistent with the projected warming. The across-model scatter of the precipitation projections is substantial.

Putkonen and Roe (2003) presented the results of a global climate modeling effort using an older simulation model (from the TAR era) that predicted a 40 percent increase in the worldwide area of land affected by rain-on-snow events from 1980–1989 to 2080–2089. Rennert et al. (2008) refined the estimate in Putkonen and Roe (2003) using daily data from a 5-member ensemble of the CCSM3 for the periods 1980–1999 and 2040–2059. The future scenario indicated increased frequency of rain-on-snow events in much of Alaska and far eastern Siberia. Decreases in rain-on-snow were shown broadly to be due to projected decreases in snow pack in the model, not a decrease in rain events.

Previous Federal Actions

Information about previous Federal actions for the polar bear can be found in our proposed rule and 12-month finding published in the **Federal Register** on January 9, 2007 (72 FR 1064), and the ‘‘Summary of Comments and Recommendations'' section below.

On April 28, 2008, the United States District Court for the Northern District of California ordered us to publish the final determination on whether the polar bear should be listed as an endangered or threatened species by May 15, 2008. AS part of its order, the Court ordered us to waive the standard 30-day effective date for the final determination.

Summary of Comments and Recommendations

In the January 9, 2007, proposed rule to list the polar bear as a threatened species under the Act (72 FR 1064), we opened a 90-day public comment period and requested that all interested parties submit factual reports, information, and comments that might contribute to development of a final determination for polar bear. The public comment period closed on April 9, 2007. We contacted appropriate Federal and State agencies, Alaska Native Tribes and tribal organizations, governments of polar bear range countries (Canada, Russian Federation, Denmark (Greenland) and Norway), city governments, scientific organizations, peer reviewers (see additional discussion below regarding peer review of proposed rule), and other interested parties to request comments. The Secretary of the Interior also announced the proposed rule and public comment period in a press release issued on December 27, 2006. Newspaper articles appeared in the *Anchorage Daily News, Washington Post, New York Times, Los Angeles Times, Wall Street Journal,* and many local or regional papers across the country, as well as local, national, and international television and radio news programs that also notified the public about the proposed listing and comment period.

In response to requests from the public, public hearings were held in Washington, DC (March 5, 2007), Anchorage, Alaska (March 1, 2007), and Barrow, Alaska (March 7, 2007). These hearings were announced in the **Federal Register** of February 15, 2007 (72 FR 7381), and in the Legal Section of the *Anchorage Daily News* (February 2, 2007). For the Barrow, Alaska, public hearing we established teleconferencing capabilities to provide an opportunity to receive testimony from outlying communities. The communities of Kaktovik, Gambell, Kotzebue, Shishmaref, and Point Lay, Alaska, participated in this public hearing via teleconference. The public hearings were attended by a total of approximately 305 people.

In addition, the Secretary of the Interior, at the time the proposal to list the polar bear as a threatened species was announced, asked the U.S. Geological Survey (USGS) to assist the Service by collecting and analyzing scientific data and developing models and interpretations that would enhance the base of scientific data for the Service's use in developing the final decision. On September 7, 2007, the USGS provided the Service with its analyses in the form of nine scientific reports that analyze and integrate a series of studies on polar bear population dynamics, range-wide habitat use, and changing sea ice conditions in the Arctic. The Service, in turn, reopened the public comment period on September 20, 2007 (72 FR 53749), for 15 days to notify the public of the availability of these nine reports, to announce our intent to consider the reports in making our final listing determination, and to ask the public for comments on the reports. On the basis of numerous requests from the public, including the State of Alaska, the public comment period on the nine reports was extended until October 22, 2007 (72 FR 56979).

While some commenters provided extensive technical comments on the reports, a thorough evaluation of comments received found no significant scientific disagreement regarding the adequacy or accuracy of the scientific information used in the reports. In general, comments on the nine reports raised the following themes: assertions that loss of sea ice reflects natural variability and not a trend; current population status or demographics do not warrant listing; new information justifies listing as endangered; and additional information is needed because of uncertainty associated with future climate scenarios. Commenters also re-iterated concerns and issues raised during the public comment period on the proposed rule. New, supplementary information became available following publication of the proposed rule that supports the climate models used in the nine USGS reports, and helps clarify the relative contribution of natural variability in future climate scenarios provided by the climate models. Comments on the significance of the status and demographic information helped clarify our analyses. We find that the USGS reports, in concert with additional new information in the literature, clarify our understanding of polar bears and their environment and support our initial conclusions regarding the status of the species. We believe the information presented by USGS and other sources provides a broad and solid scientific basis for the analyses and findings in this rule. Technical comments received from the public on the USGS reports and our responses to those comments are available on our website at: *http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm.*

During the public comment periods, we received approximately 670,000 comments including letters and post cards (43,513), e-mail (626,947), and public hearing testimony (75). We received comments from Federal agencies, foreign governments, State agencies, Alaska Native Tribes and tribal organizations, Federal commissions, local governments, commercial and trade organizations, conservation organizations, non-governmental organizations, and private citizens.

Comments received provided a range of opinions on the proposed listing, as follows: (1) unequivocal support for the listing with no additional information included; (2) unequivocal support for the listing with additional information provided; (3) equivocal support for the listing with or without additional information included; (4) unequivocal opposition to the listing with no additional information included; and (5) unequivocal opposition to the listing with additional information included. Outside the public comment periods, we received an additional approximately 58,000 cards, petitions, and letters pertaining to the proposed listing of the polar bear as a threatened species. We reviewed those submissions in detail for content and found that they did not provide information that was substantively diiferent from what we had already received. Therefore, we determined that reopening the comment period was not necessary.

To accurately review and incorporate the publicly-provided information in our final determination, we worked with the eRulemaking Research Group, an academic research team at the University of Pittsburgh that has developed the *Rule-Writer's Workbench* (RWW) analytical software. The RWW enhanced our ability to review and consider the large numbers of comments, including large numbers of similar comments, on our proposed listing, allowing us to identify similar comments as well as individual ideas, data, recommendations, or suggestions on the proposed listing.

Peer Review of the Proposed Rule

In accordance with our policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion on information contained in the proposed rule from 14 knowledgeable individuals with scientific expertise that includes familiarity with the polar bear, the geographic region in which the polar bear occurs, Arctic ecology, climatology, and Traditional Ecological Knowledge (TEK). The selected polar bear specialists included scientists from all polar bear range countries, and who work in both academia and in government. The selected climate scientists are all active in research and published in Arctic climate systems and sea ice dynamics. We sought expertise in TEK from internationally recognized native organizations.

We received responses from all 14 peer reviewers. Thirteen peer reviewers found that, in general, the proposed rule represented a thorough, clear, and balanced review of the best scientific information available from both published and unpublished sources of the current status of polar bears. The one exception expressed concern that the proposed rule was flawed, biased, and incomplete, that it would do nothing to address the underlying issues associated with global warming, and that a listing would be detrimental to the Inuit of the Arctic. In addition, peer reviewers stated that the background material on the ecology of polar bears represents a solid overview of the species' ecology relevant to the issue of population status. They also stated that information about the five natural or manmade factors that may already have affected polar bear populations, or may affect them in the future, is presented and evaluated in a fair and balanced way and is based on scientifically sound data. They further stated that the information as presented justified the conclusion that polar bears face threats throughout their range. Several peer reviewers provided additional insights to clarify points in the proposed rule, or references to recently-published studies that update material in the proposal.

Several peer reviewers referenced the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC AR4). Reports from Working Groups I, II, and III of the IPCC AR4 were published earlier in 2007, and the AR4 Synthesis Report was released in November 2007. The Working Group I report updates information in the proposed rule with considerable new observational information on global climate change, as well results from independent scientific review of the results from over 20 current-generation climate models. The significance of the Working Group I report, as noted by the peer reviewers with climatological expertise, is that the spatial resolution and physics of climate models have improved such that uncertainties associated with various model components, including prescribed ocean conditions, mobile sea ice, clouds/radiation, and land/atmosphere exchanges, have been reduced significantly from previous-generation models (i.e., those used in the IPCC *Third Assessment Report*).

One peer reviewer recommended that appropriate effort should be made to integrate the existing sources of Alaska native and other indigenous traditional and contemporary ecological knowledge (TEK) into our final rule. In addition, the peer reviewer recommended that we actively conduct community outreach to obtain this information from Alaska villages located within the range of the polar bear.

One peer reviewer opposed the listing and asserted that existing regulatory mechanisms are adequate because the Inuit people will account for climate change in setting harvest quotas for polar bears.

Peer Review Comments

We reviewed all comments received from peer reviewers for substantive issues and new information regarding the proposed designation of the polar bear as a threatened species. Comments and responses have been consolidated into key issues in this section.

Comment PR1: The importance of sea ice to polar bears is not well articulated in the proposed rule, and the consequences of polar bears using land as an alternative ‘‘platform’’ are understated.

Our response: We recognize the vital importance of sea ice as habitat for polar bears. New information and analyses of specific sea ice characteristics important to polar bears has been prepared by USGS (Durner et al. 2007), and incorporated into this final rule. Projections of changes to sea ice and subsequent effects on resource values to polar bears during the foreseeable future have also been included in the analyses in this final rule (see ‘‘Polar Bear—Sea Ice Habitat Relationships’’ section). The consequences of prolonged use of terrestrial habitats by polar bears are also discussed in detail in the ‘‘Effects of Sea Ice Habitat Change on Polar Bears’’ section of this final rule. We believe that we have objectively assessed these consequences, and have not under- or overstated them.

Comment PR2: The importance of snow cover to successful reproduction by polar bears and their primary prey, ringed seals, should receive greater emphasis.

Our response: We recognize the importance of snow cover for denning polar bears and pupping ringed seals. Additional new information has been included in the sections on climate and the section ‘‘Effects of Sea Ice Habitat Changes on Polar Bear Prey,’’ ‘‘Maternal Denning Habitat,’’ and ‘‘Access to and Alteration of Denning Areas’’ sections.

Comment PR3: Harvest programs in Canada provide conservation benefits for polar bears and are therefore important to maintain. In addition, economic benefits from subsistence hunting and sport hunting occur.

Our response: We recognize the important contribution to conservation that scientifically based sustainable use programs can have. We further recognize the past significant benefits to polar bear management in Canada that have accrued as a result of the 1994 amendments to the MMPA that allow U.S. citizens who legally sport-harvest a polar bear from an MMPA-approved population in Canada to bring their trophies back into the United States. In addition, income from fees collected for trophies imported into the United States are directed by statute to support polar bear research and conservation programs that have resulted in conservation benefits to polar bears in the Chukchi Sea region.

We recognize that hunting provides direct economic benefits to local native communities that derive income from supporting and guiding hunters, and also to people who conduct sport hunting programs for U.S. citizens. However these benefits cannot be and have not been factored into our listing decision for the polar bear.

We note that, under the MMPA, the polar bear will be considered a ‘‘depleted’’ species on the effective date of this listing. As a depleted species, imports could only be authorized under the MMPA if the import enhanced the survival of the species or was for scientific research. Therefore, authorization for the import of sport-hunted trophies will no longer be available under section 104(c)(5) of the MMPA. Neither the Act nor the MMPA restricts take beyond the United States and the high seas, so otherwise legal take in Canada is not affected by the threatened listing.

Comment PR4: The ability of polar bears to adapt to a changing environment needs to be addressed directly, with a focus on the importance of rates of environmental change relative to polar bear generation time.

Our response: We have addressed this issue by adding a section to the final rule entitled ‘‘Adaptation’’ under ‘‘Summary of Factors Affecting the Polar Bear.’’ Information regarding how polar bears survived previous warming events is scant, but some evidence indicates that polar bears survived by altering their geographic range, rather than evolving through natural selection. The pace at which ice conditions are changing and the long generation time of polar bears appear to preclude adaptation of new physiological mechanisms and physical characteristics through natural selection. In addition, the known current physiological, physical, and behavioral characteristics of polar bears suggest that behavioral adaptation will be insufficient to prevent a pronounced reduction in polar bear distribution, and therefore abundance, as a result of declining sea ice. Current evidence suggests there is little likelihood that extended periods of torpor, consumption of terrestrial foods, or capture of seals in open water will be sufficient mechanisms to counter the loss of sea ice as a platform for hunting seals. Projections of population trends based upon habitat availability, as discussed in the USGS reports by Durner et al. (2007) and Amstrup et al. (2007) serve to further clarify the changes currently occurring, or expected to occur, as sea ice declines.

Comment PR5: Harvest levels for some polar bear populations in Nunavut (Canada) are not sustainable and should be discussed; however, these concerns do not materially alter the primary finding of the proposed rule.

Our response: Although we have some concerns about the current harvest levels for some polar populations in Nunavut, we agree that these concerns do not materially alter the primary finding of the proposed rule. As discussed in Factors B and D, impacts from sport hunting or harvest are not threats to the species throughout its range. We recognize that, as discussed in detail in this final rule, the management of polar bears in Canada and other countries is evolving. We believe that our evaluation of the management of the polar bear populations in Canada, which includes participation in the annual Canadian Polar Bear Technical Committee (PBTC) meeting, provides us with the best available information upon which to base future management decisions.

Comment PR6: The most important aspect relative to climate change is that the most recent assessment of the IPCC (AR4) includes projections that climate warming and sea ice decline are likely to continue. This new information as well as other new sea ice information needs to be incorporated into the final analysis.

Our response: We agree that new information on climate warming and sea ice decline, as discussed in the IPCC AR4 as well as numerous other recent scientific papers, is of great significance relative to assessing polar bear habitat and population status and trends. Our final analysis has been updated to incorporate this new information (see ''Sea Ice Habitat'' and ''Polar Bear—Sea Ice Habitat Relationships'' sections).

Comment PR7: Polar bear population status information needs to highlight areas of both population decline and population increase, and the relationship of the two to overall status of the species.

Our response: Our final analysis has been updated with new population information (see ''Current Population Status and Trend'' section).

Comment PR8: The Service did not consider the impacts of listing the polar bear on Inuit economies.

Our response: Under section 4(b)(1)(A) of the Act, we must base a listing decision solely on the best scientific and commercial data available as it relates to the listing five factors in section 4(a)(1) of the Act. The legislative history of this provision clearly states the intent of Congress to ensure that listing decisions are ''* * * based solely on biological criteria and to prevent non-biological criteria from affecting such decisions * * *'' (House of Representatives Report Number 97–835, 97th Congress, Second Session 19 (1982)). As further stated in the legislative history, ''* * * economic considerations have no relevance to determinations regarding the status of species * * *'' (Id. at 20).

Comment PR9: Concerning sport hunting, listing will not help reduce take of polar bears.

Our response: As discussed under Factors B and D below, we recognize that sport hunting or other forms of harvest (both legal and illegal) may be affecting several polar bear populations, but we have determined that overutilization is not a threat to the species throughout all or a significant portion of its range. Amstrup et al. (2007) found that the impact of harvest on the status of polar bear populations is far outweighed by the effects of sea ice losses projected into the future. In addition, we have concluded that, in general, national and local management regimes established for the sustainable harvest of polar bears are adequate. We have determined that polar bear harvest by itself, in the absence of declines due to changes in sea ice habitat, would not be a sufficient threat to justify listing the species in all or a significant portion of its range. However, we have also concluded that harvest may become a more important factor in the future for populations experiencing nutritional stress.

Comment PR10: Inuit will account for climate change in setting subsistence harvest quotas, thus the existing regulatory mechanism is adequate.

Our response: As discussed in this final rule (see ''Polar Bear—Sea Ice Habitat Relationships'' section), the loss of sea ice habitat is considered to threaten the polar bear throughout its range. Adjusting harvest levels based on the consequences of habitat loss and corresponding reduction in physical condition, recruitment, and survival rates is prudent and precautionary, and such adjustments may be addressed through existing and future harvest management regimes. However, we find that these steps will not be sufficient to offset population declines resulting from loss of sea ice habitat.

Comment PR11: The proposed rule does not adequately reflect the state of traditional and contemporary indigenous knowledge regarding polar bears and climate change.

Our response: We have further expanded this rule to include information obtained from Kavry's work in Chukotka, Russia (Kochnev et al. 2003) and Dowsley and Taylor's work in Nunavut, Canada (Dowsley and Taylor 2005), as well as information received during our public hearings. Additionally, we have reviewed information available on polar bears and climate change from the Alaska Native Science Commission (*http://www.nativescience.org/issues/climatechange.htm*). Discussion documents available on their web page generally support the conclusions reached in this document; for example, they observe that: ''Saami are seeing their reindeer grazing pastures change, Inuit are watching polar bears waste away because of a lack of sea ice, and peoples across the Arctic are reporting new species, particularly insects'' (*http://www.arcticpeoples.org/KeyIssues/ClimateChange/Start.html*). Thus, traditional and contemporary indigenous knowledge recognizes that climate-related changes are occurring in the Arctic and that these changes are negatively impacting polar bears.

Comment PR12: The proposed rule does not sufficiently question the reliability of scientific models used. Science is not capable of responding to vague terms such as ''it is likely'' ''foreseeable future.''

Our response: Literature used in the proposed rule was the best available peer-reviewed scientific information at the time. The proposed rule was based largely on results presented in the *Arctic Climate Impact Assessment* (ACIA 2005) and the IPCC *Third Assessment Report* (TAR) (IPCC 2001), plus several individual peer-reviewed journal articles. The ACIA and IPCC TAR are synthesis documents that present detailed information on climate observations and projections, and represent the consensus view of a large number of climate change scientists. Thus, they constituted the best scientific information available at the time the proposed rule was drafted. The proposed rule contained a determination of ''foreseeable future'' (i.e., 45 years) as it pertains to a possible listing of polar bears under the Act, and an explanation of how that 45-year timeframe was determined. This final rule contains the same determination of ''foreseeable future'' (i.e., 45 years), as well as an explanation of how that 45-year timeframe was determined (through a consideration of reliable data on changes currently being observed and projected for the polar bear's sea ice habitat, and supported by information on the life history (generation time) and population dynamics of polar bears). Thus, we disagree with the commenter that this is a vague term.

The final rule has been revised to reflect the most current scientific information, including the results of the IPCC AR4 plus a large number of peer-reviewed journal articles. The IPCC AR4 assigns specific probability values to terms such as ''unlikely,'' ''likely,'' and ''very likely.'' We have attempted to use those terms in a manner consistent with how they are used in the IPCC AR4.

We have taken our best effort to identify the limitations and uncertainties of the climate models and their projections used in the proposed rule. In this final rule, we have provided a more detailed discussion to ensure a balanced analysis regarding the causes and potential impacts of climate change, and have discussed the limitations and uncertainties in the information that provided the basis for our analysis and decision.

Public Comments

We reviewed all comments received from the public for substantive issues and new information regarding the proposed designation of the polar bear as a threatened species. Comments and responses have been consolidated into key issues in this section.

Issue 1: Polar Bear Population Decline

Comment 1: Current polar bear populations are stable or increasing and the polar bear occupies its entire historical range. As such, the polar bear is not in imminent danger of extinction and, therefore, should not be listed under the Act.

Our response: We agree that polar bears presently occupy their available range and that some polar bear populations are stable or increasing. As discussed in the ''Current Population Status and Trend'' section of the rule, two polar bear populations are designated by the PBSG as increasing (Viscount Melville Sound and M'Clintock Channel); six populations are stable (Northern Beaufort Sea, Southern Hudson Bay, Davis Strait, Lancaster Sound, Gulf of Bothia, Foxe Basin); five populations are declining (Southern Beaufort Sea, Norwegian Bay, Western Hudson Bay, Kane Basin, Baffin Bay), and six populations are designated as data deficient (Barents Sea, Kara Sea, Laptev Sea, Chukchi Sea, Arctic Basin, East Greenland) with no estimate of trend (Aars et al. 2006). The two populations with the most extensive time series of data, Western Hudson Bay and Southern Beaufort Sea, are considered to be declining. The two increasing populations (Viscount Melville Sound and M'Clintock Channel) were severely reduced in the past as a result of overharvest and are now recovering as a result of coordinated international efforts and harvest management.

The current status must be placed in perspective, however, as many populations were declining prior to 1973 due to severe overharvest. In the past, polar bears were harvested extensively throughout their range for the economic or trophy value of their pelts. In response to the population declines, five Arctic nations (Canada, Denmark on behalf of Greenland, Norway, Union of Soviet Socialist Republics, and the United States), recognized the polar bear as a significant resource and adopted an inter-governmental approach for the protection and conservation of the species and its habitat, the 1973 Agreement on the Conservation of Polar Bears (1973 Agreement). This agreement limited the use of polar bears for specific purposes, instructed the Parties to manage populations in accordance with sound conservation practices based on the best available scientific data, and called the range States to take appropriate action to protect the ecosystems upon which polar bears depend. In addition, Russia banned harvest in 1956, harvest quotas were established in Canada in 1968, and Norway banned hunting in 1973. With the passage of the MMPA in 1972, the United States banned sport hunting of polar bears and limited the hunt to Native people for subsistence purposes. As a result of these coordinated international efforts and harvest management leading to a reduction in harvest, polar bear numbers in some previously-depressed populations have grown during the past 30 years.

We have determined that listing the polar bear as a threatened species under the Act is appropriate, based on our evaluation of the actual and projected effects of the five listing factors on the species and its habitat. While polar bears are currently distributed throughout their range, the best available scientific information, including new USGS studies relating status and trends to loss of sea ice habitat (Durner et al. 2007; Amstrup et al. 2007), indicates that the polar bear is not currently in danger of extinction throughout all or a significant portion of their range, but are likely to become so within the 45-year ''foreseeable future'' that has been established for this rule. This satisfies the definition of a threatened species under the Act; consequently listing the species as threatened is appropriate. For additional information on factors affecting, or projected to affect, polar bears, please see the ''Summary of Factors Affecting the Polar Bear'' section of this final rule.

Comment 2: The perceived status of the Western Hudson Bay population is disputed because data are unreliable, earlier population estimates cannot be compared to current estimates, and factors other than climate change could contribute to declines in the Western Hudson Bay population.

Our response: The Western Hudson Bay population is the most extensively studied polar bear population in the world. Long-term demographic and vital rate (e.g., survival and recruitment) data on this population exceed those available for any other polar bear population. Regehr et al. (2007a) used the most advanced analysis methods available to conduct population analyses of the Western Hudson Bay population. Trend data demonstrate a statistically-significant population decline over time with a substantial level of precision. The authors attributed the population decline to increased natural mortality associated with earlier sea ice breakup and to the continued harvest of approximately 40 polar bears per year. Other factors such as the effects of research, tourism harassment, density dependence, or shifts in distribution were not demonstrated to impact this population. Regehr et al. (2007a) indicated that overharvest did not cause the population decline; however, as the population declined, harvest rates could have contributed to further depressing the population. Additional information has been included in the ''Western Hudson Bay'' section of this final rule that provides additional details on these points.

Comment 3: The apparent decline in the Southern Beaufort Sea population is not significantly different from the previous population estimate.

Our response: The Southern Beaufort Sea and Western Hudson Bay populations are the two most studied polar bear populations. Regehr et al. (2006) found no statistically significant difference between the most recent and earlier population estimates for the Southern Beaufort Sea population due to the large confidence interval for the earlier population estimate, which caused the confidence intervals for both estimates to overlap. However, we note that the Southern Beaufort Sea population has already experienced decreases in cub survival, significant decreases in body weights for adult males, and reduced skull measurements (Regehr et al. 2006; Rode et al. 2007). Similar changes were documented in the Western Hudson Bay population before a statistically significant decline in that population was documented (Regehr et al. 2007a). The status of the Southern Beaufort Sea population was determined to be declining on the basis of declines in vital rates, reductions in polar bear habitat in this area, and declines in polar bear condition, factors noted by both the Canadian Polar Bear Technical Committee (PBTC 2007) and the IUCN Polar Bear Specialist Group (Aars et al. 2006).

Comment 4: Population information from den surveys of the Chukchi Sea polar bear population is not sufficiently reliable to provide population estimates.

Our response: We recognize that the population estimates from previous den and aerial surveys of the Chukchi Sea population (Chelintsev 1977; Derocher et al. 1998; Stishov 1991a, b; Stishov et al. 1991) are quite dated and have such wide confidence intervals that they are of limited value in determining population levels or trends for management purposes. What the best available information indicates is that, while the status of the Chukchi Sea population is thought to have increased following a reduction of hunting pressure in the United States, this population is now thought to be declining due primarily to overharvest. Harvest levels for the past 10–15 years (150–200 bears per year), which includes the legal harvest in Alaska and an illegal harvest in Chukoktka, Russia, are probably unsustainable. This harvest level is close to or greater than the unsustainable harvest levels experienced prior to 1972 (when approximately 178 bears were taken per year). Furthermore, this population has also been subject to unprecedented summer/autumn sea ice recessions in recent years, resulting in a redistribution of more polar bears to terrestrial areas in some years. Please see additional discussion of this population in the ''Current Population Status and Trend'' section of this document.

Comment 5: Interpretation of population declines is questionable due, in some cases, to the age of the data and in other cases the need for caution due to perceived biases in data collection.

Our response: We used the best available scientific information in assessing population status, recognizing the limitations of some of the information. This final rule benefits from new information on several populations (Obbard et al. 2007; Stirling et al. 2007; Regehr et al. 2007a, b) and additional analyses of the relationship between polar bear populations and sea ice habitat (Durner et al. 2007). New information on population status and trends is included in the ''Current Population Status and Trend'' section of this rule.

Comment 6: Polar bear health and fitness parameters do not provide reliable insights into population trends.

Our response: We recognize there are limits associated with direct correlations between body condition and population dynamics; however changes in body condition have been shown to affect reproduction and survival, which in turn can have population level effects. For example, the survival of polar bear cubs-of-the-year has been directly linked to their weight and the weight of their mothers, with lower weights resulting in reduced survival (Derocher and Stirling 1996; Stirling et al. 1999). Changes in body condition indices were documented in the Western Hudson Bay population before a statistically significant decline in that population was documented (Regehr et al. 2007a). Thus, changes in these indices serve as an ''early warning'' that may signal imminent population declines. New information from Rode et al. (2007) on the relationship between polar bear body condition indices and sea ice cover is also included in the ''Effects of Sea Ice Habitat Change on Polar Bears'' section of this final rule.

Comment 7: Polar bears have survived previous warming events and therefore can adapt to current climate changes.

Our response: We have addressed this issue by adding two sections to the final rule entitled ''Adaptation'' and ''Previous Warming Periods and Polar Bears'' under ''Summary of Factors Affecting the Polar Bear.'' To summarize these sections, we find that the long generation time of polar bears and the known physiological and physical characteristics of polar bears significantly constrain their ability to adapt through behavioral modification or natural selection to the unprecedentedly rapid loss of sea ice habitat that is occurring and is projected to continue throughout the species' range. Derocher et al. (2004, p. 163, 172) suggest that this rate of change will limit the ability of polar bears to respond and survive in large numbers. In addition, polar bears today experience multiple stressors (e.g., harvest, contaminants, oil and gas development, and additional interactions with humans) that were not present during historical warming periods. Thus, both the cumulative effects of multiple stressors and the rapid rate of climate change today create a unique and unprecedented challenge for present-day polar bears in comparison to historical warming events. See also above response to Comment PR4.

Comment 8: Polar bears will adapt and alternative food sources will provide nutrition in the future. There are many food resources that polar bears could exploit as alternate food sources.

Our response: New prey species could become available to polar bears in some parts of their range as climate change affects prey species distributions. However, polar bears are uniquely adapted to hunting on ice and need relatively large, stable seal populations to survive (Stirling and Øritsland 1995). The best available evidence indicates that ice-dependent seals (also called ''ice seals'') are the only species that would be accessible in sufficient abundance to meet the high energetic requirements of polar bears. Polar bears are not adapted to hunt in open water, therefore, predation on pelagic (open-ocean) seals, walruses, and whales, is not likely due to the energetic effort needed to catch them in an open-water environment. Other ice-associated seals, such as harp or hooded seals, may expand their ranges and provide a near-term source of supplemental nutrition in some areas. Over the long term, however, extensive periods of open water may ultimately stress seals as sea ice (summer feeding habitat) retreats further north from southern rookeries. We found no new evidence suggesting that seal species with expanding ranges will be able to compensate for the nutritional loss of ringed seals throughout the polar bear's current range. Terrestrial food sources (e.g., animal carcasses, birds, musk oxen, vegetation) are not likely to be reliably available in sufficient amounts to provide the caloric value necessary to sustain polar bears. For additional information on this subject, please see the expanded discussion of ''Adaptation'' under ''Summary of Factors Affecting the Polar Bear.''

Comment 9: Commenters expressed a variety of opinions on the determination of ''foreseeable future'' for the polar bear, suggesting factors such as the number and length of generations as well as the timeframe over which the threat can be analyzed be used to identify an appropriate timeframe.

Our response: ''Foreseeable future'' for purposes of listing under the Act is determined on the basis of the best available scientific data. In this rule, it is based on the timeframe over which the best available scientific data allow us to reliably assess the effect of threats—principally sea ice loss—on the polar bear, and is supported by species-specific factors, including the species' life history characteristics (generation time) and population dynamics. The timeframe over which the best available scientific data allow us to reliably assess the effect of threats on the species is the critical component for determining the foreseeable future. In the case of the polar bear, the key threat is loss of sea ice, the species' primary habitat. Available information, including results of the IPCC AR4, indicates that climate change projections over the next 40–50 years are more reliable than projections over the next 80–90 years. On the basis of our analysis, as reinforced by conclusions of the IPCC AR4, we have determined that climate changes projected within the next 40–50 years are more reliable than projections for the second half of the 21stcentury, for a number of reasons (see section on ''Projected Changes in Arctic Sea Ice'' for a detailed explanation). For this final rule, we have also identified three polar bear generations (adapted from the IUCN Red List criteria) or 45 years as an appropriate timeframe over which to assess the effects of threats on polar bear populations. This timeframe is long enough to take into account multi-generational population dynamics, natural variation inherent with populations, environmental and habitat changes, and the capacity for ecological adaptation (Schliebe et al. 2006a). The 45-year timeframe coincides with the timeframe within which climate model projections are most reliable. This final rule provides a detailed explanation of the rationale for selecting 45 years as the foreseeable future, including its relationship to observed and projected changes in sea ice habitat (as well as the precision and certainty of the projected changes) and polar bear life history and population dynamics. Therefore, this period of time is supported by species-specific aspects of polar bears and the time frame of projected habitat loss with the greatest reliability.

One commenter erroneously identified Congressional intent to limit foreseeable future to 10 years. We reviewed the particular document provided by the commenter-a Congressional Question & Answer response, dated September 26, 1972, which was provided by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration's Deputy Administrator Pollock. Rather than expressing Congressional intent, this correspondence reflects the Commerce Department's perspective at that time about foreseeable future and not Congressional intent. Furthermore, Mr. Pollock's generic observations in 1972 are not relevant to the best scientific data available regarding the status of the polar bear, which has been recognized by leading polar bear biologists as having a high degree of reliability out to 2050.

Issue 2: Changes in Environmental Conditions

Comment 10: An increase in landfast ice will result in increased seal productivity and, therefore, increased feeding opportunities for polar bears.

Our response: We agree that future feeding opportunities for polar bears will in part relate to how climate change affects landfast ice because of its importance as a platform for ringed seal lairs. As long as landfast ice is available, ringed seals probably will be available to polar bears. Research by Rosing-Asvid (2006) documented a strong increase in the number of polar bears harvested in Greenland during milder climatic periods when ringed seal habitat was reduced (less ice cover) and lair densities were higher because seals were concentrated; these two factors provide better spring hunting for polar bears. In contrast to periodic warming, however, climate models project continued loss of sea ice and changes in precipitation patterns in the Arctic. Seal lairs require sufficient snow cover for lair construction and maintenance, and snow cover of adequate quality that persists long enough to allow pups to wean prior to onset of the melt period. Several studies described in this final rule have linked declines in ringed seal survival and recruitment with climate change that has resulted in increased rain events (which has lead to increased predation on seals) and decreased snowfall. Therefore, while polar bears may initially respond favorably to a warming climate due to an increased ability to capture seals, future reductions in seal populations will ultimately lead to declines in polar bear populations. Additional information was added to the section ''Effects of Sea Ice Habitat Changes on Polar Bear Prey'' to clarify this point.

Comment 11: Polar bears will have increased hunting opportunities as the amount of marginal, unconsolidated sea ice increases.

Our response: Marginal ice occurs at the edge of the polar basin pack ice; ice is considered unconsolidated when concentrations decline to less than 50 percent. The ability of polar bears to catch a sufficient number of seals in marginal sea ice will depend upon both the characteristics of the sea ice and the abundance of and access to prey. Loss of sea ice cover will reduce seal numbers and accessibility to polar bears, as discussed in ''Reduced prey availability'' section of this final rule. Even if ringed seals maintained their current population levels, which is unlikely, Harwood and Stirling (2000) suggest that ringed seals would remain near-shore in open water during summer ice recession, thereby limiting polar bear access to them. Benthic (ocean bottom) feeders, such as bearded seals and walruses, may also decrease in abundance and/or accessibility as ice recedes farther away from shallow continental shelf waters. Increased open water and reduced sea ice concentrations will provide seals with additional escape routes, diminish the need to maintain breathing holes, and serve to make their location less predictable and less accessible to polar bears, resulting in lowered hunting success. Polar bears would also incur higher energetic costs from additional movements required for hunting in or swimming through marginal, unconsolidated sea ice. Additional information from Derocher et al. (2004) was added to the section ''Effects of Sea Ice Habitat Changes on Polar Bear Prey'' to clarify this point.

Comment 12: Polar bears will benefit from increased marine productivity as ocean waters warm farther north.

Our response: If marine productivity in the Arctic increases, polar bears may benefit from increased seal productivity initially, provided that sea ice habitat remains available. As previously mentioned, polar bears need sea ice as a platform for hunting. Evidence from Western Hudson Bay, Southern Hudson Bay, and Southern Beaufort Sea populations indicates that reductions in polar bear body condition in these populations are the result of reductions in sea ice. Additional new information on the relationship between body condition, population parameters, and sea ice habitat for the Southern Beaufort Sea population (Rode et al. 2007) has been incorporated into the section on effects of sea ice change on polar bears.

The extent to which marine productivity increases may benefit polar bears will be influenced, in part, by ringed seals' access to prey. Arctic cod (*Boreogadus saida*), which are the dominant prey item in many areas, depend on sea ice cover for protection from predators (Gaston et al. 2003). In western Hudson Bay, Gaston et al. (2003) detected Arctic cod declines during periods of reduced sea ice habitat. Should Arctic cod abundance decline in other areas, we do not know whether ringed seals will be able to switch to other pelagic prey or whether alternate food sources will be adequate to replace the reductions in cod.

Comment 13: Sufficient habitat will remain in the Canadian Arctic and polar region to support polar bears for the next 40–50 years; therefore, listing is not necessary.

Our response: Both the percentage of sea ice habitat and the quality of that habitat will be significantly reduced from historic levels over the next 40–50 years (Meehl et al. 2007; Durner et al. 2007; IPCC 2007). New information on the extent and magnitude of sea ice loss is included previously in the section entitled ''Observed Changes in Arctic Sea Ice'' of this rule. Reductions in the area, timing, extent, and types of sea ice,among other effects, are expected to increase the energetic costs of movement and hunting to polar bears, reduce access to prey, and reduce access to denning areas. The ultimate effect of these impacts are likely to result in reductions in reproduction and survival, and corresponding decreases in population numbers. We agree that receding sea ice may affect archipelagic polar bear populations later than populations inhabiting the polar basin, because seasonal ice is projected to remain present longer in the archipelago than in other areas of the polar bear's range. The high Arctic archipelago is limited however, in its ability to sustain a large number of polar bears because: (1) changes in the extent of ice and precipitation patterns are already occurring in the region; (2) the area is characterized by lower prey productivity (e.g., lower seal densities); and (3) polar bears moving into this area would increase competition among bears and ultimately affect polar bear survival. In addition, a small, higher-density population of polar bears in the Canadian Arctic would be subject to increased vulnerability to perturbations such as disease or accidental oil discharge from vessels. Because of the habitat changes anticipated in the next 40–50 years, and the corresponding reductions in reproduction and survival, and, ultimately, population numbers, we have determined that the polar bear is likely to be in danger of extinction throughout all or a significant portion of its range by 2050.

Issue 3: Anthropogenic Effects

Comment 14: Disturbance from and cumulative effects of oil and gas activities in the Arctic are underestimated or incompletely addressed.

Our response: Oil and gas activities will likely continue in the future in the Arctic. Additional, updated information has been included in the section ''Oil and Gas Exploration, Development, and Production'' in Factor A. We acknowledge that disturbance from oil and gas activities can be direct or indirect and may, if not subject to appropriate mitigation measures, displace bears or their primary prey (ringed and bearded seals). Such disturbance may be critical for denning polar bears, who may abandon established dens before cubs are ready to leave due to direct disturbance. We note that incidental take of polar bears due to oil and gas activities in Alaska are evaluated and regulated under the MMPA (Sec. 101a(5)A) and incidental take regulations are in place based on an overall negligible effect finding. Standard and site specific mitigation measures are prescribed by the Service and implemented by the industry (see detailed discussion in the section ''Marine Mammal Protection Act of 1972, as amended'' under Factor D).

Indirect and cumulative effects of the myriad of activities associated with major oil and gas developments can be a concern regionally. However, the effects of oil and gas activities, such as oil spills, are generally associated with low probabilities of occurrence, and are generally localized in nature, We acknowledge that the sum total of documented impacts from these activities in the past have been minimal (see discussion in the ''Oil and Gas Exploration, Development, and Production'' section). Therefore, we do not believe that we have underestimated or incompletely addressed disturbance from or cumulative effects of oil and gas activities on polar bears, and have accurately portrayed the effect of oil and gas activities on the status of the species within the foreseeable future.

Comment 15: The potential effects of oil spills on polar bears are underestimated, particularly given the technical limitations of cleaning up an oil spill in broken ice.

Our response: We do not wish to minimize our concern for oil spills in the Arctic marine environment. We agree that the effects of a large volume oil spill to polar bears could be significant within the specific area of occurrence, but we believe that the probability of such a spill in Alaska is generally very low. At a regional level we have concerns over the high oil spill probabilities in the Chukchi Sea under hypothetical future development scenarios (Minerals Management Service (MMS) 2007). An oil spill in this area could have significant consequences to the Chukchi Sea polar bear population (MMS 2007). However, under the MMPA, since 1991 the oil and gas industry in Alaska has sought and obtained incidental take authorization for take of small numbers of polar bears. Incidental take cannot be authorized under the MMPA unless the Service finds that any take that is likely to occur will have no more than a negligible impact on the species. Through this authorization process, the Service has consistently found that a large oil spill is unlikely to occur. The oil and gas industry has incorporated technological and response measures that minimize the risk of an oil spill. A discussion of potential additive effects of mortalities associated with an oil spill in polar bear populations where harvest levels are close to the maximum sustained yield has been included in this final rule (see discussion in the ''Oil and Gas Exploration, Development, and Production'' section).

Comment 16: The effects to polar bears from contaminants other than hydrocarbons are underestimated.

Our response: We added information on the status of regulatory mechanisms pertaining to contaminants, which summarizes what is currently known about the potential threat of each class of contaminants with respect to current production and future trends in production and use. Based on a thorough review of the scientific information on their sources, pathways, geographical distribution, and biological effects, and as discussed in the analysis section of this final rule, we do not believe that contaminants currently threaten the polar bear.

Comment 17: Cumulative effects of threat factors on polar bear populations are important, and need a more indepth analysis than presented in the proposed rule.

Our response: The best available information on the potential cumulative effects from oil and gas activities in Alaska to polar bears and their habitat was incorporated into the final rule (National Research Council (NRC) 2003). We also considered the cumulative effects of hunting, contaminants, increased shipping, increases in epizootic events, and inadequacy of existing regulatory mechanisms in our analyses. We have determined that there are no known regulatory mechanisms in place at the national or international level that directly and effectively address the primary threat to polar bears-the rangewide loss of sea ice habitat within the foreseeable future. We also acknowledge that there are some existing regulatory mechanisms to address anthropogenic causes of climate change, and these mechanisms are not expected to be effective in counteracting the worldwide growth of GHG emissions within the foreseeable future. In addition, we have determined that overutilization does not currently threaten the species throughout all or a significant portion of its range. However, harvest is likely exacerbating the effects of habitat loss in several populations. In addition, continued harvest and increased mortality from bear-human encounters or other forms of mortality may become a more significant threat factor in the future, particularly for populations experiencing nutritional stress or declining population numbers as a consequence of habitat change. We have found that the other factors, while not currently rising to a level that threatens the species, may become more significant in the future as populations face stresses from habitat loss. Modeling of potential effects on polar bears of various factors (Amstrup et al. 2007) identified loss of sea ice habitat as the dominant threat. Therefore, our analysis in this final rule has focused primarily on the ongoing and projected effects of sea ice habitat loss on polar bears within the foreseeable future.

Issue 4: Harvest

Comment 18: Illegal taking of bears is a significant issue that needs additional management action.

Our response: We recognize that illegal take has an impact on some polar bear populations, especially for the Chukchi Sea population and possibly for other populations in Russia. We also believe that a better assessment of the magnitude of illegal take in Russia is needed, and that illegal harvest must be considered when developing sustainable harvest limits. We also conclude that increased use of coastal habitat by polar bears could increase the impact of illegal hunting in Russia, by bringing bears into more frequent contact with humans. However, available scientific information indicates that poaching and illegal international trade in bear parts do not threaten the species throughout all or a significant portion of its range.

Comment 19: The Service should not rely solely on the Bilateral Agreement to remedy illegal take in Russia. Listing under the Act is necessary to allow for continued legal subsistence hunting.

Our response: As discussed in the ''Summary of Factors Affecting the Polar Bear'' section of this rule, we have found that harvest and poaching affect some polar bear populations, but those effects are not significant enough to threaten the species throughout all or a significant portion of its range. To the extent that poaching is affecting local populations in Russia, the Service believes that the best tool to address these threats is the Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population (Bilateral Agreement), which was developed and is supported by both government and Native entities and includes measures to reduce poaching. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) would address attempted international trade of unlawfully taken polar bears (or parts), and the MMPA would address attempted import into the United States of unlawfully taken animals or their parts. Subsistence hunting by natives in the United States is exempt from prohibitions under both the MMPA and the Act. Subsistence harvest does not require action under the Act to ensure its continuation into the future.

Comment 20: The Service should prohibit the importation into the United States of polar bear trophies taken in Canada, and should amend the MMPA to prohibit sport hunting of polar bears.

Our response: The polar bear is currently listed in Appendix II of CITES. Section 9(c)(2) of the Act provides that the non-commercial import of threatened and Appendix-II species, including their parts, that were taken in compliance with CITES is not presumed to be in violation of the Act. Thus, an import permit would not ordinarily be required under the Act. We note that the MMPA does not allow sport hunting of polar bears within the United States. In addition, we note that, under the MMPA, the polar bear will be considered a ''depleted'' species on the effective date of this listing. As a depleted species, imports could only be authorized under the MMPA if the import enhanced the survival of the species or was for scientific research. Therefore, authorization for the import of sport-hunted trophies would no longer be available under section 104(c)(5) of the MMPA.

Comment 21: The Service failed to consider the negative impacts of listing on the long-term management of polar bears developed in Canada that integrates subsistence harvest allocations with a token sport harvest.

Our response: We acknowledge the important contribution to conservation from scientifically-based sustainable use programs. Significant benefits to polar bear management in Canada have accrued as a result of the 1994 amendments to the MMPA that allow U.S. citizens who legally sport-harvest a polar bear from an MMPA-approved population in Canada to bring their trophies back into the United States. These benefits include economic revenues to native hunters and communities; enhanced funding a support for research; a United States conservation fund derived from permit fees that is used primarily on the Chukchi Sea population; and increased local support of scientifically-based conservation programs. Without this program, there would be a loss of funds derived from import fees; loss of economic incentives that promote habitat protection and maintain sustainable harvest levels in Canada; and loss of research opportunities in Canada and Russia, which are funded through sport-hunting revenue. While we recognize these benefits, the Service must list a species when the best scientific and commercial information available shows that the species meets the definition of endangered or threatened. The effect of the listing, in this case an end to the import provision under Section 104(c)(5) of the MMPA, is not one of the listing factors. Furthermore, the benefits accrued to the species through the import program do not offset or reduce the overall threat to polar bears from loss of sea ice habitat.

Comment 22: The Service should promulgate an exemption under section 4(d) of the Act that would allow importation of polar bear trophies.

Our response: We recognize the role that polar bear sport harvest has played in the support of subsistence, economic, and cultural values in northern communities, and we have supported the program where scientific data have been available to ensure sustainable harvest. We again note that, under the MMPA, the polar bear will be considered a ''depleted'' species on the effective date of this listing. The MMPA contains provisions that prevent the import of sport-hunted polar bear trophies from Canada once the species is designated as depleted. A 4(d) rule under the Act cannot affect existing requirements under the MMPA.

Comment 23: The rights of Alaska Natives to take polar bears should be protected.

Our response: We recognize the social and cultural importance of polar bears to coastal Alaska Native communities, and we anticipate continuing to work with the Alaska Native community in a co-management fashion to address subsistence-related issues. Section 101(b) of the MMPA already exempts take of polar bears by Native people for subsistence purposes as long as the take is not accomplished in a wasteful manner. Section 10(e) of the Act also provides an exemption for Alaska Natives that allows for taking as long as such taking is primarily for subsistence purposes and the taking is not accomplished in a wasteful manner. In addition, non-edible byproducts of species taken in accordance with the exemption, when made into authentic native articles of handicraft and clothing, may be transported, exchanged, or sold in interstate commerce. Since 1987, we have monitored the Alaska Native harvest of polar bears through our Marking, Tagging and Reporting program [50 CFR 18.23(f)]. The reported harvest of polar bears by Alaska Natives is 1,614 animals during this nearly 20-year period, of which 965 were taken from the Chukchi Sea population and 649 were taken from the Southern Beaufort Sea population.

Alaska Natives' harvest of polar bears from the Southern Beaufort and Chukchi Seas is not exclusive, since both of these populations are shared across international boundaries with Canada and Russia respectively, where indigenous populations in both countries also harvest animals. Since 1988, the Inuvialuit Game Council (IGC) (Canada) and the North Slope Borough (NSB) (Alaska) have implemented an Inuvialuit-Inupiat Polar Bear Management Agreement for harvest of polar bears in the Southern Beaufort

Sea. The focus of this agreement is to ensure that harvest of animals from this shared population is conducted in a sustainable manner. The Service works with the parties of this agreement, providing technical assistance and advice regarding, among other aspects, information on abundance estimates and sustainable harvest levels. We expect that future harvest levels may be adjusted as a result of discussions at the meeting between the IGC and NSB, held in February 2008.

We do have concerns regarding the harvest levels of polar bears from the Chukchi Sea, where a combination of Alaska Native harvest and harvest occurring in Russia may be negatively affecting this population. However, implementation of the recently ratified ''Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population'' (Bilateral Agreement), with its provisions for establishment of a shared and enforced quota system between the United States and Russia, should ensure that harvest from the Chukchi Sea population is sustainable.

Comment 24: If the polar bear is listed, subsistence hunting should be given precedence over other forms of take.

Our response: As noted above, Alaska Native harvest of polar bears for subsistence is currently exempt under both the MMPA and the Act. Sport hunting of polar bears is not allowed in the United States under the MMPA, and take for other purposes is tightly restricted. For polar bears, the other primary type of take is incidental harassment during otherwise lawful activities. The Service has issued incidental take regulations under the MMPA since 1991, and these regulations include a finding that such takings will not have an adverse impact on the availability of polar bears for subsistence uses. Thus, the needs of the Alaska Native community, who rely in part on the subsistence harvest of polar bears, are addressed by existing provisions under both the MMPA and the Act.

Issue 5: Climate Change

Comment 25: The accuracy and completeness of future climate projections drawn from climate models are questionable due to the uncertainty or incompleteness of information used in the models.

Our response: Important new climate change information is included in this final rule. The Working Group I Report of the IPCC AR4, published in early 2007, is a key part of the new information, and represents a collaborative effort among climate scientists from around the world with broad scientific consensus on the findings. In addition, a number of recent publications are used in the final rule to supplement and expand upon results presented in the AR4; these include Parkinson et al. (2006), Zhang and Walsh (2006), Arzel et al. (2006), Stroeve et al. (2007, pp. 1–5), Wang et al. (2007, pp. 1,093–1,107), Chapman and Walsh (2007), Overland and Wang (2007a, pp. 1–7), DeWeaver (2007), and others. Information from these publications has been incorporated into appropriate sections of this final rule.

Atmosphere-ocean general circulation models (AOGCMs, also known as General Circulation Models (GCMs)) are used to provide a range of projections of future climate. GCMs have been consistently improved over the years, and the models used in the IPCC AR4 are significantly improved over those used in the IPCC TAR and the ACIA report. There is ''considerable confidence that the GCMs used in the AR4 provide credible quantitative estimates of future climate change, particularly at continental scales and above'' (IPCC 2007, p. 591). This confidence comes from the foundation of the models in accepted physical principles and from their ability to reproduce observed features of current climate and past climate changes. Additional confidence comes from considering the results of suites of models (called ensembles) rather than the output of a single model. Confidence in model outcomes is higher for some climate variables (e.g., temperature) than for others (e.g., precipitation).

Despite improvements in GCMs in the last several years, these models still have difficulties with certain predictive capabilities. These difficulties are more pronounced at smaller spatial scales and longer time scales. Model accuracy is limited by important small-scale processes that cannot be represented explicitly in models and so must be included in approximate form as they interact with larger-scale features. This is partly due to limitations in computing power, but also results from limitations in scientific understanding or in the availability of detailed observations of some physical processes. Consequently, models continue to display a range of outcomes in response to specified initial conditions and forcing scenarios. Despite such uncertainties, all models predict substantial climate warming under GHG increases, and the magnitude of warming is consistent with independent estimates derived from observed climate changes and past climate reconstructions (IPCC 2007, p. 761; Overland and Wang 2007a, pp. 1–7; Stroeve et al. 2007, pp. 1–5).

We also note the caveat, expressed by many climate modelers and summarized by DeWeaver (2007), that, even if global climate models perfectly represent all climate system physics and dynamics, inherent climate variability would still limit the ability to issue accurate forecasts (predictions) of climate change, particularly at regional and local geographical scales and longer time scales. A forecast is a more-precise prediction of what will happen and when, while a projection is less precise, especially in terms of the timing of events. For example, it is difficult to accurately forecast the exact year that seasonal sea ice will disappear, but it is possible to project that sea ice will disappear within a 10–20 year window, especially if that projection is based on an ensemble of modeling results (i.e., results from several models averaged together). It is simply not possible to engineer all uncertainty out of climate models, such that accurate forecasts are possible. Climate scientists expend considerable energy in trying to understand and interpret that uncertainty. The section in this rule entitled ''Uncertainty in Climate Models'' discusses uncertainty in climate models in greater depth than is presented here.

In summary, confidence in GCMs comes from their physical basis and their ability to represent observed climate and past climate changes. Models have proven to be extremely important tools for simulating and understanding climate and climate change, and we find that they provide credible quantitative estimates of future climate change, particularly at larger geographical scales.

Comment 26: Commenters provided a number of regional examples to contradict the major conclusions regarding climate change.

Our response: As noted in our response to Comment 25, GCMs are less accurate in projecting climate change over finer geographic scales, such as the variability noted for some regions in the Arctic, than they are for addressing global or continental-level climate change. Climate change projections for the Barents Sea are difficult, for example, because regional physics includes both local winds and local currents. Cyclic processes, such as the North Atlantic Oscillation (NAO), can also drive regional variability. We agree with one commenter that the NAO is particularly strong for Greenland (Chylek et al. 2006). However, the natural variability associated with this phenomenon simply suggests that the future will also have large variability, but does not negate overall climate trends, because the basic physics of climate processes, including sea ice albedo feedback, are modeled in all major sectors of the Arctic Basin. The increased understanding of the basic physics related to climate processes and the inclusion of these parameters in current climate models, such as those used in the IPCC AR4, present a more complete, comprehensive, and accurate view of range-wide climate change than earlier models.

Comment 27: Other models should be used in the analysis of forecasted environmental and population changes including population viability assessment and precipitation models.

Our response: The Service has not relied upon the published results or use of a single climate model or single scenario in its analyses. Instead we have considered a variety of information derived from numerous climate model outputs. These include modeled changes in temperature, sea ice, snow cover, precipitation, freeze-up and breakup dates, and other environmental variables. The recent report of the IPCC AR4 provides a discussion of the climate models used, and why and how they resulted in improved analyses of climatic variable and future projections. Not only have the models themselves been improved, but many advances have been made in terms of how the model results were used. The AR4 utilized multiple results from single models (called multi-member ensembles) to, for example, test the sensitivity of response to initial conditions, as well as averaged results from multiple models (called multi-model ensembles). These two different types of ensembles allow more robust evaluation of the range of model results and more quantitative comparisons of model results against observed trends in a variety of parameters (e.g., sea ice extent, surface air temperature), and provide new information on simulated statistical variability. This final rule benefits from specific analyses of uncertainty associated with model prediction of Arctic sea ice decline (DeWeaver 2007; Overland and Wang 2007a, pp. 1–7), and identification of those models that best simulated observed changes in Arctic sea ice.

We also updated this final rule with information on recently completed population models (e.g., Hunter et al. 2007), habitat values and use models (Durner et al. 2007), and population projection models (Amstrup et al. 2007), which can be found in the ‘‘Current Population Status and Trend’’ section.

Comment 28: Future emission scenarios are unreliable or incomplete and use speculative carbon emission scenarios that inaccurately portray future levels.

Our response: Emissions scenarios used in climate modeling were developed by the IPCC and published in its Special Report on Emissions Scenarios in 2000. These emissions scenarios are representations of future levels of GHGs based on assumptions about plausible demographic, socioeconomic, and technological changes. The most recent, comprehensive climate projections in the IPCC AR4 used scenarios that represent a range of future emissions: low, medium, and high. The majority of models used a ‘‘medium’’ or ‘‘middle-of-the-road’’ scenario due to the limited computational resources for multi-model simulations using GCMs (IPCC 2007, p. 761). In addition, Zhang and Walsh (2006) use three emission scenarios representative of the suite of possibilities and DeWeaver (2007 p. 28), in subsequent analyses, used the A1B ‘‘business as usual’’ scenario as a representative of the medium-range forcing scenario, and other scenarios were not considered due to time constraints. Similarly, our final analysis considered a range of potential outcomes, based in part on the range of emission scenarios. For additional details see the previous section, ‘‘Projected Changes in Arctic Sea Ice.’’

We agree that emissions scenarios out to 2100 are less certain with regard to technology and economic growth than projections out to 2050. This is reflected in the larger confidence interval around the mean at 2100 than at 2050 in graphs of these emissions scenarios (see Figure SPM–5 in IPCC 2007). However, GHG loading in the atmosphere has considerable lags in its response, so that what has already been emitted and what can be extrapolated to be emitted in the next 15–20 years will have impacts out to 2050 and beyond (IPCC 2007, p. 749; J. Overland, NOAA, in litt. to the Service, 2007). This is reflected in the similarity of low, medium, and high SRES emissions scenarios out to about 2050 (see discussion of climate change under ‘‘Factor A. Present or Threatened Destruction, Modification, or Curtailment of the Species' Habitat or Range''). Thus, the uncertainty associated with emissions is lower for the foreseeable future timeframe (45 years) for the polar bear listing than longer timeframes.

Comment 29: Atmospheric CO_2 is an indicator of global warming and not a major contributor.

Our response: Carbon dioxide (CO_2) is one of four principal anthropogenically-generated GHGs, the others being nitrous oxide (N_2O), methane (CH_4), and halocarbons (IPCC 2007, p. 135). The IPCC AR4 considers CO_2 to be the most important anthropogenic GHG (IPCC 2007, p. 136). The GHGs affect climate by altering incoming solar radiation and out-going thermal radiation, and thus altering the energy balance of the Earth-atmosphere system. Since the start of the industrial era, the effect of increased GHG concentrations in the atmosphere has been widespread warming of the climate, with disproportionate warming in large areas of the Arctic (IPCC 2007, p. 37). A net result of this warming is a loss of sea ice, with notable reductions in Arctic sea ice.

Comment 30: Atmospheric CO_2 levels are not greater today than during pre-industrial time.

Our response: The best available scientific evidence unequivocally contradicts this comment. Atmospheric concentration of carbon dioxide (CO_2) has increased significantly during the post-industrial period based on information from polar ice core records dating back at least 650,000 years. The recent rate of change is also dramatic and unprecedented, with the increase documented in the last 20 years exceeding any increase documented over a thousand-year period in the historic record (IPCC AR4, p. 115). Specifically, the concentration of atmospheric CO_2 has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005, with an annual growth rate larger during the last 10 years than it has been since continuous direct atmospheric measurements began in 1960. These increases are largely due to global increases in GHG emissions and land use changes such as deforestation and burning (IPCC 2007, pp. 25–26).

Comment 31: Consider the impacts of black carbon (soot) due to increased shipping as a factor affecting the increase in the melting of the sea ice.

Our response: We recognize that there are large uncertainties about the contribution of soot to snow melt patterns. A general understanding is that soot (from black carbon aerosols) deposited on snow reduces the surface albedo with a resulting increase in snow melt process (IPCC 2007, p. 30). Estimates of the amount of effect from all sources of soot have wide variance, and the exact contribution from increased shipping cannot be determined at this time.

Comment 32: Climate models do not adequately address naturally occurring phenomena.

Our response: In IPCC AR4 simulations, models were run with natural and anthropogenic (i.e., GHG) forcing for the period of the observational record (i.e., the 20th century). Results from different models and different runs of the same model can be used to simulate the observed range of natural variability in the 20th century (such as warm in 1930s and cool in the 1960s). Only when GHG forcing is added to natural variability, however, do the models simulate the warming observed in the later portion of the 20th century (Wang et al. 2007). This is shown for the Arctic by Wang et al. (2007, pp. 1,093–1,107). This separation is shown graphically in Figure SPM–4 of the IPCC AR4 (shown below, reproduced from IPCC 2007 with permission); note the separation of the model results with and without greenhouse gases at the end of the 20th century for different regions. Thus comparison of forced CO_2 trends and natural variability were central to the IPCC AR4 analyses, and are discussed in this final rule.

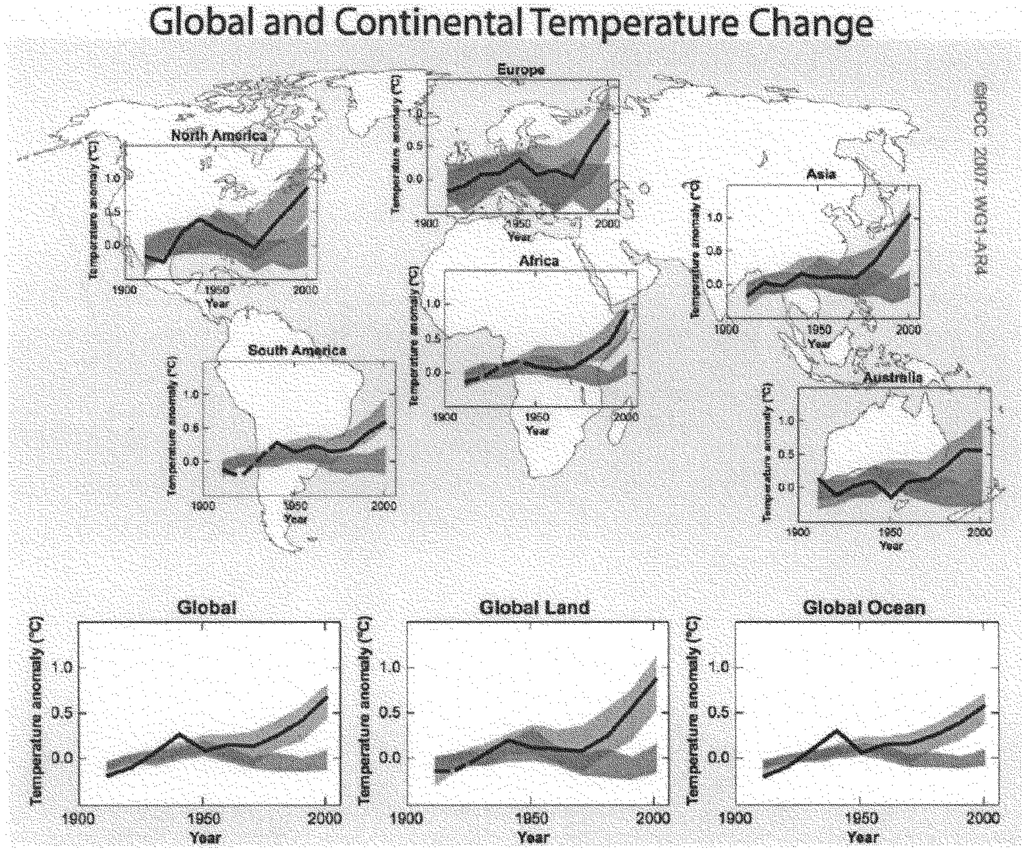


FIGURE SPM-4. Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906–2005 (black line) plotted against the centre of the decade and relative to the corresponding average for 1901–1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5–95% range for 19 simulations from 5 climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5–95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings. {FAQ 9.2, Figure 1}

Analyses of paleoclimate data increase confidence in the role of external influences on climate. The GCMs used to predict future climate provide insight into past climatic conditions of the Last Glacial Maximum and the mid-Holocene. While many aspects of these past climates are still uncertain, climate models reproduce key features by using boundary conditions and natural forcing factors for those periods. The IPCC AR4 concluded that a substantial fraction of the reconstructed Northern Hemisphere inter-decadal temperature variability of the seven centuries prior to 1950 is *very likely* attributable to natural external forcing, and it is *likely* that anthropogenic forcing contributed to the early 20th-century warming evident in these records (IPCC 2007).

Comment 33: Current climate patterns are part of the natural cycle and reflect natural variability.

Our response: Considered on a global scale, climate is subject to an inherent degree of natural variability. However, evidence of human influence on the recent evolution of climate has accumulated steadily during the past two decades. The IPCC AR4 has concluded that (1) most of the observed increase in globally-averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations; and (2) it is *likely* there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica) (IPCC 2007, p. 60).

Comment 34: There was a selective use of climate change information in the proposed rule, and the analysis ignored climate information about areas that are cooling.

Our response: We acknowledge that climate change and its effects on various physical processes (such as ice formation and advection, snowfall, precipitation) vary spatially and temporally, and that this has been considered in our analysis. While GCMs are more effective in characterizing climate change on larger scales, we have considered that the changes and effects are not uniform in their timing, location, or magnitude such as identified by Laidre et al. (2005) and Zhang and Walsh (2006). Indeed, the region southwest of Greenland does not show substantial warming by 2050 according to some climate projections. However, most polar bear habitat regions do show the substantial loss of sea ice by 2040–2050. While regional differences in climate change exist, this will not change the effect of climatic warming anticipated to occur within the foreseeable future within the range of polar bears. Updated information on regional climate variability has been added to the section ''Overview of Arctic Sea Ice Change.''

Comment 35: The world will be cooler by 2030 based on sunspot cycle phenomena, which is the most important determinant of global warming (e.g., Soon et al. 2005; Jiang et al. 2005).

Our response: The issue of solar influences, including sunspots, in climate change has been considered by many climate scientists, and there is considerable disagreement about any large magnitude of solar influences and their importance (Bertrand et al. 2002; IPCC 2007). The most current synthesis of the IPCC (AR4, p. 30) describes a well established, 11-year cycle with no significant long term trend based on new data obtained through significantly improved measurements over a 28-year period. Solar influence is considered in the IPCC models and is a small effect relative to volcanoes and CO_2 forcing in the later half of the 20th century. While more complex solar influences due to cosmic ray/ionosphere/cloud connections have been hypothesized, there is no clear demonstration of their having a large effect.

Comment 36: The IPCC report fails to give proper weight to the geological context and relationship to climate change.

Our response: Paleoclimatic events were analyzed in the IPCC AR4, which concluded that ''Confidence in the understanding of past climate change and changes in orbital forcing is strengthened by the improved ability of current models to simulate past climate conditions.'' Model results indicate that the Last Glacial Maximum (about 21,000 years ago) and the mid-Holocene (6,000 years ago) were different from the current climate not because of random variability, but because of altered seasonal and global forcing linked to known differences in the Earth's orbit. This additional information has been incorporated in this final rule.

Comment 37: Movement of sea ice from the Arctic depends on the Aleutian Low, Arctic Oscillation (AO), North Atlantic Oscillation (NAO), and Pacific Decadal Oscillation (PDO) rather than GHG emissions.

Our response: Sea ice is lost from the Arctic by a combination of dynamic and thermodynamic mechanisms. Not only is it lost by advection, but lost as a result of changes in surface air and water temperatures. Changes in surface air temperature are strongly influenced by warming linked to GHG emissions, while increases in water temperature are influenced by warming, the sea ice-albedo feedback mechanism, and the influx of warmer subpolar waters (largely in the North Atlantic) (Serreze et al. 2007). Recent studies (IPCC 2007, p. 355; Stroeve et al 2007; Overland and Wang 2007a, pp. 1–7) recognize considerable natural variability in the pattern of sea ice motion relative to the AO, NAO, and PDO, which will continue into the 21st century. However, the distribution of sea ice thickness is a factor in the amount of sea ice that is advected from the Arctic, and this distribution is significantly affected by surface air and water temperature.

Comment 38: Changes in the sea ice extent vary throughout the Arctic but overall extent has not changed in past 50 years.

Our response: All observational data collected since the 1950s points to a decline in both Arctic sea ice extent and area, as well as an increasing rate of decline over the past decade. While sea ice cover does have a component of natural variability, such variability does not account for the influence that increased air and water temperatures will have on sea ice in the future. The pattern of natural variability will continue, but will be in conjunction with the overall declining trend due to warming, and the combination could result in abrupt declines in sea ice cover faster than would be expected from GHG warming alone.

Comment 39: Evidence that does not support climate change was not included in the analyses.

Our response: We recognize that there are scientific differences of opinion on many aspects of climate change, including the role of natural variability in climate and also the uncertainties involved with both the observational record and climate change projections based on GCMs. We have reviewed a wide range of documents on climate change, including some that espouse the view that the Earth is experiencing natural cycles rather than directional climate change (e.g., Damon and Laut 2004; Foukal et al. 2006). We have consistently relied on synthesis documents (e.g., IPCC AR4; ACIA) that present the consensus view of a very large number of experts on climate change from around the world. We have found that these synthesis reports, as well as the scientific papers used in those reports or resulting from those reports, represent the best available scientific information we can use to inform our decision and have relied upon them and provided citation within our analysis.

Comment 40: Current conditions, based on past variation in Arctic sea ice and air temperatures, are by no means unprecedented and consequently the survival of polar bears and other marine mammals is not of concern.

Our response: We acknowledge that previous warming events (e.g., the Last Interglacial period (LIG), Holocene Thermal Maximum (HTM)) likely affected polar bears to some unknown degree. The fact that polar bears survived these events does not mean that they are not being affected by current sea ice and temperature changes. Indeed, the best available scientific information indicates that several populations are currently being negatively affected, and projections indicate that all populations will be negatively affected within the foreseeable future, such that the species will be in danger of extinction throughout all or a significant portion of its range within that timeframe. We have included additional information regarding previous warming events and an explanation of potential for polar bears to adapt in the section ''Effects of Sea Ice Habitat Changes on Polar Bear Prey.''

We agree that there is considerable natural variability and region-to-region differences in sea ice cover as documented by numerous journal articles and other references (Comiso 2001; Omstedt and Chen 2001; Jevrejeva 2001; Polyakov et al. 2003; Laidre and Heide-Jorgensen 2005). However, current conditions are unprecedented (IPCC 2007, p. 24). Climate scientists agree that atmospheric concentrations of

CO_2 and CH_4 far exceed the natural range over the last 650,000 years. The rate of growth in atmospheric concentration of GHGs is considered unprecedented (IPCC 2007, p. 24). The recent publication by Canadell et al. (2007) indicates that the growth rate of atmospheric CO_2 is increasing rapidly. An increasing CO_2 concentration is consistent with results of climate-carbon cycle models, but the magnitude of the observed atmospheric CO_2 concentration appears larger than that estimated by models. The authors suggest that these changes characterize a carbon cycle that is generating stronger-than-expected and sooner-than-expected climate forcing. What also is unprecedented is the potential for continued sea ice loss into the 21st century based on the physics of continued warming due to external forcing, and the accelerated impact of the ice albedo feedback as more open water areas open. Consideration of future loss of sea ice does not depend only on the sea ice observational record by itself. However, current sea ice loss, which now averages about 10 percent per decade over the last 25 years, plus the extreme loss of summer sea ice in 2007, is a warning sign that significant changes are underway, and data indicate that these extremes will continue into the foreseeable future.

Issue 6: Regulatory Mechanisms

Comment 41: Treaties, agreements, and regulatory mechanisms for population management of polar bears exist and are effective; thus there is no need to list the species under the Act.

Our response: The Service recognizes that existing polar bear management regulatory mechanisms currently in place have been effective tools in the conservation of the species; the ability of the species as a whole to increase in numbers from low populations, as discussed in our response to Comment 1, associated with over-hunting pressures of the mid 20th century attest to such effectiveness. As discussed under Factor D, there is a lack of regulatory mechanisms to address the loss of habitat due to reductions in sea ice. We acknowledge that progress is being made, and may continue to be made, to address climate change resulting from human activity; however, the current and expected impact to polar bear habitat indicates that in the foreseeable future, as defined in this rule, such efforts will not ameliorate loss of polar bear habitat or numbers of polar bears.

Comment 42: The Service did not consider existing local, State, National, and International efforts to address climate change (e.g., the Kyoto Protocol or United Nations Framework Convention on Climate Change) and is incorrect in concluding that there are no known regulatory mechanisms effectively addressing reductions in sea ice habitat. Furthermore, the Service failed to consider the probability of a global response to growing demands to deal with global climate change.

Our response: We have included discussion of domestic and international efforts to address climate change in the ''Inadequacy of Existing Regulatory Mechanisms'' (Factor D) section. While we note various efforts are ongoing, we conclude that such efforts have not yet proven to be effective at preventing loss of sea ice. The Service's ''Policy for Evaluation of Conservation Efforts When Making Listing Decisions'' (68 FR 15100) provides guidance for analyzing future conservation efforts and requires that the Service only rely on efforts that we have found will be both implemented and effective. While we note that efforts are being made to address climate change, we are unaware of any programs currently being shown to effectively reduce loss of polar bear ice habitat at a local, regional, or Arctic-wide scale.

Comment 43: The Service should evaluate the recent Supreme Court ruling that the U.S. Environmental Protection Agency (EPA) has the authority under the Clean Air Act to regulate GHGs.

Our response: The Service recognizes the leading role the EPA plays in implementing the Clean Air Act. However, specific considerations regarding the recent Supreme Court decision are beyond the scope of this decision.

Comment 44: The effort to list the polar bear is an inappropriate attempt to regulate GHG emissions. Any decision to limit GHG emissions should be debated in the open and not regulated through the ''back door'' by the Act.

Our response: The Service was petitioned to evaluate the status of polar bears under the Act. In doing so, we evaluated the best scientific and commercial information available on present and foreseeable future status of polar bears and their habitat as required by the Act. The role of the Service is to determine the appropriate biological status of the polar bear and that is the scope of this rule. Some commenters to the proposed rule suggested that the Service should require other agencies (e.g., the EPA) to regulate emissions from all sources, including automobiles and power plants. The science, law, and mission of the Service do not lead to such action. Climate change is a worldwide issue. A direct causal link between the effects of a specific action and ''take'' of a listed species is well beyond the current level of scientific understanding (see additional discussion of this topic under the ''Available Conservation Measures'' section).

Comment 45: Listing of the polar bear is more about the politics of global climate change than biology of polar bears.

Our response: The Service was petitioned to list polar bears under the Act and we evaluated the best available scientific and commercial information available on threats to polar bears and their habitat as required by the Act. The role of the Service is to determine the appropriate status of the polar bear under the Act, and that is the scope of this rule.

Issue 7: Listing Justification

Comment 46: Justification for listing is insufficient or limited to few populations, and thus range-wide listing is not warranted.

Our response: This document contains a detailed evaluation of the changing sea ice environment and research findings that describe the effect of environmental change on the declining physical condition of polar bears, corresponding declines in vital rates, and declines in population abundance. We acknowledge that the timing, rate and magnitude of impacts will not be the same for all polar bear populations. However, the best available scientific information indicates that several populations are currently being negatively affected, and projections indicate that all populations will be negatively affected within the foreseeable future, such that the species will be in danger of extinction throughout all or a significant portion of its range within that timeframe.

Since the proposed rule was published (72 FR 1064), the USGS completed additional analyses of population trajectories for the Southern Beaufort Sea population (Hunter et al. 2007), and updated population estimates for the Northern Beaufort Sea (Stirling et al. 2007) and Southern Hudson Bay (Obbard et al. 2007) populations (summarized in the ''Background'' section of this final rule). The USGS also has conducted additional modeling of habitat resource selection in a declining sea ice environment (Durner et al. 2007), and an evaluation of the levels of uncertainty or likelihood of outcomes for a variety of climate models (DeWeaver 2007). Information from these recent USGS analyses is included and cited within this rule and balanced with other published information evaluating current and projected polar bear status. In addition, since the publication of the proposed rule (72 FR 1064), the IPCC AR4 and numerous other publications related to climate change and modeled climate projections have become available in published form and are now included and cited within this rule.

We considered whether listing particular Distinct Population Segments (DPSs) is warranted, but we could not identify any geographic areas or populations that would qualify as a DPS under our 1996 DPS Policy (61 FR 4722), because there are no population segments that satisfy the criteria of the DPS Policy.

Finally, we analyzed the status of polar bears in portions of its range to determine if differential threat levels in those areas warrant a determination that the species is endangered rather than threatened in those areas. The overall direction and magnitude of threats to polar bears lead us to conclude that the species is threatened throughout its range, and that there are no significant portions of the range where the polar bear would be considered currently in danger of extinction.

On the basis of all these analyses, we have concluded that the best available scientific information supports a determination that the species is threatened throughout all of its range.

Comment 47: Traditional ecological knowledge (TEK) does not support the conclusion that polar bear populations are declining and negatively impacted by climate change.

Our response: We acknowledge that TEK may provide a relevant source of information on the ecology of polar bears obtained through direct individual observations. We have expanded and incorporated additional discussion of TEK into our determination. Additionally, we have received and reviewed comments from individuals with TEK on both climate change and polar bears. While there may be disagreement among individuals on the impacts of climate change on polar bears, we believe there is general scientific consensus that sea ice environment is diminishing.

Comment 48: Cannibalism, starvation, and drowning are naturally occurring events and should not be inferred as reasons for listing.

Our response: We agree that cannibalism, starvation, and drowning occur in nature; however, we have not found that these are mortality factors that threaten the species throughout all or a significant portion of its range. Rather, we find that recent research findings have identified the unusual nature of some reported mortalities, and that these events serve as indicators of stressed populations. The occurrence and anecdotal observation of these events and potential relationship to sea ice changes is a current cause for concern. In the future, these events may take on greater significance, especially for populations that may be experiencing nutritional stress or related changes in their environment.

Comment 49: The Service did not adequately consider polar bear use of marginal ice zones in the listing proposal.

Our response: Due to the dynamic and cyclic nature of sea ice formation and retreat, marginal ice zones occur on an annual basis within the circumpolar area and indeed are important habitat for polar bears. The timing of occurrence, location, and persistence of these zones over time are important considerations because they serve as platforms for polar bears to access prey. Marginal ice zones that are associated with shallow and productive nearshore waters are of greatest importance, while marginal ice zones that occur over the deeper, less productive central Arctic basin are not believed to provide values equivalent to the areas nearshore. New information on polar bear habitat selection and use (Durner et al. 2007) is included in this rule's sections ''Polar Bear-Sea Ice Habitat Relationships'' and ''Effects of Sea Ice Habitat Change on Polar Bears.''

Comment 50: The effects of climate change on polar bears will vary among populations.

Our response: We recognize that the effects of climate change will vary among polar bear populations, and have discussed those differences in detail in this final rule. We have determined that several populations are currently being negatively affected, and projections indicate that all populations will be negatively affected within the foreseeable future. Preliminary modeling analyses of future scenarios using a new approach (the Bayesian Network Model) describe four ''ecoregions'' based on current and projected sea ice conditions (Amstrup et al. 2007); a discussion of these analyses is included in Factor A of the ''Summary of Factors Affecting the Species.'' Consistent with other projections, the preliminary model projects that southern populations with seasonal ice-free conditions and open Arctic Basin populations in areas of ''divergent'' sea ice will be affected earliest and to the greatest extent,while populations in the Canadian archipelago populations and populations in areas of ''convergent ''sea ice'' will be affected later and to a lesser extent. These model projections indicate that impacts will happen at different times and rates in different regions. On the basis of the best available scientific information derived from this preliminary model and other extensive background information, we conclude that the species is not currently in danger of extinction throughout all or a significant portion of its range, but is very likely to become so within the foreseeable future. We have not identified any areas or populations that would qualify as Distinct Population Segments under our 1996 DPS Policy, or any significant portions of the polar bear's range that would qualify for listing as endangered (see response to Comment 47).

Comment 51: The 19 populations the Service has identified cannot be thought of as discrete or stationary geographic units, and polar bears should be considered as one Arctic population.

Our response: We agree that the boundaries of the 19 populations are not static or stationary. Intensive scientific study of movement patterns and genetic analysis reinforces boundaries of some populations while confirming that overlap and mixing occur among others. Neither movement nor genetic information is intended to mean that the boundaries are absolute or stationary geographic units; instead, they most accurately represent discrete functional management units based on generalized patterns of use.

Comment 52: The Service should evaluate the status of the polar bear in significant portions of the range or distinct population segments, due to regional differences in climate parameters, and therefore the response of polar bears.

Our response: We analyzed the status of polar bears by population and region in the section ''Demographic Effects of Sea Ice Changes on Polar Bear'' and considered how threats may differ between areas. We recognize that the level, rate, and timing of threats will be uneven across the Arctic and, thus, that polar bear populations will be affected at different rates and magnitudes depending on where they occur. We find that, although habitat (i.e., sea ice) changes may occur at different rates, the direction of change is the same. Accepted climate models (IPCC AR4 2007; DeWeaver 2007), based on their ability to simulate present day ice patterns, all project a unidirectional loss of sea ice. Similarly, new analyses of polar bear habitat distribution in the polar basin projected over time (Durner et al. 2007) found that while the rate of change in habitat varied between GCMs, all models projected habitat loss in the polar basin within the 45-year foreseeable future timeframe. Therefore, despite the regional variation in changes and response, we find that the primary threat (loss of habitat) is occurring and is projected to continue to occur throughout the Arctic. In addition, the USGS also examined how the effects of climate change will vary across time and space; their model projections also indicate that impacts will happen at different times and rates in different regions (Amstrup et al. 2007).

Recognizing the differences in the timing, rate, and magnitude of threats, we evaluated whether there were any specific areas or populations that may be disproportionately threatened such that they currently meet the definition of an endangered species versus a threatened species. We first considered whether listing one or more Distinct Population Segments (DPS) as endangered may be warranted. We then considered whether there are any significant portions of the polar bear's range (SPR) where listing the species as endangered may be warranted. In evaluating current status of all populations and projected sea ice changes and polar bear population projections, we were unable to identify any distinct population segments or significant portions of the range of the polar bear where the species is currently in danger of extinction. Rather, we have concluded that the polar bear is likely to become an endangered species throughout its range within the foreseeable future. Thus, we find that threatened status throughout the range is currently the most appropriate listing under the Act.

Comment 53: One commenter asserted that the best available scientific information indicates that polar bear populations in two ecoregions defined by Amstrup et al. (2007)—the Seasonal Ice ecoregion and the polar basin Divergent ecoregion—should be listed as endangered.

Our response: We separately evaluated whether polar bear populations in these two ecoregions qualify for a different status than polar bears in the remainder of the species' range. We determined that while these polar bears are likely to become in danger of extinction within the foreseeable future, they are not currently in danger of extinction. See our analysis in the section ''Distinct Population Segment (DPS) and Significant Portion of the Range (SPR) Evaluation.''

Comment 54: There is insufficient evidence to conclude that the polar bear will be threatened or extinct within three generations as no quantitative analysis or models of population numbers (or prey abundance) are offered.

Our response: New information on population status and trends for the Southern Beaufort Sea (Hunter et al. 2007; Regehr et al. 2007b) and updated population estimates for the Northern Beaufort Sea (Stirling et al. 2007) and Southern Hudson Bay (Obbard et al. 2007) populations is included in this rule along with range-wide population projections based on polar bear ecological relationship to sea ice and to changes in sea ice over time (Amstrup et al. 2007). These studies, plus the IPCC AR4, and additional analyses of climate change published within the last year, have added substantially to the final rule. Taken together, the new information builds on previous analyses to provide sufficient evidence to demonstrate that: (1) polar bears are sea ice-dependent species; (2) reductions in sea ice are occurring now and are very likely to continue to occur within the foreseeable future; (3) the linkage between reduced sea ice and population reductions has been established; (4) impacts on polar bear populations will vary in their timing and magnitude, but all populations will be affected within the foreseeable future; and (5) the rate and magnitude of the predicted changes in sea ice will make adaptation by polar bears unrealistic. On these bases, we have determined that the polar bear is not currently in danger of extinction throughout all or a significant portion of its range, but is likely to become so within the foreseeable future.

Comment 55: Perceptions differ as to whether polar bear populations will decline with loss of sea ice habitat.

Our response: Long-term data sets necessary to establish the linkage between population declines and climate change do not exist for all polar bear populations within the circumpolar Arctic. However, the best available scientific information indicates a link between polar bear vital rates or population declines and climate change. For two populations with extensive time series of data, Western Hudson Bay and Southern Beaufort Sea, either the population numbers or survival rates are declining and can be related to reductions in sea ice. In addition, scientific literature indicates that the Davis Strait, Baffin Bay, Foxe Basin, and the Eastern and Western Hudson Bay populations are expected to decline significantly in the foreseeable future based on reductions of sea ice projected in Holland et al. (2006, pp. 1–5). Additional population analyses (Regehr et al. 2007a, b; Hunter et al. 2007; Obbard et al. 2007) that further detail this relationship have been recently completed and are included in this final rule.

Comment 56: Factors supporting listing are cumulative and thus are unlikely to be quickly reversed. Polar bears are likely to become endangered within one to two decades.

Our response: We have concluded that habitat loss (Factor A) is the primary factor that threatens the polar bear throughout its range. We have also determined that there are no known regulatory mechanisms in place, and none that we are aware of that could be put in place, at the national or international level, that directly and effectively address the rangewide loss of sea ice habitat within the foreseeable future (Factor D). However, we have also concluded that other factors (e.g., overutilization) may interact with and exacerbate these primary threats (particularly habitat loss) within the 45-year foreseeable future.

Polar bear populations are being affected by habitat loss now, and will continue to be affected within the foreseeable future. We do not believe that the species is currently endangered, but we believe it is likely that the species will become endangered during the foreseeable future given current and projected trends; see detailed discussion under Factor A in the section ''Demographic Effects of Sea Ice Changes on Polar Bear''. We intend to continue to evaluate the status of polar bears and will review and amend the status determination if conditions warrant. Through 5-year reviews and international circumpolar monitoring, we will closely track the status of the polar bear over time.

Comment 57: Polar bears face unprecedented threats from climate change, environmental degradation, and hunting for subsistence and sport.

Our response: We agree in large part as noted in detail within this final rule, but clarify that hunting for subsistence or sport does not currently threaten the species in all or a significant portion of its range, and where we have concerns regarding the harvest we are hopeful that existing or newly established regulatory processes, e.g., the recently adopted Bilateral Agreement, will be adequate to ensure that harvest levels are sustainable and can be adjusted as our knowledge of population status changes over time. Please see the ''Summary of Factors Affecting the Polar Bear'' for additional discussion of these issues.

Issue 8: Listing Process

Comment 58: Listing the polar bear under the Act should be delayed until reassessment of the status of the species under Canada's Species at Risk Act (SARA) is completed.

Our response: When making listing decisions, section 4 of the Act establishes firm deadlines that must be followed, and does not allow for an extension unless there is substantial scientific disagreement regarding the sufficiency or accuracy of relevant data. Section 4(b) directs the Secretary to take into account any efforts being made by any State or foreign nation to protect the species under consideration; however, the Act does not allow the Secretary to defer a listing decision pending the outcome of any such efforts. The status of the polar bear under Canada's SARA is discussed under Factor D.

Comment 59: The Act was not designed to list species based on future status.

Our response: We agree. We have determined that the polar bear's current status is that it is ''likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' This is the definition of a threatened species under the Act, and we are accordingly designating the species as threatened.

Comment 60: Use of the IUCN Red Listing criteria for a listing determination under the Act is questionable, and should not be used.

Our response: While we may consider the opinions and recommendations of other experts (e.g., IUCN), the determination as to whether a species meets the definition of threatened or endangered must be made by the Service, and must be based upon the criteria and standards in the Act. After reviewing the best available scientific and commercial information, we have determined that the polar bear is threatened throughout its range, based upon an assessment of threats according to section 4 of the Act. While some aspects of our determination may be in line with the IUCN Red List criteria (e.g., we used some Red List criteria for determination of generation time), we have not used the Red List criteria as a standard for our determination. Rather, in accordance with the Act, we conducted our own analyses and made our own determination based on the beast available information. Please see the ''Summary of Factors Affecting the Species'' section for in-depth discussion.

Comment 61: The peer review process is flawed due to biases of the individual peer reviewers.

Our response: We conducted our peer review in accordance with our policy published on July 1, 1994 (59 FR 34270), and based on our implementation of the OMB Final Information Quality Bulletin for Peer Review, dated December 16, 2004. Peer reviewers were chosen based upon their ability to provide independent review, their standing as experts in their respective disciplines as demonstrated through publication of articles in peer reviewed or referred journals, and their stature promoting an international cross-section of views. Please see ''Peer Review'' section above for additional discussion.

Peer review comments are available to the public and have been posted on the Service's web site at: *http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm.* In addition to peer review comments, the Service also provides an open public comment process to ensure in part that any potential issues of bias are specifically identified to allow for the issue to be evaluated for merit. In our analysis of peer review and public comments we find that peer review comments were objective, balanced and without bias.

Comment 62: Requests were received for additional public hearings and extension of the public comment period.

Our response: Procedures for public participation and review in regard to proposed rules are provided at section 4(b)(5) of the Act, 50 CFR 424, and the Administrative Procedure Act (5 U.S.C. 551 et seq.)(APA). We are obligated to hold at least one public hearing on a listing proposal, if requested to do so within 45 days after the publication of the proposal (16 U.S.C. 1533(b)(5)(E)). As described above, in response to requests from the public, we held three public hearings. We were not able to hold a public hearing that could be easily accessed by each and every requester, as we received comments from throughout the United States and many other countries. We accepted and considered oral comments given at the public hearings, and we incorporated those comments into the administrative record for this action. In making our decision on the proposed rule, we gave written comments the same weight as oral comments presented at hearings. Furthermore, our regulations require a 60-day comment period on proposed rules (50 CFR 424.16(c)(2)), but the initial public comment period on the proposed rule to list the polar bear was open from January 9 to April 9, 2007, encompassing approximately 90 days. The comment period was reopened for comments on new scientific information from September 20 through October 22, 2007, an extra 32 days. We believe the original 90-day comment period, three public hearings, and second public comment period provided ample opportunity for public comment, as intended under the Act, our regulations, and the APA.

Comment 63: The Service's conclusion that this regulatory action does not constitute a significant energy action and that preparation of a ''Statement of Energy Effects'' is not required is flawed.

Our response: In 1982, the Act was amended by the United States Congress to clarify that listing and delisting determinations are to be based on the best scientific and commercial data available (Pub. L. 97–304, 96 Stat. 1411) to clarify that the determination was intended to be a biological decision and made without reference to economic or other non-biological factors. The specific language from the accompanying House Report (No. 97–567) stated, ''The principal purpose of the amendments to Section 4 is to ensure that decisions pertaining to the listing and delisting of species are based solely upon biological criteria and to prevent non-biological considerations from affecting such decisions.'' Further as noted in another U.S. House of Representatives Report, economic considerations have no relevance to determinations regarding the status of the species and the economic analysis requirements of Executive Order 12291, and such statutes as the Regulatory Flexibility Act and Paperwork Reduction Act, will not apply to any phase of the listing process.'' (H.R. Rep. No 835, 97th Cong., Sess. 19 (1982)). On the basis of the amendments to the Act put forth by Congress in 1982 and Congressional intent as evidenced in the quotation above, we have determined that the provisions of Executive Order 13211 ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use'' (66 FR 28355), do not apply to listing and delisting determinations under section 4 of the Act because of their economic basis. Therefore, Executive Order 13211 does not apply to this determination to list the polar bear as threatened throughout its range.

Comment 64: There is insufficient information to proceed with a listing, and thus our proposal was arbitrary and capricious.

Our response: Under the APA, a court may set aside an agency rulemaking if found to be, among other things, ''arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law'' (5 U.S.C. 706(2)(A)). The Endangered Species Act requires that listing decisions be based solely on the best scientific and commercial information available. We have used the best available scientific information throughout our analysis, and have taken a number of steps-as required by the Act and its implementing regulations, the APA, and our peer review policy—to ensure that our analysis of the available information was balanced and objective. The evaluation of information contained within the final rule and all other related documents (e.g., the Status Review (Schliebe et al. 2006a) is a result of multiple levels of review and validation of information. We sought peer review and public comment, and incorporated all additional information received through these processes, where applicable. These steps were transparent and made available to the public for inspection, review, and comment. We have determined that the best available scientific and commercial information is sufficient to find that the polar bear meets the definition of a threatened species under the Act.

Comment 65: The Service did not comply with the Information Quality Act and with the Service's Information Quality Guidelines.

Our response: The Information Quality Act requires Federal agencies to ensure the quality, objectivity, utility, and integrity of the information they disseminate. ''Utility'' refers to the usefulness of the information to its intended users, and ''integrity'' pertains to the protection of the information from unauthorized access or revision. According to OMB guidelines (67 FR 8452), technical information that has been subjected to formal, independent, external peer review, as is performed by scientific journals, is presumed to be of acceptable objectivity. Literature used in the proposed rule was considered the best available peer-reviewed literature at the time. In addition, our proposed rule was peer-reviewed by 14 experts in the field of polar bear biology and climatology. In instances where information used in the proposed rule has become outdated, this final rule has been revised to reflect the most current scientific information. Despite being peer-reviewed, most scientific information has some limitations and statements of absolute certainty are not possible. In this rule, and in accordance with our responsibilities under the Act, we sought to provide a balanced analysis by considering all available information relevant to the status of polar bears and potential impacts of climate change and by acknowledging and considering the limitations of the information that provided the basis for our analysis and decision-making (see ''Summary of Factors Affecting the Polar Bear'' and ''Issue 5: Climate Change'' for more information).

Comment 66: National Environmental Policy Act (NEPA) compliance is lacking, and an Environmental Impact Statement is needed as this is a significant Federal action.

Our response: The rule is exempt from NEPA procedures. In 1983, upon recommendation of the Council on Environmental Quality, the Service determined that NEPA documents are not required for regulations adopted pursuant to section 4(a) of the Act. A notice outlining the Service's reasons for this determination was published in the **Federal Register** on October 25, 1983 (48 FR 49244). A listing rule provides the appropriate and necessary prohibitions and authorizations for a species that has been determined to be threatened under section 4(a) of the Act. The opportunity for public comments-one of the goals of NEPA-is also already provided through section 4 rulemaking procedures. This determination was upheld in *Pacific Legal Foundation* v. *Andrus,* 657 F.2d 829 (6th Cir. 1981).

Comment 67: The Service should fulfill its requirement to have regular and meaningful consultation and collaboration with Alaska Native organizations in the development of this Federal action.

Our response: As detailed in the preamble to this section of the final rule, we actively engaged in government-to-government consultation with Alaska Native Tribes in accordance with E.O. 13175 and Secretarial Order 3225. Since 1997, the Service has worked closely with the Alaska Nanuuq Commission (Commission) on polar bear management and conservation for subsistence purposes. Not only was the Commission kept fully informed throughout the development of the proposed rule, but that organization was asked to serve as a peer reviewer of the Status Review (Schliebe et al. 2006a) and the proposed rule (72 FR 1064). Following publication of the proposed rule, the Service actively solicited comments from Alaska Natives living within the range of the polar bear. We received comments on the proposed rule from seven tribal associations. We held a public hearing in Barrow, Alaska, to enable Alaska Natives to provide oral comment. We invited the 15 villages in the Commission to participate in the hearing, and we offered the opportunity to provide oral comment via teleconference. Thus, we believe we have fulfilled our requirement to have regular and meaningful consultation and collaboration with Alaska Native organizations in the development of this final rule.

Comment 68: An Initial Regulatory Flexibility Analysis (IRFA) should be completed prior to the publication of a final rule.

Our response: Under the Regulatory Flexibility Act (5 U.S.C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), an IRFA is prepared in order to describe the effects of a rule on small entities (small businesses, small organizations, and small government jurisdictions). An IRFA is not prepared in a listing decision because we consider only the best available scientific information and do not consider economic impacts (please see response to Comment 70 for additional discussion).

Comment 69: Some commenters stated that the Service should designate critical habitat concurrent with this rulemaking; however, several other commenters disagreed.

Our response: Section 4(a)(3) of the Act requires that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time the species is listed. Accordingly, we are not able to forego the process of designating critical habitat when doing so is prudent and critical habitat is determinable. Service regulations (50 CFR 424.12(a)) state that critical habitat is not determinable if information sufficient to perform required analyses of the impacts of designation is lacking or if the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat. Given the complexity and degree of uncertainty at this time as to which specific areas in Alaska might be essential to the conservation of the polar bear in the long-term under rapidly changing environmental conditions, we have determined that we will need additional time to conduct a thorough evaluation and peer review of a potential critical habitat designation. Thus, we are not publishing a proposed designation of critical habitat concurrently with this final listing rule, but we intend to publish a proposed designation in the very near future. Please see the ''Critical Habitat'' section below for further discussion.

Issue 9: Impacts of Listing

Comment 70: Several comments highlighted potential impacts of listing, such as economic consequences, additional regulatory burden, and conservation benefits. Other commenters noted that economic factors cannot be taken into consideration at this stage of the listing.

Our response: Under section 4(b)(1)(A) of the Act, we must base a listing decision solely on the best scientific and commercial data available. The legislative history of this provision clearly states the intent of Congress to ensure that listing decisions are ''* * * based solely on biological criteria and to prevent non-biological criteria from affecting such decisions * * *'' (see reponse to Comment PR8 for more details). Therefore, we did not consider the economic impacts of listing the polar bear. In our Notice of Interagency Cooperative Policy of Endangered Species Act Section 9 Prohibitions (59 FR 34272), we stated our policy to identify, to the extent known at the time a species is listed, specific activities that will not be considered likely to result in violation of section 9 of the Act. In accordance with that policy, we have published in this final rule a list of activities we believe will not result in violation of section 9 of the Act (see ''Available Conservation Measures'' section of this rule for further discussion). However, because the polar bear is listed as a threatened species and the provisions of section 4(d) of the Act authorize the Service to implement, by regulation, those measures included in section 9 of the Act that are deemed necessary and advisable to provide for the conservation of the species, please consult the special rule for the polar bear that is published in today's edition of the **Federal Register** for all of the prohibitions and exceptions that apply to this threatened species.

Comment 71: Several comments were received pertaining to the effectiveness of listing the polar bear under the Act, specifically whether listing would or would not contribute to the conservation of the species.

Our response: The potential efficacy of a listing action to conserve a species cannot be considered in making the listing decision. The Service must make its determination based on a consideration of the factors affecting the species, utilizing only the best scientific and commercial information available and is not able to consider other factors or impacts (see response to Comment 70 for additional discussion). Listing recognizes the status of the species and invokes the protection and considerations under the Act, including regulatory provisions, consideration of Federal activities that may affect the polar bear, potential critical habitat designation. The Service will also develop a recovery plan and a rangewide conservation strategy. Please see the responses to comments under ''Issue 10: Recovery'' as well as the ''Available Conservation Measures'' section of this rule for further discussion.

Comment 72: Listing under the Act may result in additional regulation of industry and development activities in the Arctic. A discussion of incidental take authorization should be included in the listing rule. Some comments reflected concern regarding the perceived economic implications of regulatory and administrative requirements stemming from listing.

Our response: Section 7(a)(2) of the Act, as amended, requires Federal agencies to consult with the Service to ensure that the actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species. Informal consultation provides an opportunity for the action agency and the Service to explore ways to modify the action to reduce or avoid adverse effects to the listed species or designated critical habitat. In the event that adverse effects are unavoidable, formal consultation is required. Formal consultation is a process in which the Service determines if the action will result in incidental take of individuals, assesses the action's potential to jeopardize the continued existence of the species, and develops an incidental take statement. Formal consultation concludes when the Service issues a biological opinion, including any mandatory measures prescribed to reduce the amount or extent of incidental take of the action. In the case of marine mammals, the Service must also ensure compliance with regulations promulgated under section 101(a)(5) of the MMPA. Authorization of incidental take under the MMPA is discussed under Factor D. Actions that are already subject to section 7 consultation requirements in the Arctic, some of which may involve the polar bear, include, but are not limited to: Refuge operations and research permits; U.S. Army Corps of Engineers and Environmental Protection Agency permitting actions under the Clean Water Act and Clean Air Act; Bureau of Land Management land-use planning and management activities including onshore oil and gas leasing activities; Minerals Management Service administration of offshore oil and gas leasing activities; and Denali Commission funding of fueling and power generation projects.

Issue 10: Recovery

Comment 73: Several comments identified additional research needs related to polar bears, their prey, indigenous people, climate, and anthropogenic and cumulative effects on polar bears. Some specific recommendations include increased research and continued monitoring of polar bear populations and their prey, monitoring of polar bear harvest, and development of more comprehensive climate change models.

Our response: We agree that additional research would benefit the conservation of the polar bear. The Service will continue to work with the USGS, the State of Alaska, the IUCN/PBSG, independent scientists, indigenous people, and other interested parties to conduct research and monitoring on Alaska's shared polar bear populations. While the Service does not have appropriate resources or management responsibility for conducting climate research, we have and will continue to work with climatologists and experts from USGS, NASA, and NOAA to address polar bear-climate related issues. Furthermore, we will consider appropriate research and monitoring recommendations received from the public in the development of a rangewide conservation strategy.

Comment 74: Several commenters provided recommendations for recovery actions, to be considered both in addition to and in lieu of listing. Other commenters cited the need for immediate recovery planning and implementation upon completion of a final listing rule.

Our response: As discussed throughout this final rule, the Service has been working with Range countries on conservation actions for the polar bears for a number of years. Due to the significant threats to the polar bear's habitat, however, it is our determination that the polar bear meets the definition of a threatened species under the Act and requires listing. With completion of this final listing rule, the Service will continue and expand coordination with the Range countries regarding other appropriate international initiatives that would assist in the development of a rangewide conservation strategy. However, it must be recognized that the threats to the polar bear's habitat may only be addressed on a global level. Recovery planning under section 4(f) of the Act will be limited to areas under U.S. jurisdiction, since the preparation of a formal recovery plan would not promote the conservation of polar bears in foreign countries that are not subject to the implementation schedules and recovery goals established in such a plan. However, the Service will use its section 8 authorities to carry out conservation measures for polar bears in cooperation with foreign countries.

Summary of Factors Affecting the Polar Bear

Section 4 of the Act (16 U.S.C. 1533), and implementing regulations at 50 CFR part 424, set forth procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a) of the Act, we may list a species on the basis of any of five factors, as follows: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. In making this finding, the best scientific and commercial information available regarding the status and trends of the polar bear is considered in relation to the five factors provided in section 4(a)(1) of the Act.

In the context of the Act, the term ''endangered species'' means any species or subspecies or, for vertebrates, Distinct Population Segment (DPS), that is in danger of extinction throughout all or a significant portion of its range, and a ''threatened species'' is any species that is likely to become an endangered species within the foreseeable future. The Act does not define the term ''foreseeable future.'' For this final rule, we have identified 45 years as the foreseeable future for polar bears; our rationale for selecting this timeframe is presented in the following section.

Foreseeable Future

For this final rule, we have determined the ''foreseeable future'' in terms of the timeframe over which the best available scientific data allow us to reliably assess the effects of threats on the polar bear.

The principal threat to polar bears is the loss of their primary habitat-sea ice. The linkage between habitat loss and corresponding effects on polar bear populations was hypothesized in the past (Budyko 1966, p. 20; Lentfer 1972, p. 169; Tynan and DeMaster 1997, p. 315; Stirling and Derocher 1993, pp. 241–244; Derocher et al. 2004, p. 163), but is now becoming well established through long-term field studies that span multiple generations (Stirling et al. 1999, pp. 300–302; Stirling and Parkinson 2006, pp. 266–274; Regehr et al. 2006; Regehr et al. 2007a, 2007b; Rode et al. 2007, pp. 5–8; Hunter et al. 2007, pp. 8–14; Amstrup et al. 2007).

The timeframe over which the best available scientific data allows us to reliably assess the effect of threats on the species is the critical component for determining the foreseeable future. In the case of the polar bear, the key threat is loss of sea ice, the species' primary habitat. Sea ice is rapidly diminishing throughout the Arctic, and the best available evidence is that Arctic sea ice will continue to be affected by climate change. Recent comprehensive syntheses of climate change information (e.g., IPCC AR4) and additional modeling studies (e.g., Overland and Wang 2007a, pp. 1–7; Stroeve et al. 2007, pp. 1–5) show that, in general, the climate models that best simulate Arctic conditions all project significant losses of sea ice over the 21st century. A key issue in determining what timeframe to use for the foreseeable future has to do with the uncertainty associated with climate model projections at various points in the future. Virtually all of the climate model projections in the AR4 and other studies extend to the end of the 21st century, so we considered whether a longer timeframe for the foreseeable future was appropriate. The AR4 and other studies help clarify the scientific uncertainty associated with climate change projections, and allow us to make a more objective decision related to the timeframe over which we can reliably assess threats.

Available information indicates that climate change projections over the next 40–50 years are more reliable than projections over the next 80–90 years. This is illustrated in Figure 5 above. Examination of the trend lines for temperature using the three emissions scenarios, as shown in Figure 5, illustrates that temperature increases over the next 40–50 years are relatively insensitive to the SRES emissions scenario used to model the projected change (i.e., the lines in Figure 5 are very close to one another for the first 40–50 years). The ''limited sensitivity'' of the results is because the state-of-the-art climate models used in the AR4 have known physics connecting increases in GHGs to temperature increases through radiation processes (Overland and Wang 2007a, pp. 1–7, cited in J. Overland, NOAA, in litt. to the Service, 2007), and the GHG levels used in the SRES emissions scenarios follow similar trends until around 2040–2050. Because increases in GHGs have lag effects on climate and projections of GHG emissions can be extrapolated with greater confidence over the next few decades, model results projecting out for the next 40–50 years (near-term climate change estimates) have greater credibility than results projected much further into the future (long-term climate change) (J. Overland, NOAA, in litt. to the Service, 2007). Thus, the uncertainty associated with emissions is relatively smaller for the 45-year ''foreseeable future'' for the polar bear listing. After 2050, greater uncertainty associated with various climate mechanisms, including the carbon cycle, is reflected in the increasingly larger confidence intervals around temperature trend lines for each of the SRES emissions scenarios (see Figure 5). In addition, beyond 40–50 years, the trend lines diverge from one another due to differences among the SRES emissions scenarios. These SRES scenarios diverge because each makes different assumptions about the effects that population growth, potential technological improvements, societal and regulatory changes, and economic growth have on GHG emissions, and those differences are more pronounced after 2050. The divergence in the lines beyond 2050 is another source of uncertainty in that there is less confidence in what changes might take place to affect GHG emissions beyond 40–50 years from now.

The IPCC AR4 reaches a similar conclusion about the reliability of projection results over the short term (40–50 years) versus results over the long term (80–90 years) (IPCC 2007, p. 749) in discussing projected changes in surface air temperatures (SATs):

> ''There is close agreement of globally averaged SAT multi-model mean warming for the early 21st century for concentrations derived from the three non-mitigated IPCC Special Report on Emission Scenarios (SRES: B1, A1B and A2) scenarios (including only anthropogenic forcing) run by the AOGCMs * * * this warming rate is affected little by different scenario assumptions or different model sensitivities, and is consistent with that observed for the past few decades * * *. Possible future variations in natural forcings (e.g., a large volcanic eruption) could change those values somewhat, but about half of the early 21st-century warming is committed in the sense that it would occur even if atmospheric concentrations were held fixed at year 2000 values. By mid-century (2046–2065), the choice of scenario becomes more important for the magnitude of multi-model globally averaged SAT warming * * *. About a third of that warming is projected to be due to climate change that is already committed. By late century (2090–2099), differences between scenarios are large, and only about 20% of that warming arises from climate change that is already committed.''

On the basis of our analysis, reinforced by conclusions of the IPCC AR4, we have determined that climate changes projected within the next 40–50 years are more reliable than projections for the second half of the 21st century.

The 40–50 year timeframe for a reliable projection of threats to habitat corresponds closely to the timeframe of three polar bear generations (45 years), as determined by the method described in the following paragraph. Long-term studies have demonstrated, and world experts (e.g., PBSG) are in agreement, that three generations is an appropriate timespan to use to reliably assess the status of the polar bear and the effects of threats on population-level parameters (e.g., body condition indices, vital rates, and population numbers). This is based on the life history of the polar bear, the large natural variability associated with polar bear population processes, and the capacity of the species for ecological and behavioral adaptation (Schliebe et al. 2006a, pp. 59–60). Although not relied on as the basis for determining ''foreseeable future'' in this rule, the correspondence of this timeframe with important biological considerations provides greater confidence for this listing determination.

Polar bears are long-lived mammals, and adults typically have high survival rates. Both sexes can live 20 to 25 years (Stirling and Derocher 2007), but few polar bears in the wild live to be older than 20 years (Stirling 1988, p. 139; Stirling 1990, p. 225). Due to extremely low reproductive rates, polar bears require a high survival rate to maintain population levels. Survival rates increase up to a certain age, with cubs-of-the-year having the lowest rates and prime age adults (between 5 and 20 years of age) having survival rates that can exceed 90 percent. Generation length is the average age of parents of the current cohort; generation length therefore reflects the turnover rate of breeding individuals in a population. We adapted the criteria of the IUCN Red List process (IUCN 2004) for determining polar bear generation time in both the proposed rule (72 FR 1064) and this final rule. A generation span, as defined by IUCN, is calculated as the age of sexual maturity (5 years for polar bears) plus 50 percent of the length of the lifetime reproductive period (20 years for polar bears). The IUCN Red List process also uses a three-generation timeframe ''to scale the decline threshold for the species'' life history'' (IUCN 2004), recognizing that a maximum time cap is needed for assessments based on projections into the future because ''the distant future cannot be predicted with enough certainty to justify its use'' in determining whether a species is threatened or endangered. Based on these criteria, the length of one generation for the polar bear is 15 years, and, thus, three generations are 45 years.

The appropriate timeframe for assessing the effects of threats on polar bear population status must be determined on the basis of an assessment of the reliability of available biological and threat information at each step. For polar bear, the reliability of biological information and, therefore, population status projections, increases if a multigenerational analysis is used. In general, the reliability of information and projections increases with time, until a point when reliability begins to decline again due to uncertainty in projecting threats and corresponding responses by polar bear populations (S. Schliebe, pers. comm., 2008). This decline in reliability depends on the level of uncertainty associated with projected threats and their relationship to the population dynamics of the species. With polar bears, we expect the reliability of population status projections to diminish around 4–5 generations. Thus, ±3 generations is the optimal timeframe to reliably assess the status of the polar bear response to population-level threats. This progression can be illustrated by results from studies of the Western Hudson Bay polar bear population.

In western Hudson Bay, break-up of the annual sea ice now occurs approximately 2.5 weeks earlier than it did 30 years ago (see discussion of ''Western Hudson Bay'' population under Factor A and Stirling and Parkinson 2006, p. 265). Stirling and colleagues measured mean estimated mass of lone adult female polar bears from 1980 through 2004, and determined that their average weight declined by about 65 kg (143 lbs) over that period. Stirling and Parkinson (2006, p. 266) project that cub production could cease in 20 to 30 years if climate trends continue as projected by the IPCC. The overall timeframe covered by this scenario is 45–55 years, which is within the ±3 generation timeframe. In addition, Regehr et al. (2007a, p. 2,673) analyzed population trend data for 1987 through 2004 and documented a long-term, gradual decline in population size that is anticipated to continue into the future. These two lines of evidence indicate that the species will likely be in danger of extinction within the next 45 years. Beyond that timeframe, the population trend and threats information are too uncertain to reliably project the status of the species.

In summary, we considered the timeframe over which the best available scientific data allow us to reliably assess the effect of threats on the polar bear, and determined that there is substantial scientific reliability associated with climate model projections of sea ice change over the next 40–50 years. Confidence limits are much closer (i.e., more certain) for projections of the next 40–50 years and all projections agree that sea ice will continue to decrease. In comparison, periods beyond 50 years exhibit wider confidence limits, although all trends continue to express warming and loss of sea ice (IPCC 2007, p. 749; Overland and Wang 2007a, pp. 1–7; Stroeve et al. 2007, pp. 1–5). This timespan compares well with the 3-generation (45-year) timeframe over which we can reliably evaluate the effects of environmental change on polar bear life history and population parameters. Therefore, we believe that a 45-year foreseeable future is a reasonable and objective timeframe for analysis of whether polar bears are likely to become endangered.

This 45-year timeframe for assessing the status of the species is consistent with the work of the PBSG in reassessing the status of polar bears globally in June 2005 (Aars et al. 2006, p. 31) for purposes of IUCN Red List classification. More than 40 technical experts were involved in the PBSG review (including polar bear experts from the range countries and other invited polar bear specialists), and these PBSG technical experts supported the definition of a polar bear generation as 15 years, and the application of three generations as the appropriate timeframe over which to evaluate polar bear population trends for the purposes of IUCN Red List categorization. Although the Red List process is not the same as our evaluation for listing a species under the Act, the basic rationale for determining generation length and timeframe for analysis of threats is similar in both. None of the experts raised an issue with the 45-year timeframe for analysis of population trends.

In addition, when seeking peer review of both the *Status Review* (Schliebe et al. 2006a) and the proposed rule to list the polar bear as threatened (72 FR 1064), we specifically asked peer reviewers to comment on the 45-year foreseeable future and the method we used to derive that timeframe. All reviewers that commented on this subject indicated that a 45-year timeframe for the foreseeable future was appropriate, with the exception of one reviewer who thought the foreseeable future should be 100 years. Thus, both the independent reviews by PBSG and the input from peer reviewers corroborate our final decision and our rationale for using 45 years as the foreseeable future for the polar bear.

Our evaluation of the five factors with respect to polar bear populations is presented below. We considered all relevant available scientific and commercial information under each of the listing factors in the context of the present-day distribution of the polar bear.

Factor A. Present or Threatened Destruction, Modification, or Curtailment of the Polar Bear's Habitat or Range

Introduction

As described in detail in the ''Species Biology'' section of this rule, polar bears are evolutionarily adapted to life on sea ice (Stirling 1988, p. 24; Amstrup 2003, p. 587). They need sea ice as a platform for hunting, for seasonal movements, for travel to terrestrial denning areas, for resting, and for mating (Stirling and Derocher 1993, p. 241). Moore and Huntington (in press) classify polar bears as an ''ice-obligate'' species because of their reliance on sea ice as a platform for resting, breeding, and hunting. Laidre et al. (in press) similarly describe the polar bear as a species that principally relies on annual sea ice over the continental shelf and areas toward the southern extent of the edge of sea ice for foraging. Some polar bears use terrestrial habitats seasonally (e.g., for denning or for resting during open water periods). Open water by itself is not considered to be a habitat type frequently used by polar bears, because life functions such as feeding, reproduction, or resting do not occur in open water. However, open water is a fundamental part of the marine system that supports seal species, the principal prey of polar bears, and seasonally refreezes to form the ice needed by the bears (see ''Open Water Habitat'' section for more information). In addition, the extent of open water is important because vast areas of open water may limit a bear's ability to access sea ice or land (see ''Open Water Swimming'' section for more detail). Snow cover, both on land and on sea ice, is an important component of polar bear habitat in that it provides insulation and cover for young polar bears and ringed seals in snow dens or lairs on sea ice (see ''Maternal Denning Habitat'' section for more detail).

Previous Warming Periods and Polar Bears

Genetic evidence indicates that polar bears diverged from grizzly bears between 200,000–400,000 years ago (Talbot and Shields 1996a, p. 490; Talbot and Shields 1996b, p. 574); however, polar bears do not appear in the fossil record until the Last Interglacial Period (LIG) (115,000–140,000 years ago) (Kurten 1964, p. 25; Ingolfsson and Wiig 2007). Depending on the exact timing of their divergence, polar bears may have experienced several periods of climatic warming, including a period 115,000–140,000 years ago, a period of warming 4,000–12,000 years ago (Holocene Thermal Maximum), and most recently during medieval times (800 to 1200 A.D.). During these periods there is evidence suggesting that regional air temperatures were higher than present day and that sea ice and glacial ice were significantly reduced (Circumpolar Arctic PaleoEnvironments (CAPE) 2006, p. 1394; Jansen et al. 2007, p. 435, 468). This section considers historical information available on polar bears and the environmental conditions during these warming periods.

During the LIG (115,000–140,000 years ago), some regions of the world including parts of the Arctic experienced warmer than present day temperatures as well as greatly reduced sea ice in some areas, including what is now coastal Alaska and Greenland (Jansen et al. 2007, p. 453). CAPE (2006, p.1393) concludes that all sectors of the Arctic were warmer than present during the LIG, but that the magnitude of warming was not uniform across all regions of the Arctic. Summer temperature anomalies at lower Northern Hemisphere latitudes below the Arctic were not as pronounced as those at higher latitudes but still are estimated to have ranged from 0–2 degrees C above present (CAPE 2006, p. 1394). Furthermore, according to the IPCC, while the average temperature when considered globally during the LIG was not notably higher than present day, the rate of warming averaged 10 times slower than the rate of warming during the 20th century (Jansen et al. 2007, p. 453). However, the rate at which change occurred may have been more rapid regionally, particularly in the Arctic (CAPE 2006, p. 1394). While the specific responses of polar bears to regional changes in climate during the LIG are not known, they may have survived regional warming events by altering their distribution and/or retracting their range. Similar range retraction is projected for polar bears in the 21st century (Durner et al. 2007). However, the slower rate of climate change and more regional scale of change during the LIG suggest that polar bears had more opportunity to adapt during this time in comparison to the current observed and projected relatively rapid, global climate change (Jansen et al. 2007, p. 776; Lemke et al. 2007, p. 351).

The HTM 4,000–12,000 years ago also appears to have affected climate Arctic-wide, though summer temperature anomalies were lower than those that occurred during the LIG (CAPE 2006, p. 1394). Kaufman et al. (2003, p. 545) report that mean surface temperatures during the HTM were 1.6 ± 0.8 degrees C (range: 0.5–3 degrees C) higher in terrestrial habitats and 3.8 ± 1.9 degrees C at marine sites than present-day temperatures at 120 sites throughout the western Arctic (Northeast Russia to Iceland, including all of North America). Furthermore, Birks and Amman (2000, pp. 1,392–1,393) provide evidence that change in some areas may have been rapid, including an increase of 0.2–0.3 degrees C per 25 years in Norway and Switzerland. However, the timing of warming across the Arctic was not uniform, with Alaska and northwest Canada experiencing peak warming 4,000 years prior to northeast Canada (Kaufman et al. 2004, p. 529). Thus while regional changes in temperature are believed to have occurred, the IPCC concluded that annual global mean temperatures were not warmer than present day any time during the Holocene (Jansen et al. 2007, p. 465). While polar bears did experience warmer temperatures in their range during this time, the regional nature of warming that occurred may have aided their survival through this period in certain areas. However, the degree to which polar bears may have been impacted either regionally or Arctic-wide is unknown.

The most recent period of warming occurred during the Medieval period (generally considered to be the period from 950 to 1300 AD). This episode again appears to have been regional rather than global (Broecker 2001, p. 1,497; Jansen et al. 2007, p. 469); additionally, temperatures during this period are estimated to be 0.1–0.2 degrees C below the 1961 to 1990 mean and significantly below the instrumental data after 1980 (Jansen et al. 2007, p. 469). Thus, temperatures and rate of change estimated for this time period do not appear comparable to present day conditions.

Unfortunately, the limited scientific evidence currently available to us for these time periods does limit our ability to assess how polar bears responded to previous warming events. For example, while genetic analyses can be useful for identifying significant reductions in population size throughout a species' history (Hedrick 1996, p. 897; Driscoll et al. 2002, p. 414), most genetic studies of polar bears have focused on analyzing variation in micro-satellite DNA for the purposes of differentiating populations (i.e., identifying genetic structure; Paetkau et al. 1995, p. 347; Paetkau et al. 1999, p. 1,571; Cronin et al. 2006, p. 655). Additionally, genetic analyses for the purpose of identifying population bottlenecks require accurate quantification of mutation rates to determine how far back in time an event can be detected and a combination of mitochondrial and nuclear DNA analyses to eliminate potential alternative factors, other than a population bottleneck, that might result in or counteract low genetic variation (Driscoll et al. 2002, pp. 420–421; Hedrick 1996, p. 898; Nystrom et al. 2006, p. 84). The results of micro-satellite studies for polar bears have documented that within-population genetic variation is similar to black and grizzly bears (Amstrup 2003, p. 590), but that among populations, genetic structuring or diversity is low (Paetkau et al. 1995, p. 347; Cronin et al. 2006, pp. 658–659). The latter has been attributed with extensive population mixing associated with large home ranges and movement patterns, as well as the more recent divergence of polar bears in comparison to grizzly and black bears (Talbot and Shields 1996a, p. 490; Talbot and Shields 1996b, p. 574; Paetkau et al. 1999, p. 1,580). Inferring whether the degree of genetic variation from these studies is indicative of a population bottleneck, however, requires additional analyses that have yet to be conducted. Furthermore, the very limited fossil record of polar bears sheds little light on possible population-level responses of polar bears to previous warming events (Derocher et al. 2004, p. 163).

Thus, while polar bears as a species have survived at least one period of regional warming greater than present day, it is important to recognize that the degree that they were impacted is not known and there are differences between the circumstances surrounding historical periods of climate change and present day. First, the IPCC concludes that the current rate of global climate change is much more rapid and very unusual in the context of past changes (Jansen et al. 2007, p. 465). Although large variation in regional climate has been documented in the past 200,000 years, there is no evidence that mean global temperature increased at a faster rate than present warming (Jansen et al. 2007, p. 465), nor is there evidence that these changes occurred at the same time across regions. Furthermore, projected rates of future global change are much greater than rates of global temperature increase during the past 50 million years (Jansen et al. 2007, p. 465). Derocher et al. (2004, p. 163, 172) suggest that this rate of change will limit the ability of polar bears to respond and survive in large numbers. Secondly, polar bears today experience multiple stressors that were not present during historical warming periods. As explained further under Factors B, C, and E, polar bears today contend with harvest, contaminants, oil and gas development, and additional interactions with humans (Derocher et al. 2004, p. 172) that they did not experience in previous warming periods, whereas during the HTM, humans had just begun to colonize North America. Thus, both the cumulative effects of multiple stressors and the rapid rate of climate change today create a unique and unprecedented challenge for present-day polar bears in comparison to historical warming events.

Effects of Sea Ice Habitat Change on Polar Bears

Observed and predicted changes in sea ice cover, characteristics, and timing have profound effects on polar bears (Derocher and Stirling 1996, p. 1,250; Stirling et al. 1999, p. 294; Stirling and Parkinson 2006, p. 261; Regehr et al. 2007b, p. 18). As noted above, sea ice is a highly dynamic habitat with different types, forms, stages, and distributions that all operate as a complex matrix in determining biological productivity and use by marine organisms, including polar bears and their primary prey base, ice seal species. Polar bear use of sea ice is not uniform. Their preferred habitat is the annual ice located over the continental shelf and inter-island archipelagos that circle the Arctic basin. Ice seal species demonstrate a similar preference for these ice habitats.

In the Arctic, Hudson Bay, Canada has experienced some of the earliest ice changes due to its southerly location on a divide between a warming and a cooling region (Arctic Monitoring Assessment Program (AMAP) 2003, p. 22), making it an ideal area to study the impacts of climate change. In addition, Hudson Bay has the most extensive long-term data on the ecology of polar bears and is the location where the first evidence of major and ongoing impacts to polar bears from sea ice changes has been documented. Many researchers over the past 40 years have predicted an array of impacts to polar bears from climatic change that include adverse effects on denning, food chain disruption, and prey availability (Budyko 1966, p. 20; Lentfer 1972, p. 169; Tynan and DeMaster 1997, p. 315; Stirling and Derocher 1993, pp. 241–244). Stirling and Derocher (1993, p. 240) first noted changes, such as declining body condition, lowered reproductive rates, and reduced cub survival, in polar bears in western Hudson Bay; they attributed these changes to a changing ice environment. Subsequently, Stirling et al. (1999, p. 303) established a statistically significant link between climate change in western Hudson Bay, reduced ice presence, and observed declines in polar bear physical and reproductive parameters, including body condition (weight) and natality. More recently Stirling and Parkinson (2006, p. 266) established a statistically significant decline in weights of lone and suspected pregnant adult female polar bears in western Hudson Bay between 1988 and 2004. Reduced body weights of adult females during fall have been correlated with subsequent declines in cub survival (Atkinson and Ramsay 1995, p. 559; Derocher and Stirling 1996, p. 1,250; Derocher and Wiig 2002, p. 347).

Increased Polar Bear Movements

The best scientific data available suggest that polar bears are inefficient moving on land and expend approximately twice the average energy than other mammals when walking (Best 1982, p. 63; Hurst 1982, p. 273). However, further research is needed to better understand the energy dynamics of this highly mobile species. Studies have shown that, although sea ice circulation in the Arctic is clockwise, polar bears tend to walk against this movement to maintain a position near preferred habitat within large geographical home ranges (Mauritzen et al. 2003a, p. 111). Currently, ice thickness is diminishing (Rothrock et al. 2003, p. 3649; Yu et al. 2004) and movement of sea ice out of the polar region has occurred (Lindsay and Zhang 2005). As the climate warms, and less multi-year ice is present, we expect to see a decrease in the export of multi-year ice (e.g., Holland et al. 2006, pp. 1–5). Increased rate and extent of ice movements will, in turn, require additional efforts and energy expenditure by polar bears to maintain their position near preferred habitats (Derocher et al. 2004, p. 167). This may be an especially important consideration for females encumbered with small cubs. Ferguson et al. (2001, p. 51) found that polar bears inhabiting areas of highly dynamic ice had much larger activity areas and movement rates compared to those bears inhabiting more stable, persistent ice habitat.

Although polar bears are capable of living in areas of highly dynamic ice movement, they show inter-annual fidelity to the general location of preferred habitat (Mauritzen et al. 2003b, p. 122; Amstrup et al. 2000b, p. 963).

As sea ice becomes more fragmented, polar bears would likely use more energy to maintain contact with consolidated, higher concentration ice, because moving through highly fragmented sea ice is more energy-intensive than walking over consolidated sea ice (Derocher et al. 2004, p. 167). During summer periods, the remaining ice in much of the central polar basin is now positioned away from more productive continental shelf waters and occurs over much deeper, less productive waters, such as in the Beaufort and Chukchi Seas of Alaska. If the width of leads or extent of open water increases, the transit time for bears and the need to swim or to travel will increase (Derocher et al. 2004, p. 167). Derocher et al. (2004, p. 167) suggest that as habitat patch sizes decrease, available food resources are likely to decline, resulting in reduced residency time and increased movement rates. The consequences of increased energetic costs to polar bears from increased movements are likely to be reduced body weight and condition, and a corresponding reduction in survival and recruitment rates (Derocher et al. 2004, p. 167).

Additionally, as movement of sea ice increases and areas of unconsolidated ice also increase, some bears are likely to lose contact with the main body of ice and drift into unsuitable habitat from which it may be difficult to return (Derocher et al. 2004, p. 167). This has occurred historically in some areas such as Southwest Greenland as a result of the general drift pattern of sea ice in the area (Vibe 1967) and also occurs offshore of Newfoundland, Canada (Derocher et al. 2004, p. 167). Increased frequency of such events could negatively impact survival rates and contribute to population declines (Derocher et al. 2004, p. 167).

Polar Bear Seasonal Distribution Patterns Within Annual Activity Areas

Increasing temperatures and reductions in sea ice thickness and extent, coupled with seasonal retraction of sea ice poleward, will cause redistribution of polar bears seasonally into areas previously used either irregularly or infrequently. While polar bears have demonstrated a wide range of space-use patterns within and between populations, the continued retraction and fragmentation of sea ice habitats that is projected to occur will alter previous patterns of use seasonally and regionally. These changes have been documented at an early onset stage for a number of polar bear populations with the potential for large-scale shifts in distribution by the end of the 21st century (Durner et al. 2007, pp. 18–19).

This section provides examples of distribution changes and interrelated consequences. Recent studies indicate that polar bear movements and seasonal fidelity to certain habitat areas are changing and that these changes are strongly correlated to similar changes in sea ice and the ocean-ice system. Changes in movements and seasonal distributions can have effects on polar bear nutrition, body condition, and more significant longer term redistribution. Specifically, in western Hudson Bay, break-up of the annual sea ice now occurs approximately 2.5 weeks earlier than it did 30 years ago (Stirling et al. 1999, p. 299). The earlier spring break-up was highly correlated with dates that female polar bears came ashore (Stirling et al. 1999, p. 299). Declining reproductive rates, subadult survival, and body mass (weights) have occurred because of longer periods of fasting on land as a result of the progressively earlier break-up of the sea ice and the increase in spring temperatures (Stirling et al. 1999, p. 304; Derocher et al. 2004, p. 165).

Stirling et al. (1999, p. 304) cautioned that, although downward trends in the size of the Western Hudson Bay population had not been detected, if trends in life history parameters continued downward, ‘‘they will eventually have a detrimental effect on the ability of the population to sustain itself.’’ Subsequently, Parks et al. (2006, p. 1282) evaluated movement patterns of adult female polar bears satellite-collared from 1991 to 2004 with respect to their body condition. Reproductive status and variation in ice patterns were included in the analysis. Parks et al. (2006, p. 1281) found that movement patterns were not dependent on reproductive status of females but did change significantly with season. They found that annual distances moved had decreased in Hudson Bay since 1991. This suggested that declines in body condition were due to reduced prey consumption as opposed to increased energy output from movements (Parks et al. 2006, p. 281). More recently, Regehr et al. (2007a, p. 2,673) substantiated Stirling et al.’s (1999, p. 304) predictions, noting population declines in western Hudson Bay during analysis of data from an ongoing mark-recapture population study. Between 1987 and 2004, the number of polar bears in the Western Hudson Bay population declined from 1,194 to 935, a reduction of about 22 percent (Regehr et al. 2007a, p. 2,673). Progressive declines in the condition and survival of cubs, subadults, and bears 20 years of age and older appear to have been caused by progressively earlier sea ice break-up, and likely initiated the decline in population. Once the population began to decline, existing harvest rates contributed to the reduction in the size of the population (Regehr et al. 2007a, p. 2,680).

Since 2000, Schliebe et al. (2008) observed increased use of coastal areas by polar bears during the fall open-water period in the southern Beaufort Sea. High numbers of bears (a minimum of 120) were found to be using coastal areas during some years, where prior to the 1990s, according to native hunters, industrial workers, and researchers operating on the coast at this time of year, such observations of polar bears were rare. This study period (2000–2005) also included record minimal sea ice conditions for the month of September in 4 of the 6 survey years. Polar bear density along the mainland coast and on barrier islands during the fall open water period in the southern Beaufort Sea was related to distance from pack ice edge and the density of ringed seals over the continental shelf. The distance between pack ice edge and the mainland coast, as well as the length of time that these distances prevailed, was directly related to polar bear density onshore. As the sea ice retreated and the distance to the edge of the ice increased, the number of bears near shore increased. Conversely, as near-shore areas became frozen or sea ice advanced toward shore, the number of bears near shore decreased (Schliebe et al. 2008). The presence of subsistence-harvested bowhead whale carcasses and their relationship to polar bear distribution were also analyzed. These results suggest that, while seal densities near shore and availability of bowhead whale carcasses may play a role in polar bear distribution changes, that sea ice conditions (possibly similar to conditions observed in western Hudson Bay) are influencing the distribution of polar bears in the southern Beaufort Sea. They also suggest that increased polar bear use of coastal areas may continue if the summer retreat of the sea ice continues into the future as predicted (Serreze et al. 2000, p. 159; Serreze and Barry 2005).

Others have observed increased numbers of polar bears in novel habitats. During bowhead whale surveys conducted in the southern Beaufort Sea during September, Gleason et al. (2006)

observed a greater number of bears in open water and on land during surveys in 1997–2005, years when sea ice was often absent from their study area, compared to surveys conducted between 1979–1996, years when sea ice was a predominant habitat within their study area. Bears in open water likely did not select water as a choice habitat, but rather were swimming in an attempt to reach offshore pack ice or land. Their observation of a greater number of bears on land during the later period was concordant with the observations of Schliebe et al. (2008). Further, the findings of Gleason et al. (2006) coincide with the lack of pack ice (concentrations of greater than 50 percent) caused by a retraction of ice in the study area during the latter period (Stroeve et al. 2005, p. 2; Comiso 2003, p. 3,509; Comiso 2005, p. 52). The findings of Gleason et al. (2006) confirm an increasing use of coastal areas by polar bears in the southern Beaufort Sea in recent years and a decline in ice habitat near shore. The immediate causes for changes in polar bear distribution are thought to be (1) retraction of pack ice far to the north for greater periods of time in the fall and (2) later freeze-up of coastal waters.

Other polar bear populations exhibiting seasonal distribution changes with larger numbers of bears on shore have been reported. Stirling and Parkinson (2006, pp. 261–275) provide an analysis of pack ice and polar bear distribution changes for the Baffin Bay, Davis Strait, Foxe Basin, and Hudson Bay populations. They indicate that earlier sea ice break-up will likely result in longer periods of fasting for polar bears during the extended open-water season. This may explain why more polar bears have been observed near communities and hunting camps in recent years. Seasonal distribution changes of polar bears have been noted during a similar period of time for the northern coast of Chukotka (Kochnev 2006, p. 162) and on Wrangel Island, Russia (Kochnev 2006, p. 162; N. Ovsyanikov, Russian Federation Nature Reserves, pers. comm.). The relationship between the maximum number of polar bears, the number of dead walruses, and the distance to the ice edge from Wrangel Island was evaluated. The subsequent results revealed that the most significant correlation was between bear numbers and distance to the ice-edge (Kochnev 2006, p. 162), which again supports the observation that when sea ice retreats far off shore, the numbers of bears present or stranded on land appears to increase.

In Baffin Bay, traditional Inuit knowledge studies and anecdotal reports indicate that in many areas greater numbers of bears are being encountered on land during the summer and fall open-water seasons (Dowsley 2005, p. 2). Interviews with elders and senior hunters (Dowsley and Taylor 2005, p. 2) in three communities in Nunavut, Canada, revealed that most respondents (83 percent) believed that the population of polar bears had increased. The increase was attributed to more bears seen near communities, cabins, and camps; hunters also encountered bear sign (e.g., tracks, scat) in areas not previously used by bears. Some people interviewed noted that these observations could reflect a change in bear behavior rather than an increase in population. Many (62 percent) respondents believed that bears were less fearful of humans now than 15 years ago. Most (57 percent) respondents reported bears to be skinnier now, and five people in one community reported an increase in fighting among bears. Respondents also discussed climate change, and they indicated that there was more variability in the sea ice environment in recent years than in the past. Some respondents indicated a general trend for ice floe edge to be closer to the shore than in the past, the sea ice to be thinner, fewer icebergs to be present, and glaciers to be receding. Fewer grounded icebergs, from which shorefast ice forms and extends, were thought to be partially responsible for the shift of the ice edge nearer to shore. Respondents were uncertain if climate change was affecting polar bears or what form the effects may be taking (Dowsley 2005, p. 1). Also, results from an interview survey of 72 experienced polar bear hunters in Northwest Greenland in February 2006 indicate that during the last 10–20 years, polar bears have occurred closer to the coast. Several of those interviewed believed the change in distribution represented an increase in the population size (e.g., Kane Basin and Baffin Bay), although others suggested that it may be an effect of a decrease in the sea ice (Born et al., in prep).

Recently Vladilen Kavry, former Chair of the Union of Marine Mammal Hunters of Chukotka, Russia, Polar Bear Commission, conducted a series of traditional ecological knowledge interviews with indigenous Chukotka coastal residents regarding their impression of environmental changes based on their lifetime of observations (Russian Conservation News No. 41 Spring/Summer 2006). The interviewees included 17 men and women representing different age and ethnic groups (Chukchi, Siberian Yupik, and Russian) in Chukotka, Russia. Respondents noted that across the region there was a changing seasonal weather pattern with increased unpredictability and instability of weather. Respondents noted shorter winters, observing that the fall-winter transition was occurring later, and spring weather was arriving earlier. Many described these differences as resulting in a one-month-later change in the advent of fall and one-month-earlier advent of spring. One 71-year-old Chukchi hunter believed that winter was delayed two months and indicated that the winter frosts that had previously occurred in September were now taking place in November. He also noted that thunderstorms were more frequent. Another 64-year-old hunter noted uncharacteristic snow storms and blizzards as well as wintertime rains. He also noted that access to sea ice by hunters was now delayed from the normal access date of November to approximately one month later into December. This individual also noted that blizzards and weather patterns had changed and that snow is more abundant and wind patterns caused snow drifts to occur in locations not previously observed. With increased spring temperatures, lagoons and rivers are melting earlier. The sea ice extent has declined and the quality of ice changed. The timing of fall sea ice freezing is delayed two months into November. The absence of sea ice in the summer is thought to have caused walrus to use land haulouts for resting in greater frequency and numbers than in the past.

Stirling and Parkinson (2006, p. 263) evaluated sea ice conditions and distribution of polar bears in five populations in Canada: Western Hudson Bay, Eastern Hudson Bay, Baffin Bay, Foxe Basin, and Davis Strait. Their analysis of satellite imagery beginning in the 1970s indicates that the sea ice is breaking up at progressively earlier dates, so bears must fast for longer periods of time during the open-water season. Stirling and Parkinson (2006, pp. 271–272) point out that long-term data on population size and body condition of bears from the Western Hudson Bay population, and population and harvest data from the Baffin Bay population, indicate that these populations are declining or likely to be declining. The authors indicate that as bears in these populations become more nutritionally stressed, the numbers of animals will decline, and the declines will probably be significant. Based on the recent findings of Holland et al.

(2006, pp. 1–5) regarding sea ice changes, these events are predicted to occur within the foreseeable future as defined in this rule (Stirling, pers. comm. 2006).

Seasonal polar bear distribution changes noted above, the negative effect of reduced access to primary prey, and prolonged use of terrestrial habitat are a concern for polar bears. Although polar bears have been observed using terrestrial food items such as blueberries (*Vaccinium sp.*), snow geese (*Anser caerulescens*), and reindeer (*Rangifer tarandus*), these alternate foods are not believed to represent significant sources of energy (Ramsay and Hobson 1991, p. 600; Derocher et al. 2004, p. 169) because they do not provide the high fat, high caloric food source that seals do. Also, the potential inefficiency of polar bear locomotion on land noted above may explain why polar bears are not known to regularly hunt musk oxen (*Ovibos moschatus*) or snow geese, despite their occurrence as potential prey in many areas (Lunn and Stirling 1985, p. 2,295). The energy needed to catch such species would almost certainly exceed the amount of energy a kill would provide (Lunn and Stirling 1985, p. 2,295). Consequently, greater use of terrestrial habitats as a result of reduced presence of sea ice seasonally will not offset energy losses resulting from decreased seal consumption. Nutritional stress appears to be the only possible result.

Effects of Sea Ice Habitat Changes on Polar Bear Prey

Reduced Seal Productivity

Polar bear populations are known to fluctuate with prey abundance (Stirling and Lunn 1997, p. 177). Declines in ringed and bearded seal numbers and productivity have resulted in marked declines in polar bear populations (Stirling 1980, p. 309; Stirling and Øritsland 1995, p. 2,609; Stirling 2002, p. 68). Thus, changes in ringed seal productivity have the potential to affect polar bears directly as a result of reduced predation on seal pups and indirectly through reduced recruitment of this important prey species. Ringed seal productivity is dependent on the availability of secure habitat for birth lairs and rearing young and, as a result, is susceptible to changes in sea ice and snow dynamics. Ringed seal pups are the smallest of the seals and survive because they are born in snow lairs (subnivian dens) that afford protection from the elements and from predation (Hall 1866; Chapskii 1940; McLaren 1958; Smith and Stirling 1975, all cited in Kelly 2001, p. 47). Pups are born between mid-March and mid-April, nursed for about 6 weeks, and weaned prior to spring break-up in June (Smith 1980, p. 2,201; Stirling 2002, p. 67). During this time period, both ringed seal pups and adults are hunted by polar bears (Smith 1980, p. 2,201). Stirling and Lunn (1997, p. 177) found that ringed seal young-of-the-year represented the majority of the polar bear diet, although the availability of ringed seal pups from about mid-April to ice break up sometime in July (Stirling and Lunn 1997, p. 176) is also important to polar bears.

In many areas, ringed seals prefer to create birth lairs in areas of accumulated snow on stable, shore-fast ice over continental shelves along Arctic coasts, bays, and inter-island channels (Smith and Hammill 1981, p. 966). While some authors suggest that landfast ice is the preferred pupping habitat of ringed seals due to its stability throughout the pupping and nursing period (McLaren 1958, p. 26; Burns 1970, p. 445), others have documented ringed seal pupping on drifting pack ice both nearshore and offshore (Burns 1970; Smith 1987; Finley et al. 1983, p. 162; Wiig et al. 1999, p. 595; Lydersen et al. 2004). Either of these habitats can be affected by earlier warming and break-up in the spring, which shortens the length of time pups have to grow and mature (Kelly 2001, p. 48; Smith and Harwood 2001). Harwood et al. (2000, pp. 11–12) reported that an early spring break-up negatively impacted the growth, condition, and apparent survival of unweaned ringed seal pups. Early break-up was believed to have interrupted lactation in adult females, which in turn, negatively affected the condition and growth of pups. Earlier ice break-ups similar to those documented by Harwood et al. (2000, p. 11) and Ferguson et al. (2005, p. 131) are predicted to occur more frequently with warming temperatures, and result in a predicted decrease in productivity and abundance of ringed seals (Ferguson et al. 2005, p. 131; Kelly 2001). Additionally, high fidelity to birthing sites exhibited by ringed seals makes them more susceptible to localized impacts from birth lair snow degradation, harvest, or human activities (Kelly 2006, p. 15).

Unusually heavy ice has also been documented to result in markedly lower productivity of ringed seals and reduced polar bear productivity (Stirling 2002, p. 59). While reduced ice thickness associated with warming in some areas could be expected to improve seal productivity, the transitory and localized benefits of reduced ice thickness on ringed seals are expected to be outweighed by the negative effects of increased vulnerability of seal pups to predation and thermoregulatory costs (Derocher et al. 2004, p. 168). The number of studies that have documented negative effects associated with earlier warming and break-up and reduced snow cover (Hammill and Smith 1989, p. 131; Harwood et al. 2000, p. 11; Smith et al. 1991; Stirling and Smith 2004, p. 63; Ferguson et al. 2005, p. 131), in comparison to any apparent benefits of reduced ice thickness further support this conclusion.

Snow depth on the sea ice, in addition to the timing of ice break-up, appears to be important in affecting the survival of ringed seal pups. Ferguson et al. (2005, pp. 130–131) attributed decreased snow depth in April and May with low ringed seal recruitment in western Hudson Bay. Reduced snowfall results in less snow drift accumulation on the leeward side of pressure ridges; pups in lairs with thin snow roofs are more vulnerable to predation than pups in lairs with thick roofs (Hammill and Smith 1989, p.131; Ferguson et al. 2005, p. 131). Access to birth lairs for thermoregulation is also considered to be crucial to the survival of nursing pups when air temperatures fall below 0 degrees C (Stirling and Smith 2004, p. 65). Warming temperatures that melt snow-covered birth lairs can result in pups being exposed to ambient conditions and suffering from hypothermia (Stirling and Smith 2004, p. 63). Others have noted that when lack of snow cover has forced birthing to occur in the open, nearly 100 percent of pups died from predation (Kumlien 1879; Lydersen et al. 1987; Lydersen and Smith 1989, p. 489; Smith and Lydersen 1991; Smith et al. 1991, all cited in Kelly 2001, p. 49). More recently, Kelly et al. (2006, p. 11) found that ringed seal emergence from lairs was related to structural failure of the snow pack, and PM satellite measurements indicating liquid moisture in snow. These studies suggest that warmer temperatures have and will continue to have negative effects on ringed seal pup survival, particularly in areas such as western Hudson Bay (Ferguson et al. 2005, p. 121).

Similar to earlier spring break-up or reduced snow cover, increased rain-on-snow events during the late winter also negatively impact ringed seal recruitment by damaging or eliminating snow-covered pupping lairs, increasing exposure and the risk of hypothermia, and facilitating predation by polar bears and Arctic foxes (*Alopex lagopus*) (Stirling and Smith 2004, p. 65). Stirling and Smith (2004, p. 64) document the collapse of snow roofs of ringed seal birth lairs associated with rain events near southeastern Baffin Island and the resultant exposure of adult seals and pups to hypothermia. Predation of pups by polar bears was observed, and the researchers suspect that most of the pups in these areas were eventually killed by polar bears (Stirling and Archibald 1977, p. 1,127), Arctic foxes (Smith 1976, p. 1,610) or possibly gulls (Lydersen and Smith 1989). Stirling and Smith (2004, p. 66) postulated that should early season rain become regular and widespread in the future, mortality of ringed seal pups will increase, especially in more southerly parts of their range. Any significant decline in ringed seal numbers, especially in the production of young, could negatively affect reproduction and survival of polar bears (Stirling and Smith 2004, p. 66).

Changes in snow and ice conditions can also have impacts on polar bear prey other than ringed seals (Born 2005a, p. 152). These species include harbor seals (*Phoca vitulina*), spotted seals (*Phoca largha*), and ribbon seals (*Phoca fasciata*), and in the north Atlantic, harp seals (*Phoca greenlandica*) and hooded seals (*Crystophora cristata*). The absence of ice in southerly pupping areas or the relocation of pupping areas for other ice-dependent seal species to more northerly areas has been demonstrated to negatively affect seal production. For example, repeated years of little or no ice in the Gulf of St. Lawrence resulted in almost zero production of harp seal pups, compared to hundreds of thousands in good ice years (ACIA 2005, p. 510). Marginal ice conditions and early ice break-up during harp seal whelping (pupping) are believed to have resulted in increased juvenile mortality from starvation and cold stress and an overall reduction in this age class (Johnston et al. 2005, pp. 215–216). Northerly shifts of whelping areas for hooded seals were reported to occur during periods of warmer climate and diminished ice (Burns 2002, p. 42). In recent years, the location of a hooded seal whelping patch near Jan Mayen, in East Greenland, changed position apparently in response to decreased sea ice in this area. This change in distribution has corresponded with a decrease in seal numbers (T. Haug, pers. comm. 2005). Laidre et al. (in press) concluded that harp and hooded seals will be susceptible to negative effects associated with reduced sea ice because they whelp in large numbers at high density with a high degree of fidelity to traditional and critical whelping locations. Because polar bears prey primarily on seal species whose reproductive success is closely linked to the availability of stable, spring ice, the productivity of these species, and, therefore, prey availability for polar bears, is expected to decline in response to continued declines in the extent and duration of sea ice.

Reduced Prey Availability

Current evidence suggests that prey availability to polar bears will be altered due to reduced prey abundance, changes in prey distribution, and changes in sea ice availability as a platform for hunting seals (Derocher et al. 2004, pp. 167–169). Young, immature bears may be particularly vulnerable to changes in prey availability. Polar bears feed preferentially on blubber, and adult bears often leave much of a kill behind (Stirling and McEwan 1975, p. 1,021). Younger bears, which are not as efficient at taking seals, are known to utilize these kills to supplement their diet (Derocher et al. 2004, p. 168). Younger bears may be disproportionately impacted if there are fewer kills or greater consumption of kills by adults, resulting in less prey to scavenge (Derocher et al. 2004, pp. 167–168). Altered prey distribution would also likely lead to increased competition for prey between dominant and subordinate bears, resulting in subordinate or subadult bears having reduced access to prey (Derocher et al. 2004, p. 167). Thus, a decrease in prey abundance and availability would likely result in a concomitant effect to polar bears.

Reduction in food resources available to seals, in addition to the previously discussed effects on reproduction, could affect seal abundance and availability as a prey resource to polar bears. Ringed seals are generalist feeders but depend on Arctic cod (*Boreogadus saida*) as a major component of their diet (Lowry et al. 1980, p. 2,254; Bradstreet and Cross 1982, p. 3; Welch et al. 1997, p. 1,106; Weslawski et al. 1994, p. 109). Klumov (1937) regarded Arctic cod as the 'biological pivot' for many northern marine vertebrates, and as an important intermediary link in the food chain. Arctic cod are strongly associated with sea ice throughout their range and use the underside of the ice to escape from predators (Bradstreet and Cross 1982, p. 39; Craig et al. 1982, p. 395; Sekerak 1982, p. 75). While interrelated changes in the Arctic food web and effects to upper level consumers are difficult to predict, a decrease in seasonal ice cover could negatively affect Arctic cod (Tynan and DeMaster 1997, p. 314; Gaston et al. 2003, p. 231). Though decreased ice could improve the ability of ringed seals to access and prey upon Arctic cod in open water, this change would come at increased costs for pups that are forced into the water at an earlier age and at risk of predation and thermal challenges (Smith and Harwood 2001). For example, studies have shown that even in the presence of abundant prey, growth and condition of ringed seals continued to be negatively affected by earlier ice break-up (Harwood et al. 2000, p. 422). Ice seals, including the ringed seal, are vulnerable to habitat loss from changes in the extent or concentration of Arctic ice because they depend on pack-ice habitat for pupping, foraging, molting, and resting (Tynan and DeMaster 1997, p. 312; Derocher et al. 2004, p. 168).

Sea ice is an essential platform that allows polar bears to access their prey. The importance of sea ice to polar bear foraging is supported by documented relationships between the duration and extent of sea ice and polar bear condition, reproduction, and survival that are apparent across decades, despite likely fluctuations in ringed seal abundance (Stirling et al. 1999, p. 294; Regehr et al. 2007a; p. 2,673; Regehr et al. 2007b, p. 18; Rode et al. 2007, p. 6–8). Ferguson et al. (2000b, p. 770) reported that higher seal density in Baffin Bay in comparison to the Arctic Archipelago did not correspond with a higher density of polar bears as a result of the more variable ice conditions that occur there. These results emphasize the dependence of polar bears on sea ice as a means of accessing prey. Not only does ice have to be present over areas of abundant prey, but the physical characteristics of sea ice appear to also be important. Stirling et al. (2008, in press) noted that unusually rough and rafted sea ice in the southeastern Beaufort Sea from about Atkinson Point to the Alaska border during the springs of 2004–2006 resulted in reduced hunting success of polar bears seeking seals despite extensive searching for prey. Thus, transitory or localized increases in prey abundance will have no benefit for polar bears if these changes are accompanied by a reduction in ice habitat or changes in physical characteristics of ice habitat that negate its value for hunting or accessing seals. Observations-to-date and projections of future ice conditions support the conclusion that accessibility of prey to polar bears is likely to decline.

Adaptation

Animals can adapt to changing environmental conditions principally through behavioral plasticity or as a result of natural selection. Behavioral changes allow adaptation over shorter timeframes and can complement and be a precursor to the forces of natural selection that allow animals to evolve to better fit new or changed environmental patterns. Unlike behavioral plasticity, natural selection is a multi-generational response to changing conditions, and its speed is dependent upon the organism's degree of genetic variation and generation time and the rate of environmental change (Burger and Lynch 1995, p. 161). While some short-lived species have exhibited micro-evolutionary responses to climate change (e.g., red squirrels (Reale et al. 2003, p. 594)), the relatively long generation time (Amstrup 2003, pp. 599–600) and low genetic variation of polar bears (Amstrup 2003, p. 590) combined with the relatively rapid rate of predicted sea ice changes that are expected (Comiso 2006, p. 72; Serreze et al. 2007, p. 1,533–1,536; Stroeve et al. 2007, pp. 1–5; Hegerl et al. 2007, p. 716), suggest that adaptation through natural selection will be limited for polar bears (Stirling and Derocher 1990, p. 201). Furthermore, several recent reviews of species adaptation to changing climate suggest that rather than evolving, species appear to first alter their geographic distribution (Walther et al. 2002, p. 390; Parmesan 2006, p. 655). For example, evidence suggests that altered species distribution was the mechanism allowing many species to survive during the Pleistocene warming period (Parmesan 2006, p. 655). Because polar bears already occur in cold extreme climates, they are constrained from responding to climate change by significantly altering their distribution (Parmesan 2006, p. 653). Furthermore, a number of physiological and physical characteristics of polar bears constrain their ability to adapt behaviorally to rapid and extensive alteration of their sea-ice habitat.

Bears as a genus display a high degree of behavioral plasticity (Stirling and Derocher 1990, p. 189), opportunistic feeding strategies (Lunn and Stirling 1985, p. 2295; Schwartz et al. 2003, p. 568), and physiological mechanisms for energy conservation (Derocher et al. 1990, p. 196; McNab 2002, p. 385). However, polar bears evolved to be the largest of the bear species (Amstrup 2003, p. 588) by specializing on a calorically dense, carnivorous diet that differs from all other bear species. Their large size has the advantage of both increased fat storage capability (McNab 2002, p. 383) and reduced surface-area to volume ratios that minimize heat loss in the Arctic environment (McNab 2002, pp. 102–103). Because reproduction in polar bears and other bears is dependent upon achieving sufficient body mass (Atkinson and Ramsay 1995, p. 559; Derocher and Stirling 1996, p. 1,246; Derocher and Stirling 1998, p. 253), population density is directly linked to the availability of high-quality food and primary productivity (Hilderbrand et al. 1999, p. 135; Ferguson and McLoughlin 2000, p. 196). Thus, maintenance of a high caloric intake is facilitated by the high fat content of seals, which is required to maintain polar bears at the body size and in the numbers in which they exist today.

The most recent population estimates of ringed seals, the preferred prey of most polar bear populations, range to about 4 million or more, making them one of the most abundant seal species in the world (Kingsley 1990, p. 140). Rather than switching to alternative prey items when ringed seal populations decline as a result of environmental conditions, several studies demonstrated corresponding declines in polar bear abundance (Stirling and Øritsland 1995, p. 2,594; Stirling 2002, p. 68). For those polar bear populations that have been shown to utilize alternative prey species in response to changing availability, such shifts have been among other ice-dependent pinnipeds (Derocher et al. 2002, p. 448; Stirling 2002, p. 67; Iverson et al. 2006, pp. 110–112). For example, Stirling and Parkinson (2006, p. 270) and Iverson et al. (2006, p. 112) have shown that polar bears in the Davis Strait region have taken advantage of increases in availability of harp and hooded seals. See also the section ''Effects of Sea Ice Habitat Changes on Polar Bear Prey.'' However, harp and hooded seals have historically occurred in areas not frequented by polar bears, and are extremely vulnerable to polar bear predation and in Davis Strait survival of juveniles is believed to have declined in recent years due to significant and rapid reduction in sea ice in the spring (Stirling and Parkinson 2006, p. 270).

Changes in ringed seal distribution and abundance in response to changing ice conditions and the ability of polar bears to respond to those changes will likely be the most important factor determining effects on polar bear populations. Currently, access to ringed seals is seasonal for most polar bear populations, resulting in cycles of weight gain and weight loss. The most important foraging periods occur during the spring, early summer, and following the open-water period in the fall (Stirling et al. 1999, p. 303; Derocher et al. 2002, p. 449; Durner et al. 2004, pp. 18–19). Because observed and predicted changes in sea ice are most dramatic during the summer/fall period (Lemke et al. 2007, p. 351; Serreze et al. 2007, p. 1,533–1,536), this is the timeframe with the greatest potential for reduced access to ringed seals as prey. Most POLAR BEAR POPULATIONs forage minimally during the fall open-water period, but a reduction in sea ice can extend the time period in which bears have minimal or no access to prey (Stirling et al. 1999, p. 299). The effects of a lengthened ice-free season during this time period have been associated with declines in polar bear condition (Stirling et al. 1999, p. 304; Rode et al. 2007, p. 8), reproduction (Regehr et al. 2006; Rode et al. 2007, p. 8–9), survival (Regehr et al. 2007a, p. 2,677–2,678; Regehr et al 2007b, p. 13) and population size (Regehr et al. 2007a, p. 2,678–2,679;).

Marine mammal carcasses do not currently constitute a large portion of polar bear diets and are unlikely to contribute substantially to future diets of polar bears. Although marine mammal carcass availability occasionally is predictable where whales are harvested for subsistence by Native people (Miller et al. 2006, p. 1) or where walruses haul out on land and are killed in stampeding events (Kochnev 2006, p. 159), in most cases scavenging opportunities are unpredictable and not a substitute for normal foraging by polar bears. Even where their distribution is predictable, marine mammal carcasses are presently used by only a small proportion of most populations or contribute minimally to total diet (Bentzen 2006, p. 23; Iverson et al. 2006, p. 111), and do not appear to be a preferred substitute for the normal diet. For example, on the Alaskan Southern Beaufort Sea coast, from 2002–2004, on average less than 5 percent of the estimated population size of 1,500 polar bears visited subsistence-harvested whale carcasses (Miller et al. 2006, p. 9). A small fraction of collared pregnant adult females visited whale harvest sites (Fischbach et al. 2007, pp. 1,401–1,402). Quotas on subsistence whale harvest preclude the possibility that carcasses will be increasingly available in the future. Similarly, while walrus contributed up to 24 percent of diets of a few individual bears in Davis Strait, population wide, walruses composed a small fraction of the total diet (Iverson et al. 2006, p. 112). Less predictable sea-ice conditions could increase the frequency of future marine mammal strandings (Derocher et al. 2004, p. 89), and some polar bears may benefit from such increases in marine mammal mortality. However, if stranding events become frequent, they are likely to result in declines of source populations. Thus, the likelihood of polar bears relying heavily on stranded or harvested marine mammals as a food source is low.

The potential for polar bears to substitute terrestrial food resources in place of their current diet of marine mammals is limited by the low quality and availability of foods in most northern terrestrial environments. Although smaller bears can maintain their body weight consuming diets consisting largely of berries and vegetation, low digestibility (Pritchard and Robbins 1990, p. 1,645), physical constraints on intake rate, and in the case of berries, low protein content, prevent larger bears from similarly subsisting on vegetative resources (Stirling and Derocher 1990, p. 191; Rode and Robbins 2000, p. 1,640; Rode et al. 2001, p. 70; Welch et al. 1997, p. 1,105). While some meat sources are available in terrestrial Arctic habitats, such as caribou, muskox, and Arctic char, the relative scarcity of these resources results in these areas supporting some of the smallest grizzly bears in the world at some of the lowest densities of any bear populations (Hilderbrand et al. 1999, p. 135; Miller et al. 1997, p. 37). Lunn and Stirling (1985, p. 2,295) suggest that predation on terrestrially-based prey by polar bears may be rare due to the high energetic cost of locomotion in polar bears in comparison to grizzly bears (Best 1982, p. 63). Energy expended to pursue terrestrial prey could exceed the amount of energy obtained. Furthermore, terrestrial meat resources are primarily composed of protein and carbohydrates that provide approximately half as many calories per gram as fats (Robbins 1993, p. 10). Because the wet weight of ringed seals is composed of up to 50 percent fat (Stirling 2002, p. 67), they provide a substantially higher caloric value in comparison to terrestrial foods. Physiological and environmental limitations, therefore, preclude the possibility that terrestrial food sources alone or as a large portion of the diet would be an equivalent substitute for the high fat diet supporting the population densities and body size of present-day polar bear populations.

An alternative to maintaining caloric intake would be for polar bears to adopt behavioral strategies that reduce energy expenditure and requirements. Across populations, polar bears do appear to alter home range size and daily travel distances in response to varying levels of prey density (Ferguson et al. 2001, p. 51). Additionally, polar bears exhibit a variety of patterns of fasting and feeding throughout their range, including 3-to 8-month-long fasts, denning by pregnant females, and moving between a fasting and a feeding metabolism based on continuously changing food availability throughout the year (Derocher et al. 1990, p. 202). These physiological and behavioral strategies have occurred in response to regional variation in environmental conditions but have limitations relative to their application across all regions and habitats. Both the long fasts that occur in Western Hudson Bay and denning of females throughout polar bear ranges are dependent on prey availability that allows sufficient accumulation of body fat to survive fasting periods (Derocher and Stirling 1995, p. 535). The 3-to 8-month-long periods of food deprivation exhibited by bears in the southern reaches of their range are supported by a rich marine environment that allows spring weight gains sufficient to sustain extended summer fasts. In the southern Beaufort Sea, for example, the heaviest polar bears were observed during autumn (Durner and Amstrup 1996, p. 483). In the Beaufort Sea and other regions of the polar basin, the probability that polar bears could survive extended summer fasting periods appears to be low. The documented reduction in polar bear condition in Western Hudson Bay associated with the recent lengthening of the ice-free season (Stirling et al. 1999, p. 294) suggests that even in the productive Hudson Bay environment there are limits to the ability of polar bears to fast.

Any period of fasting, whether while denning or resting onshore, would require an increase in food availability during alternative, non-fasting periods for fat accumulation. Adequate food may not be available to support sex and age classes other than pregnant females to adopt a strategy of denning over extended periods of time during food shortage. Furthermore, the ability to take advantage of seasonally fluctuating food availability and avoid extended torpor and associated physiological costs (Humphries et al. 2003, p. 165) has allowed polar bears to maximize access to food resources and is an important factor contributing to their large size.

The known current physiological and physical characteristics of polar bears suggest that behavioral adaptation will be sufficiently constrained to cause a pronounced reduction in polar bear distribution, and abundance, as a result of declining sea ice. The pace at which ice conditions are changing and the long generation time of polar bears precludes adaptation of new physiological mechanisms and physical characteristics through natural selection. Current evidence opposes the likelihood that extended periods of torpor, consumption of terrestrial foods, or capture of seals in open water will be sufficient mechanisms to counter the loss of ice as a platform for hunting seals. Polar bear survival and maintenance at sustainable population sizes depends on large and accessible seal populations and vast areas of ice from which to hunt.

Open Water Habitat

While sea ice is considered essential habitat for polar bear life functions because of the importance for feeding, reproduction, or resting, open water is not. Vast areas of open water can present a barrier or hazard under certain circumstances for polar bears to access sea ice or land. Diminished sea ice cover will increase the energetic cost to polar bears for travel, and will increase the risk of drowning that may occur during long distance swimming or swimming under unfavorable weather conditions. In addition, diminished sea ice cover may result in hypothermia for young cubs that are forced to swim for longer periods than at present. Under diminishing sea ice projections (IPCC 2001, p. 489; ACIA 2005, p. 192; Serreze 2006), ice-dependent seals, the principal prey of polar bears, will also be affected through distribution changes and reductions in productivity that will ultimately translate into reductions in seal population size.

Reduced Hunting Success

Polar bears are capable of swimming great distances, but exhibit a strong preference for sea ice (Mauritzen et al. 2003b, pp. 119–120). However, polar bears will also quickly abandon sea ice for land once the sea ice concentration drops below 50 percent. This is likely due to reduced hunting success in broken ice with significant open water (Derocher et al. 2004, p. 167; Stirling et al. 1999, pp. 302–303). Bears have only rarely been reported to capture ringed seals in open water (Furnell and Oolooyuk 1980, p. 88), therefore, hunting in ice-free water would not compensate for the corresponding loss of sea ice and the access sea ice affords polar bears to hunt ringed seals (Stirling and Derocher 1993, p. 241; Derocher et al. 2004, p. 167).

Reduction in sea ice and corresponding increase in open water would likely result in a net reduction in ringed and bearded seals, and Pacific walrus abundance (ACIA 2005, p. 510), as well as a reduction in ribbon and spotted seals (Born 2005a). While harp and hooded seals may change their distribution and temporarily serve as alternative prey for polar bears, it appears that these species cannot successfully redistribute in a rapidly changing environment and reproduce and survive at former levels. Furthermore, a recent study suggests that these two species will be the most vulnerable to effects of changing ice conditions (Laidre et al. in press). Loss of southern pupping areas due to inadequate or highly variable ice conditions will, in the long run, also serve to reduce these species as a potential polar bear prey (Derocher et al. 2004, p. 168). That increased take of other species such as bearded seals, walrus, harbor seals, or harp and hooded seals, if they were available, would not likely compensate for reduced availability of ringed seals (Derocher et al. 2004, p. 168).

Open Water Swimming

Open water is considered to present a potential hazard to polar bears because it can result in long distances that must be crossed to access sea ice or land habitat. In September 2004, four polar bears drowned in open water while attempting to swim in an area between shore and distant ice (Monnett and Gleason 2006, p. 5). Seas during this period were rough, and extensive areas of open water persisted between pack ice and land. Because the survey area covered 11 percent of the study area, an extrapolation of the survey data to the entire study area suggests that a larger number of bears may have drowned during this event. Mortalities due to offshore swimming during years when sea ice formation nearshore is delayed (or mild) may also be an important and unaccounted source of natural mortality given energetic demands placed on individual bears engaged in long-distance swimming (Monnett and Gleason 2006, p. 6). This suggests that drowning related deaths of polar bears may increase in the future if the observed trend of recession of pack ice with longer open-water periods continues. However, this phenomenon may be shortlived if natural selection operates against the behavioral inclination to swim between ice and land and favors bears that remain on land or on ice.

Wave height (sea state) increases as a function of the amount of open water surface area. Thus ice reduction not only increases areas of open water across which polar bears must swim, but may have an influence on the size of wave action. Considered together, these may result in increases in bear mortality associated with swimming when there is little sea ice to buffer wave action (Monnett and Gleason 2006, p. 5). Evidence of such mortality was also reported east of Svalbard in 2006, where one exhausted and one apparently dead polar bear were stranded (J. Dowdeswell, Head of the Scott Polar Research Institute of England, pers. obs.).

Terrestrial Habitat

Although sea ice is the polar bear's principal habitat, terrestrial habitat serves a vital function seasonally for maternal denning. In addition, use of terrestrial habitat is seasonally important for resting and feeding in the absence of suitable sea ice. Due to retreating sea ice, polar bears may be forced to make increased use of land in future years. The following sections describe the effects or potential effects of climate change and other factors on polar bear use of terrestrial habitat. One section focuses on access to or changes in the quality of denning habitat, and one focuses on distribution changes and corresponding increases in polar bear-human interactions in coastal areas. Also discussed are the potential consequences of and potential concerns for development, primarily oil and gas exploration and production which occur in polar bear habitat (both marine and terrestrial).

Access to and Alteration of Denning Areas

Many female polar bears repeatedly return to specific denning areas on land (Harrington 1968, p. 11; Schweinsburg et al. 1984, p. 169; Garner et al. 1994, p. 401; Ramsay and Stirling 1990, p. 233; Amstrup and Gardner 1995, p. 8). For bears to access preferred denning areas, pack ice must drift close enough or must freeze sufficiently early in the fall to allow pregnant females to walk or swim to the area by late October or early November (Derocher et al. 2004, p. 166), although polar bears may den into early December (Amstrup 2003, p. 597). Stirling and Andriashek (1992, p. 364) found that the distribution of polar bear maternal dens on land was related to the proximity of persistent summer sea ice, or areas that develop sea ice early in the autumn.

Derocher et al. (2004, p. 166) predicted that under future climate change scenarios, pregnant female polar bears will likely be unable to reach many of the most important denning areas in the Svalbard Archipelago, Franz Josef Land, Novaya Zemlya, Wrangel Island, Hudson Bay, and the Arctic National Wildlife Refuge and north coast of the Beaufort Sea (see Figure 8). Under likely climate change scenarios, the distance between the edge of the pack ice and land will increase (ACIA 2005, pp. 456–459). As distance increases between the southern edge of the pack ice and coastal denning areas, it will become increasingly difficult for females to access preferred denning locations. In addition to suitable access and availability of den sites, body condition is an important prerequisite for cub survival, and recruitment into the population as pregnant bears with low lipid stores are less likely to leave the den with healthy young in the spring (Atkinson and Ramsay 1995, pp. 565–566). Messier et al. (1994) postulated that pregnant bears may reduce activity levels up to 2 months prior to denning to conserve energy.

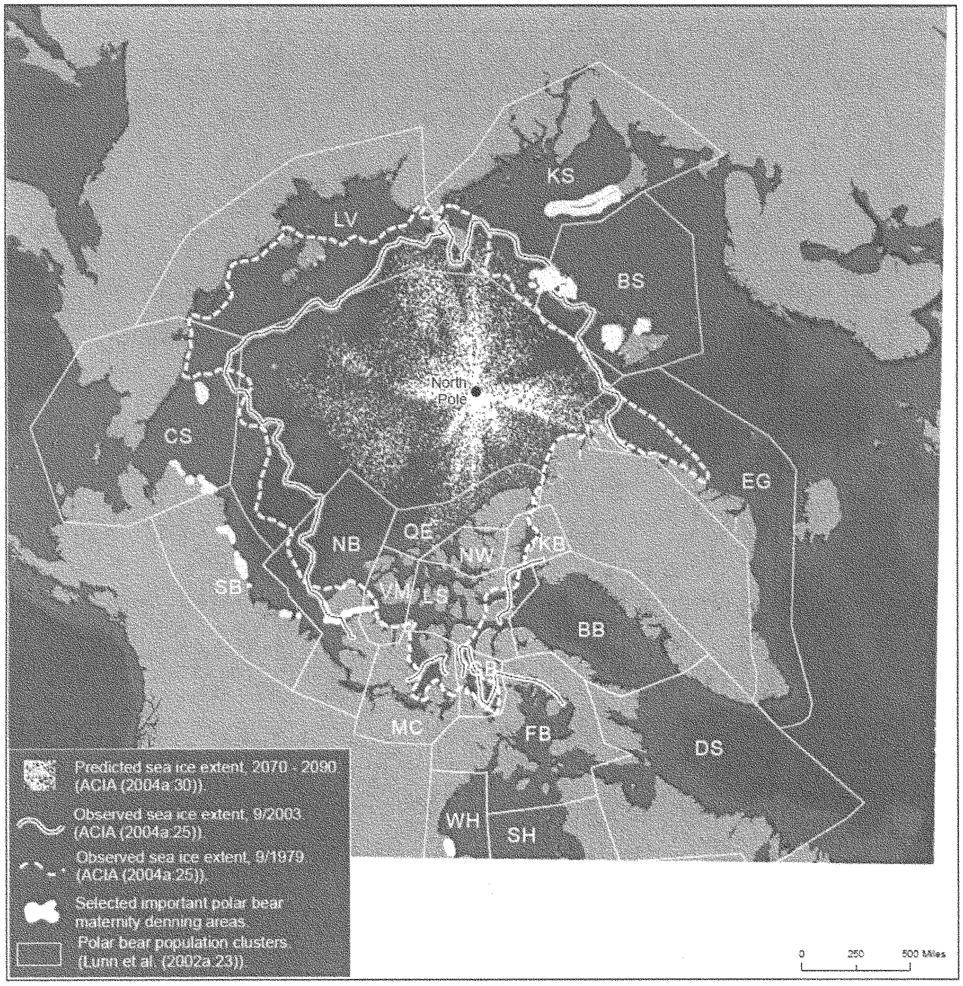


Figure 8. Circumpolar map of higher density polar bear terrestrial denning areas compared to past, present, and projected future extents of summer sea ice. Source: Adapted from Lunn et al. (2002a, p. 23) and ACIA (2005, pp. 25, 30).

Polar Bear Population Abbreviations. CS = Chukchi Sea; SB = Southern Beaufort Sea; NB = Northern Beaufort Sea; QE = Queen Elizabeth Islands; VM = Viscount Melville Sound; NW = Norwegian Bay; LS = Lancaster Sound; MC = M'Clintock Channel; GB = Gulf of Boothia; FB = Foxe Basin; WH = Western Hudson Bay; SH = Southern Hudson Bay; KB = Kane Basin; BB = Baffin Bay; DS = Davis Strait; EG = East Greenland; BS = Barents Sea; KS = Kara Sea; LV = Laptev Sea; Arctic Basin is the unlabelled area centered on the North Pole.

Bergen et al. (2007, p. 2) hypothesized that denning success is inversely related to the distance a pregnant polar bear must travel to reach denning habitat. These authors developed an approach using observed sea ice distributions (1979–2006) and GCM-derived sea ice projections (1975–2060) to estimate minimum distances that pregnant polar bears would have to travel between summer sea ice habitats and a terrestrial den location in northeast Alaska (Bergen et al. 2007, p. 2–3). In this pilot assessment, calculations were made with and without the constraint of least cost movement paths, which required bears to optimally follow high-quality sea ice habitats. Although variation was evident and considerable among the five GCMs analyzed, the smoothed multi-model average distances aligned well with those derived from the observational record. The authors found that between 1979 and 2006, the minimum distance polar bears traveled to denning habitats in northeast Alaska increased at an average linear rate of 6–8 km per year (3.7–5.0 mi per year), and almost doubled after 1992. They projected that travel would increase threefold by 2060 (Bergen et al. 2007, p. 2–3).

Based on projected retraction of sea ice in the future, Bergen et al. (2007, p. 2) states, "thus, pregnant polar bears will likely incur greater energetic expense in reaching traditional denning regions if sea ice loss continues along the projected trajectory." Increased travel distances could negatively affect individual fitness, denning success, and ultimately populations of polar bears (Aars et al. 2006). While the Bergen et al. (2007, p. 2) study focused on polar bears using denning habitat in northern Alaska, other denning regions in the Arctic, particularly within the polar basin region, are much farther from areas where summer ice is predicted to persist in the future. Polar bears returning to other denning locales, such as Wrangel Island or the Chukotka Peninsula, will likely have to travel greater distances than those reported here. Most high-density denning areas are located at more southerly latitudes (see Figure 8). For populations that den at high latitudes in the Canadian archipelago islands, access to, and availability of, suitable den sites may not currently be a problem. However, access to historically-used den sites in the future may become more problematic in the northern areas. The degree to which polar bears may use nontraditional denning habitats at higher latitudes in the future, through facultative adaptation, is largely unknown but is possible.

Climate change could also impact populations where females den in snow (Derocher et al. 2004). Insufficient snow would prevent den construction or result in use of poor sites where the roof could collapse (Derocher et al. 2004). Too much snow could necessitate the reconfiguration of the den by the female throughout the winter (Derocher et al. 2004). Changes in amount and timing of snowfall could also impact the thermal properties of the dens (Derocher et al. 2004). Since polar bear cubs are born helpless and need to nurse for three months before emerging from the den, major changes in the thermal properties of dens could negatively impact cub survival (Derocher et al. 2004). Finally, unusual rain events are projected to increase throughout the Arctic in winter (ACIA 2005), and increased rain in late winter and early spring could cause den collapse (Stirling and Smith 2004). Den collapse following a warming period was observed in the Beaufort Sea and resulted in the death of a mother and her two young cubs (Clarkson and Irish 1991). After March 1990 brought unseasonable rain south of Churchill, Manitoba, Canada, researchers observed large snow banks along creeks and rivers used for denning that had collapsed because of the weight of the wet snow, and noted that had there been maternity dens in this area the bears likely would have been crushed (Stirling and Derocher 1993).

Oil and Gas Exploration, Development, and Production

Each of the Parties to the 1973 Polar Bear Agreement (see International Agreements and Oversight section below) has developed detailed regulations pertaining to the extraction of oil and gas within their countries. The greatest level of oil and gas activity within polar bear habitat is currently occurring in the United States (Alaska). Exploration and production activities are also actively underway in Russia, Canada, Norway, and Denmark (Greenland). In the United States, all such leasing and production activities are evaluated as specified by the National Environmental Policy Act (42 U.S.C. 4321 et seq.) (NEPA), Outer Continental Shelf Lands Act (43 U.S.C. 1331 et seq.) (OCSLA), and numerous other statutes, that evaluate and guide exploration, development, and production in order to minimize possible environmental impacts. In Alaska, the majority of oil and gas development is on land; however, some offshore production sites have been developed, and others are planned.

Historically, oil and gas activities have resulted in little direct mortality to polar bears, and that mortality which has occurred has been associated with human-bear interactions as opposed to a spill event. However, oil and gas activities are increasing as development continues to expand throughout the U.S. Arctic and internationally, including in polar bear terrestrial and marine habitats. The greatest concern for future oil and gas development is the effect of an oil spill or discharges in the marine environment impacting polar bears or their habitat. Disturbance from activities associated with oil and gas activities can result in direct or indirect effects on polar bear use of habitat. Direct disturbances include displacement of bears or their primary prey (ringed and bearded seals) due to the movement of equipment, personnel, and ships through polar bear habitat. Female polar bears tend to select secluded areas for denning, presumably to minimize disturbance during the critical period of cub development. Direct disturbance may cause abandonment of established dens before their cubs are ready to leave. For example, expansion of the network of roads, pipelines, well pads, and infrastructure associated with oil and gas activities may force pregnant females into marginal denning locations (Lentfer and Hensel 1980, p. 106; Amstrup et al. 1986, p. 242). The potential effects of human activities are much greater in areas where there is a high concentration of dens such as Wrangel Island. Although bear behavior is highly variable among individuals and the sample size was small, Amstrup (1993, pp. 247–249) found that in some instances denning bears were fairly tolerant to some levels of activity. Increased shipping may increase the amount of open water, cause disturbance to polar bears and their prey, and increase the potential for additional oil spills (Granier et al. 2006 p. 4). Much of the North Slope of Alaska contains habitat suitable for polar bear denning (Durner et al. 2001, p. 119). Furthermore, in northern Alaska and Chukotka, Russia, polar bears appear to be using land areas with greater frequency during the season of minimum sea ice. Some of these areas coincide with areas that have traditionally been used for oil and gas production and exploration. These events increase the potential for interactions with humans (Durner et al. 2001, p. 115; National Research Council (NRC) 2003, p. 168); however, current regulations minimize these interactions by establishing buffer zones around active den sites.

The National Research Council (NRC 2003, p. 169) evaluated the cumulative effects of oil and gas development in Alaska and concluded the following related to polar bears and ringed seals:

- ''Industrial activity in the marine waters of the Beaufort Sea has been limited and sporadic and likely has not caused serious cumulative effects to ringed seals or polar bears.
- Careful mitigation can help to reduce the effects of oil and gas development and their accumulation, especially if there are no major oil spills. However, the effects of full-scale industrial development of waters off the North Slope would accumulate through the displacement of polar bears and ringed seals from their habitats, increased mortality, and decreased reproductive success.
- A major Beaufort Sea oil spill would have major effects on polar bears and ringed seals.
- Climatic warming at predicted rates in the Beaufort Sea region is likely to have serious consequences for ringed seals and polar bears, and those effects will accumulate with the effects of oil and gas activities in the region.
- Unless studies to address the potential accumulation of effects on North Slope polar bears or ringed seals are designed, funded, and conducted over long periods of time, it will be impossible to verify whether such effects occur, to measure them, or to explain their causes.''

Some alteration of polar bear habitat has occurred from oil and gas development, seismic exploration, or other activities in denning areas, and potential oil spills in the marine environment and expanded activities increase the potential for additional alteration. Any such impacts would be additive to other factors already or potentially affecting polar bears and their habitat. However, mitigative regulations that have been instituted, and will be modified as necessary, have proven to be highly successful in providing for polar bear conservation in Alaska.

Oil and gas exploration, development, and production activities do not threaten the species throughout all or a significant portion of its range based on: (1) mitigation measures in place now and likely to be used in the future; (2) historical information on the level of oil and gas development activities occurring within polar bear habitat within the Arctic; (3) the lack of direct quantifiable impacts to polar bear habitat from these activities noted to date in Alaska; (4) the current availability of suitable alternative habitat; and (5) the limited and localized nature of the development activities, or possible events, such as oil spills.

Documented direct impacts on polar bears by the oil and gas industry during the past 30 years are minimal. Polar bears spend a limited amount of time on land, particularly in the southern Beaufort Sea, coming ashore to feed, den, or move to other areas. At times, fall storms deposit bears along the coastline where bears remain until the ice returns. For this reason, polar bears have mainly been encountered at or near most coastal and offshore production facilities, or along the roads and causeways that link these facilities to the mainland. During those periods, the likelihood of incidental interactions between polar bears and industry activities increases. As discussed under our Factor D analysis below, the MMPA has specific provisions for such incidental take, including specific findings that must be made by the Service and the provision of mitigation actions, which serve to minimize the likelihood of impacts upon polar bears. We have found that the polar bear interaction planning and training requirements set forth in the incidental take regulations and required through the letters of authorization (LOA) process, and the overall review of the regulations every one to five years has increased polar bear awareness and minimized these encounters in the United States. The LOA requirements have also increased our knowledge of polar bear activity in the developed areas.

Prior to issuance of regulations, lethal takes by industry were rare. Since 1968, there have been two documented cases of lethal take of polar bears associated with oil and gas activities. In both instances, the lethal take was reported to be in defense of human life. In the winter of 1968–1969, an industry employee shot and killed a polar bear (Brooks et al. 1971, p. 15). In 1990, a female polar bear was killed at a drill site on the west side of Camden Bay (USFWS internal correspondence, 1990). In contrast, 33 polar bears were killed in the Canadian Northwest Territories from 1976 to 1986 due to encounters with industry (Stenhouse et al. 1988, p. 276). Since the beginning of the incidental take program, which includes requirements for monitoring, project design, and hazing of bears presenting a safety problem, no polar bears have been killed due to encounters associated with the current industry activities on the North Slope of Alaska.

Observed Demographic Effects of Sea Ice Changes on Polar Bear

The potential demographic effects of sea ice changes on polar bear reproductive and survival rates (vital rates) and ultimately on population size are difficult to quantify due to the need for extensive time series of data. This is especially true for a long-lived and widely dispersed species like the polar bear. Recent research by Stirling et al. (2006), Regehr et al. (2007a, b), Hunter et al. (2007), and Rode et al. (2007), however, evaluates these important relationships and adds significantly to our understanding of how and to what extent environmental changes influence essential life history parameters. The key demographic factors for polar bears are physical condition, reproduction, and survival. Alteration of these characteristics has been associated with elevated risks of extinction for other species (McKinney 1997, p. 496; Beissinger 2000, p. 11,688; Owens and Bennett 2000, p. 12,145).

Physical condition of polar bears determines the welfare of individuals, and, ultimately, through their reproduction and survival, the welfare of populations (Stirling et al. 1999, p. 304; Regehr et al. 2007a, p. 13; Regehr et al 2007b, pp. 2,677–2,680; Hunter et al. 2007, pp. 8–13). In general, Derocher et al. (2004, p. 170) predict that declines in the physical condition will initially affect female reproductive rates and juvenile survival and then under more severe conditions adult female survival rates. Adult females represent the most important sex and age class within the population regarding population status (Taylor et al. 1987, p. 811).

Declines in fat reserves during critical times in the polar bear life cycle detrimentally affect populations through delay in the age of first reproduction, decrease in denning success, decline in litter sizes with more single cub litters and fewer cubs, and lower cub body weights and lower survival rates (Atkinson and Ramsay 1995, pp. 565–566; Derocher et al. 2004, p. 170). Derocher and Stirling (1998, pp. 255–256) demonstrated that body mass of adult females is correlated with cub mass at den emergence, with heavier females producing heavier cubs and lighter females producing lighter cubs. Heavier cubs have a higher rate of survival (Derocher and Stirling 1996, p. 1,249). A higher proportion of females in poor condition do not initiate denning or are likely to abandon their den and cub(s) mid-winter (Derocher et al. 2004, p. 170). Females with insufficient fat stores or in poor hunting condition in the early spring after den emergence could lead to increased cub mortality (Derocher et al. 2004, p. 170). In addition, sea ice conditions that include broken or more fragmented ice may require young cubs to enter water more frequently and for more prolonged periods of time, thus increasing mortality from hypothermia. Blix and Lenter (1979, p. 72) and Larsen (1985, p. 325) indicate that cubs are unable to survive immersion in icy water for more than approximately 10 minutes. This is due to cubs having little insulating fat, their fur losing its insulating ability when wet (though the fur of adults sheds water and recovers its insulating properties quickly), and the core body temperature dropping rapidly when they are immersed in icy water (Blix and Lentfer 1979, p. 72).

Reductions in sea ice, as discussed in previous sections, will alter ringed seal distribution, abundance, and availability for polar bears. Such reductions will, in turn, decrease polar bear body condition (Derocher et al. 2004, p. 165). Derocher et al. (2004, p. 165) projected that most females in the Western Hudson Bay population may be unable to reach the minimum 189 kg (417 lbs) body mass required to successfully reproduce by the year 2012. Stirling (Canadian Wildlife Service, pers comm. 2006) indicates, based on the decline in weights of lone and suspected pregnant females in the fall (Stirling and Parkinson 2006), that the 2012 date is likely premature. However, Stirling (Canadian Wildlife Service, pers comm. 2006) found that the trend of continuing weight loss by adult female polar bears in the fall is clear and continuing, and, therefore, Stirling believed that the production of cubs in these areas will probably be negligible within the next 15–25 years.

Furthermore, with the extent of sea ice projected to be substantially reduced in the future (e.g., Stroeve et al. 2007, pp. 1–5), opportunities for increased feeding to recover fat stores during the season of minimum ice may be limited

(Durner et al. 2007, p. 12). It should be noted that the models project decreased ice cover in all months in the Arctic, but that (as has been observed) the projected changes in the 21st century are largest in summer (Holland et al. 2006, pp. 1–5; Stroeve et al. 2007, pp. 1–5; Durner et al. 2007, p. 12; DeWeaver 2007, p. 2; IPCC 2007). Mortality of polar bears is thought to be the highest in winter when fat stores are low and energetic demands are greatest. Pregnant females are in dens during this period using fat reserves and not feeding. The availability and accessibility of seals to polar bears, which often hunt at the breathing holes, is likely to decrease with increasing amounts of open water or fragmented ice (Derocher et al. 2004, p. 167).

Demographic Effects on Polar Bear Populations with Long-term Data Sets

This section summarizes demographic effects on polar bear populations for which long-term data sets are available. These populations are: Western Hudson Bay, Southern Hudson Bay, Southern Beaufort Sea, Northern Beaufort Sea, and, to a lesser extent, Foxe Basin, Baffin Bay, Davis Strait, and Eastern Hudson Bay.

Western Hudson Bay

The Western Hudson Bay polar bear population occurs near the southern limit of the species' range and is relatively discrete from adjacent populations (Derocher and Stirling 1990, p. 1,390; Stirling et al. 2004, p. 16). In winter and spring, polar bears of the Western Hudson Bay population disperse over the ice-covered Bay to hunt seals (Iverson et al. 2006, p. 98). In summer and autumn, when Hudson Bay is ice-free, the population is confined to a restricted area of land on the western coast of the Bay. There, nonpregnant polar bears are cut off from their seal prey and must rely on fat reserves until freeze-up, a period of approximately 4 months. Pregnant bears going into dens may be food deprived for up to an additional 4 months (a total of 8 months).

In the past 50 years, spring air temperatures in western Hudson Bay have increased by 2–3 degrees C (Skinner et al. 1998; Gagnon and Gough 2005, p. 289). Consequently, the sea ice on the Bay now breaks up approximately 3 weeks earlier than it did 30 years ago (Stirling and Parkinson 2006, p. 265). This forces the Western Hudson Bay polar bears off the sea ice earlier, shortening the spring foraging period when seals are most available, and reducing the polar bears' ability to accumulate the fat reserves needed to survive while stranded onshore. Previous studies have shown a correlation between rising air temperatures, earlier sea ice break-up, and declining recruitment and body condition for polar bears in western Hudson Bay (Derocher and Stirling 1996, p. 1,250; Stirling et al. 1999, p. 294; Stirling and Parkinson 2006, p. 266). Based on GCM projections of continued warming and progressively earlier sea ice break-up (Zhang and Walsh 2006), Stirling and Parkinson (2006, p. 271–272) predicted that conditions will become increasingly difficult for the Western Hudson Bay population.

Regehr et al. (2007a, p. 2,673) used capture-recapture models to estimate population size and survival for polar bears captured from 1984 to 2004 along the western coast of Hudson Bay. During this period the Western Hudson Bay population experienced a statistically significant decline of 22 percent, from 1,194 bears in 1987 to 935 bears in 2004. Regehr et al. (2007a, p. 2,673) notes that while survival of adult female and male bears was stable, survival of juvenile, subadult, and senescent (nonreproductive) bears was negatively correlated with the spring sea ice break-up date—a date that occurred approximately 3 weeks earlier in 2004 than in 1984. Long-term observations suggest that the Western Hudson Bay population continues to exhibit a high degree of fidelity to the study area during the early part of the sea ice-free season (Stirling et al. 1977, p. 1,126; Stirling et al. 1999, p. 301; Taylor and Lee 1995, p. 147), which precludes permanent emigration as a cause for the population decline. The authors (Regehr et al. 2007a, p. 2,673) attribute the decline of the Western Hudson Bay population to increased natural mortality associated with earlier sea ice break-up, and the continued harvest of approximately 40 polar bears per year (Lunn et al. 2002, p. 104). No support for alternative explanations was found.

Southern Hudson Bay

Evidence of declining body condition for polar bears in the Western Hudson Bay population suggests that there should be evidence of parallel declines in adjacent polar bear populations experiencing similar environmental conditions. In an effort to evaluate an adjacent population, Obbard et al. (2006, p. 2) conducted an analysis of polar bear condition in the Southern Hudson Bay population by comparing body condition for two time periods, 1984–1986 and 2000–2005. The authors found that the average body condition for all age and reproductive classes combined was significantly poorer for Southern Hudson Bay bears captured from 2000–2005 than for bears captured from 1984–1986 (Obbard et al. 2006, p. 4). The results indicate a declining trend in condition for all age and reproductive classes of polar bears since the mid-1980s. The results further reveal that the decline has been greatest for pregnant females and subadult bears—trends that will likely have an impact on future reproductive output and subadult survival (Obbard et al. 2006, p. 1).

Obbard et al (2006, p. 4) evaluated inter-annual variability in body condition in relation to the timing of ice melt and to duration of ice cover in the previous winter and found no significant relationship despite strong evidence of a significant trend towards both later freeze-up and earlier break-up (Gough et al. 2004, p. 298; Gagnon and Gough 2005, p. 293). While southern Hudson Bay loses its sea ice cover later in the year than western Hudson Bay, the authors believe that other factors or combinations of factors (that likely also include later freeze-up and earlier break-up) are operating to affect body condition in southern Hudson Bay polar bears. These factors may include unusual spring rain events that occur during March or April when ringed seals are giving birth to pups in on-ice birthing lairs (Stirling and Smith 2004, pp. 60–63), depth of snow accumulation and roughness of the ice that vary over time and also affect polar bear hunting success (Stirling and Smith 2004, p. 60–62; Ferguson et al. 2005, p. 131), changes in the abundance and distribution of ringed seals, and reduced pregnancy rates and of reduced pup survival in ringed seals from western Hudson Bay during the 1990s (Ferguson et al. 2005, p. 132; Stirling 2005, p. 381).

A more recent status assessment using open population capture-recapture models was conducted to evaluate population trend in the Southern Hudson Bay population (Obbard et al. 2007, pp. 3–9). The authors found that the population and survival estimates for subadult female and male polar bears were not significantly different between 1984–1986 and 1999–2005 respectively. There was weak evidence of lower survival of cubs, yearlings, and senescent adults in the recent time period (Obbard et al. 2007, pp. 10–11). As previously reported, no association was apparent between survival and cub-of-the-year body condition, average body condition for the age class, or extent of ice cover. The authors indicate that lack of association could be real or attributable to various factors—the coarse scale of average body condition measure, or to limited sample size, or limited years of intensive sampling (Obbard et al. 2007, pp. 11–12).

The decline in survival estimates, although not statistically significantly, combined with the evidence of significant declines in body condition for all age and sex classes, suggest that the Southern Hudson Bay population may be under increased stress at this time (Obbard et al. 2007, p. 14). The authors also indicated that if the trend in earlier ice break-up and later freeze-up continues in this area, it is likely that the population will exhibit changes similar to the Western Hudson Bay population even though no current significant relationships exist between extent of ice cover and the survival estimates and the average body condition for each age class (Obbard et al. 2007, p. 14).

Southern Beaufort Sea

The Southern Beaufort Sea population has also been subject to dramatic changes in the sea ice environment, beginning in the winter of 1989–1990 (Regehr et al. 2006, p. 2). These changes were linked initially through direct observation of distribution changes during the fall open-water period. With the exception of the Western Hudson Bay population, the Southern Beaufort Sea population has the most complete and extensive time series of life history data, dating back to the late 1960s. A 5-year coordinated capture-recapture study of this population to evaluate changes in the health and status of polar bears and life history parameters such as reproduction, survival, and abundance was completed in 2006. Results of this study indicate that the estimated population size has gone from 1,800 polar bears (Amstrup et al. 1986, p. 244; Amstrup 2000, p. 146) to 1,526 polar bears in 2006 (Regehr et al. 2006, p. 16). The precision of the earlier estimate (1,800 polar bears) was low, and consequently there is not a statistically significant difference between the two point estimates. Amstrup et al. (2001, p. 230) provided a population estimate of as many as 2,500 bears for this population in the late 1980s, but the statistical variance of this estimate could not be calculated and thus precludes the comparative value of the estimate.

Survival rates, weights, and skull sizes were compared for two periods of time, 1967–1989 and 1990–2006. In the later period, estimates of cub survival declined significantly, from 0.65 to 0.43 (Regehr et al. 2006, p. 11). Cub weights also decreased slightly. The authors believed that poor survival of new cubs may have been related to declining physical condition of females entering dens and consequently of cubs born during recent years, as reflected by smaller skull measurements. In addition, body weights for adult males decreased significantly, and skull measurements were reduced since 1990 (Regehr et al. 2006, p 1). Because male polar bears continue to grow into their teen years (Derocher et al. 2005, p. 898), if nutritional intake was similar since 1990, the size of males should have increased (Regehr et al. 2006, p. 18). The observed changes reflect a trend toward smaller size adult male bears. Although a number of the indices of population status were not independently significant, nearly all of the indices illustrated a declining trend. In the case of the Western Hudson Bay population, declines in cub survival and physical stature were recorded for a number of years (Stirling et al. 1999, p. 300; Derocher et al. 2004, p. 165) before a statistically significant decline in the population size was confirmed (Regehr et al. 2007, p. 2,673).

In further support of the interaction of environmental factors, nutritional stress, and their effect on polar bears, several unusual mortality events have been documented in the southern Beaufort Sea. During the winter and early spring of 2004, three observations of polar bear cannibalism were recorded (Amstrup et al. 2006b, p. 1). Similar observations had not been recorded in that region despite studies extending back for decades. In the fall of 2004, four polar bears were observed to have drowned while attempting to swim between shore and distant pack ice in the Beaufort Sea. Despite offshore surveys extending back to 1987, similar observations had not previously been recorded (Monnett and Gleason 2006, p. 3). In spring of 2006, three adult female polar bears and one yearling were found dead. Two of these females and the yearling had no fat stores and apparently starved to death, while the third adult female was too heavily scavenged to determine a cause of death. This mortality is suspicious because prime age females have had very high survival rates in the past (Amstrup and Durner 1995, p. 1,315). Similarly, the yearling that was found starved was the offspring of another radio-collared prime age female whose collar had failed prior to her yearling being found dead. Annual survival of yearlings, given survival of their mother, was previously estimated to be 0.86 (Amstrup and Durner 1995, p. 1,316). The probability, therefore, that this yearling died while its mother was still alive was only approximately 14 percent. Regehr et al. (2006, p. 27) indicate that these anecdotal observations, in combination with changes in survival of young and declines in size and weights reported above, suggest mechanisms by which a changing sea ice environment can affect polar bear demographics and population status.

The work by Regehr et al. (2006, pp. 1, 5) described above suggested that the physical stature (as measured by skull size and body weight data) of some sex and age classes of bears in the Southern Beaufort Sea population had changed between early and latter portions of this study, but trends in or causes of those changes were not investigated. Rode et al. (2007, pp. 1–28), using sea ice and polar bear capture data from 1982 to 2006, investigated whether these measurements changed over time or in relation to sea ice extent. Annual variation in sea ice habitat important to polar bear foraging was quantified as the percent of days between April to November when mean sea ice concentration over the continental shelf was greater than or equal to 50 percent. The 50 percent concentration threshold was used because bears make little use of areas where sea ice concentration is lower (Durner et al. 2004, p. 19). The April to November period was used because it is believed to be the primary foraging period for polar bears in the southern Beaufort Sea (Amstrup et al. 2000b, p. 963). The frequency of capture events for individual bears was evaluated to determine if this factor had an effect on bear size, mass, or condition. Rode et al. (2007, pp. 5–8) found that mass, length, skull size, and body condition indices (BCI) of growing males (aged 3–10), mass and skull size of cubs-of-the year, and the number of yearlings per female in the spring and fall were all positively and significantly related to the percent of days in which sea ice covered the continental shelf. Unlike Regehr et al. (2006, p. 1), Rode et al. (2007, p. 8) did not document a declining trend in skull size or body size of cubs-of-the-year when the date of capture was considered. Condition of adult males 11 years and older and of adult females did not decline. There was some evidence, based on capture dates, that females with cubs have been emerging from dens earlier in recent years. Thus, though cubs were smaller in recent years, they also were captured earlier in the year. Why females may be emerging from dens earlier than they used to is not certain and warrants additional research.

Skull sizes and/or lengths of adult and subadult males and females decreased over time during the study (Rode et al. 2007, p. 1). Adult body mass was not related to sea ice cover and did not show a trend with time. The condition of adult females exhibited a positive trend over time, reflecting a decline in length without a parallel trend in mass. Though cub production increased over time, the number of cubs-of-the-year per female in the fall and yearlings per female in the spring declined (Rode et al. 2007, p. 1), corroborating the reduced cub survival, as noted previously by Regehr et al. (2006, p. 1). Males exhibited a stronger relationship with sea ice conditions and more pronounced declines over time than females. The mean body mass of males of ages 3–10 years (63 percent of all males captured over the age of 3) declined by 2.2 kg (4.9 lbs) per year, consistent with Regehr et al. (2006, p. 1), and was positively related to the percent of days with greater than or equal to 50 percent mean ice concentration over the continental shelf (Rode et al. 2007, p. 10). Because declines were not apparent in older, fully grown males, but were apparent in younger, fully grown males, the authors suggest that nutritional limitations may have occurred only in more recent years after the time when older males in the population were fully grown. Bears with prior capture history were either larger or similar in stature and mass to bears captured for the first time, indicating that research activities did not influence trends in the data.

The effect of sea ice conditions on the mass and size of subadult males suggests that, if sea ice conditions changed over time, this factor could be associated with the observed declines in these measures. While the sea ice metric used in Rode et al. (2007, p. 3) was meaningful to the foraging success of polar bears, recent habitat analyses have resulted in improvements in the understanding of preferred sea ice conditions of bears in the Southern Beaufort Sea population. Durner et al. (2007, pp. 6, 9) recently identified optimal polar bear habitat based on bathymetry (water depth), proximity to land, sea ice concentration, and distance to sea ice edges using resource selection functions. The sum of the monthly extent of this optimal habitat for each year within the range of the Southern Beaufort Sea population (Amstrup et al. 2004, p. 670) was strongly correlated with the Rode et al. (2007, p. 10) sea ice metric for the 1982–2006 period. This suggests that the Rode et al. (2007, p. 10) sea ice metric effectively quantified important habitat value. While the Rode et al. (2007, p. 10) sea ice metric did not exhibit a significantly negative trend over time, the optimal habitat available to bears in the southern Beaufort Sea as identified by Durner et al. (2007, pp. 5–6) did significantly decline between 1982 and 2006. This further supports the observation that the declining trend in bear size and condition over time were associated with a declining trend in availability of foraging habitat, particularly for subadult males whose mass and stature were related to sea ice conditions.

Rode et al. (2007, p. 12) concludes that the declines in mass and body condition index of subadult males, declines in growth of males and females, and declines in cub recruitment and survival suggest that polar bears of the Southern Beaufort Sea population have experienced a declining trend in nutritional status. The significant relationship between several of these measurements and sea ice cover over the continental shelf suggests that nutritional limitations may be associated with changing sea ice conditions.

Regehr et al. (2007b, p. 3) used multistate capture-recapture models that classified individual polar bears by sex, age, and reproductive category to evaluate the effects of declines in the extent and duration of sea ice on survival and breeding probabilities for polar bears in the Southern Beaufort Sea population. The study incorporated data collected from 2001–2006. Key elements of the models were the dependence of survival on the duration of the ice-free period over the continental shelf in the southern Beaufort Sea region, and variation in breeding probabilities over time. Other factors considered included harvest mortality, uneven capture probability, and temporary emigrations from the study area. Results of Regehr et al. (2007b, p. 1) reveal that in 2001 and 2002, the ice-free period was relatively short (mean 92 days) and survival of adult female polar bears was high (approximately 0.99). In 2004 and 2005, the ice-free period was long (mean 135 days) and survival of adult female polar bears was lower (approximately 0.77). Breeding and cub-of-the-year litter survival also declined from high rates in early years to lower rates in latter years of the study. The short duration of the study (5 years) introduced uncertainty associated with the logistic relationship between the sea ice covariate and survival. However, the most supported noncovariate models (i.e., that excluded ice as a covariate) also estimated declines in survival and breeding from 2001 to 2005 that were in close agreement to the declines estimated by the full model set.

Although the precision of vital rates estimated by Regehr et al. (2007b, pp. 17–18) was low, subsequent analyses (Hunter et al. 2007, p. 6) indicated that the declines in vital rates associated with longer ice-free periods have ramifications for the trend of the Southern Beaufort Sea population (i.e., result in a declining population trend). The Southern Beaufort Sea population occupies habitats similar to four other populations (Chukchi, Laptev, Kara, and Barents Seas) which represent over one-third of the world's polar bears. These areas have experienced sea ice declines in recent years that have been more severe than those experienced in the southern Beaufort Sea (Durner et al. 2007, pp. 32–33), and declining trends in status for these populations are projected to be similar to or greater than those projected for the Southern Beaufort Sea population (Amstrup et al. 2007, pp 7–8, 32).

Northern Beaufort Sea

The Northern Beaufort Sea population, unlike the Southern Beaufort Sea and Western Hudson Bay populations, is located in a region where sea ice converges on shorelines throughout most of the year. Stirling et al. (2007, pp. 1–6) used open population capture-recapture models of data collected from 1971–2006 to assess the relationship between polar bear survival and sex, age, time period, and a number of environmental covariates in order to assess population trends. Three covariates, two related to sea ice habitat and yearly seal productivity, were used to assess the recapture probability for estimates of long-term trends in the size of the Northern Beaufort Sea population (Stirling et al. 2007, pp. 4–8). Associations between survival estimates and the three covariates (sea ice habitat variables and seal abundance) were not, in general, supported by the data. Population estimates (model averaged) from 2004–2006 (980) were not significantly different from estimates for the periods of 1972–1975 (745) and 1985–1987 (867). The abundance during the three sampling periods, 1972–1975, 1985–1987, and 2004–2006 may be slightly low because (1) some bears residing in the extreme northern portions of the population may not have been equally available for capture and (2) the number of polar bears around Prince Patrick Island was not large relative to the rest of the population. Stirling et al. (2007, p. 10) concluded that currently the Northern Beaufort Sea population appears to be stable, probably because ice conditions remain suitable for feeding through much of the summer and fall in most years and harvest has not exceeded sustainable levels.

Other Populations

As noted earlier in the ‘‘Distribution and Movement’’ and the ‘‘Polar Bear Seasonal Distribution Patterns Within Annual Activity Areas’’ sections of this final rule, Stirling and Parkinson (2006, pp. 261–275) investigated ice break-up relative to distribution changes in five other polar bear populations in Canada: Foxe Basin, Baffin Bay, Davis Strait, Western Hudson Bay, and Eastern Hudson Bay. They found that sea-ice break-up in Foxe Basin has been occurring about 6 days earlier each decade; ice break-up in Baffin Bay has been occurring 6 to 7 days earlier per decade; and ice break-up in Western Hudson Bay has been occurring 7 to 8 days earlier per decade. Although long-term results from Davis Strait were not conclusive, particularly because the maximum percentage of ice cover in Davis Strait varies considerably more between years than in western Hudson Bay, Foxe Basin, or Baffin Bay, Stirling and Parkinson (2006, p. 269) did document a negative shortterm trend from 1991 to 2004 in Davis Strait. In eastern Hudson Bay, there was not a statistically significant trend toward earlier sea-ice break-up.

In four populations, Western Hudson Bay, Foxe Basin, Baffin Bay, and Davis Strait, residents of coastal settlements have reported seeing more polar bears and having more problem bear encounters during the open-water season, particularly in the fall. In those areas, the increased numbers of sightings, as well as an increase in the number of problem bears handled at Churchill, Manitoba, have been interpreted as indicative of an increase in population size. As discussed earlier, the declines in population size, condition, and survival of young bears in the Western Hudson Bay population as a consequence of earlier sea ice break-up brought about by climate warming have all been well documented (Stirling et al. 1999, p. 294; Gagnon and Gough 2005; Regehr et al. 2007a, p. 2,680). In Baffin Bay, the available data suggest that the population is being overharvested, so the reason for seeing more polar bears is unlikely to be an increase in population size. Ongoing research in Davis Strait (Peacock et al. 2007, pp. 6–7) indicates that this population may be larger than previously believed, which may at first seem inconsistent with the Stirling and Parkinson (2006, pp. 269–270) hypothesis of declining populations over time. This observation, however, is not equilavent to an indication of population growth. The quality of previous population estimates for this region, and the lack of complete coverage of sampling used to derive the previous estimates, preclude establishment of a trend in numbers. Although the timing and location of availability of sea ice in Davis Strait may have been declining (Amstrup et al. 2007, p. 25), changes in numbers and distribution of harp seals at this time may support large numbers of polar bears even if ringed seals are less available (Stirling and Parkinson 2006, p. 270; Iverson et al. 2006, p. 110). As stated previously, continuing loss of sea ice ultimately will have negative effects on this population and other populations in the Seasonal Ice ecoregion.

Polar Bear Populations without Long-term Data Sets

The remaining circumpolar polar bear populations either do not have data sets of sufficiently long time series or do not have data sets of comparable information that would allow the analysis of population trends or relationships to various environmental factors and other variables over time.

Projected Effects of Sea Ice Changes on Polar Bears

This section reviews a study by Durner et al. (2007) that evaluated polar bear habitat features and future habitat distribution and seasonal availability into the future. Studies by Amstrup et al. (2007) and Hunter et al. (2007) are also reviewed which included new analyses and approaches to examine trends and relationships for populations or groups of populations based on commonly understood relationships with habitat features and environmental conditions.

Habitat loss has been implicated as the greatest threat to the survival for most species (Wilcove et al. 1998, p. 614). Extinction theory suggests that the most vulnerable species are those that are specialized (Davis et al. 2004), long-lived with long generation times and low reproductive output (Bodmer et al. 1997), and carnivorous with large geographic extents and low population densities (Viranta 2003, p. 1,275). Because of their specialized habitats and life history constraints (Amstrup 2003, p. 605), polar bears have many qualities that make their populations susceptible to the potential negative impacts of sea ice loss resulting from climate change.

As discussed in detail in the ‘‘Sea Ice Habitat’’ section of this final rule, contemporary observations and state-of-the-art models point to a warming global climate, with some of the most accelerated changes in Arctic regions. In the past 30 years, average world surface temperatures have increased 0.2 degrees C per decade, but parts of the Arctic have experienced warming at a rate of 10 times the world average (Hansen et al. 2006). Since the late 1970s there have been major reductions in summer (multi-year) sea ice extent (Meier et al. 2007, pp. 428–434) (see detailed discussion in section entitled ‘‘Summer Sea Ice’’); decreases in ice age (Rigor and Wallace 2004; Belchansky et al. 2005) and thickness (Rothrock et al. 1999; Tucker et al. 2001) (see detailed discussion in section entitled ‘‘Sea Ice Thickness’’); and increases in length of the summer melt period (Belchansky et al. 2004; Stroeve et al. 2005) (see detailed discussion in section entitled ‘‘Length of the Melt Period’’). Recent observations further indicate that winter ice extent is declining (Comiso 2006) (see detailed discussion in section entitled ‘‘Winter Sea Ice’’). Empirical evidence therefore establishes that the environment on which polar bears depend for their survival has already changed substantially.

Without sea ice, polar bears lack the platform that allows them to access prey. Longer melt seasons and reduced summer ice extent will force polar bears into habitats where their hunting success will be compromised (Derocher et al. 2004, p. 167; Stirling and Parkinson 2006, pp. 271–272). Increases in the duration of the summer season, when polar bears are restricted to land or forced over relatively unproductive Arctic waters, may reduce individual survival and ultimately population size (Derocher et al. 2004, pp. 165–170). Ice seals typically occur in open-water during summer and therefore are inaccessible to polar bears during this time (Harwood and Stirling 1992, p. 897). Thus, increases in the length of the summer melt season have the potential to reduce annual availability of prey. In addition, unusual movements, such as long distance swims to reach pack ice or land, place polar bears at risk and may affect mortality (Monnett and Gleason 2006, pp. 4–6). Because of the importance of sea ice to polar bears, projecting patterns of ice habitat availability has direct implications on their future status. This section reports on recent studies that project the effects of sea ice change on polar bears.

Polar Bear Habitat

Durner et al. (2007, pp. 4–10) developed resource selection functions (RSFs) to identify ice habitat characteristics selected by polar bears and used these selection criteria as a basis for projecting the future availability of optimal polar bear habitat throughout the 21st century. Location data from satellite-collared polar bears and environmental data (e.g., sea ice concentration, bathymetry, etc.) were used to develop RSFs (Manly et al. 2002), which are considered to be a quantitative measure of habitat selection by polar bears. Important habitat features identified in the RSF models were then used to determine the availability of optimal polar bear habitat in GCM projections of 21st century sea ice distribution. The following information has been excerpted or extracted from Durner et al. (2007).

Durner et al. (2007, p. 5) used the outputs from 10 GCMs from the IPCC 4AR report as inputs into RSFs models to forecast future distribution and quantities of preferred polar bear habitat. The 10 GCMs were selected based on their ability to accurately simulate actual ice extent derived from passive microwave satellite observations (as described in DeWeaver 2007). The area of the assessment was the pelagic ecoregion of the Arctic polar basin comprised of the Divergent and Convergent ecoregions described by Amstrup et al. (2007, pp. 5–7) as described previously in introductory materials contained in the ‘‘Polar Bear Ecoregions’’ section of this final rule. Predictions of the amount and rate of change in polar bear habitat varied among GCMs, but all predicted net losses in the polar basin during the 21st century. Projected losses in optimal habitat were greatest in the peripheral seas of the polar basin (Divergent ecoregion) and projected to be greatest in the Southern Beaufort, Chukchi, and Barents Seas. Observed losses of sea ice in the Southern Beaufort, Chukchi, and Barents Seas are occurring more rapidly than projected and suggest that trajectories may vary at regional scales. Losses were least in high-latitude regions where the RSF models predicted an initial increase in optimal habitat followed by a modest decline. Optimal habitat changes in the Queen Elizabeth and Arctic Basin units of the Canada-Greenland group (Convergent ecoregion) were projected to be negligible if not increasing. Very little optimal habitat was observed or predicted to occur in the deep water regions of the central Arctic basin.

Durner et al. (2007, p. 13) found that the largest seasonal reductions in habitat were predicted for spring and summer. Based on the multi-model mean of 10 GCMs, the average area of optimal polar bear habitat during summer in the polar basin declined from an observed 1.0 million sq km (0.39 million sq mi) in 1985–1995 (baseline) to a projected multi-model average of 0.58 million sq km (0.23 million sq mi) in 2045–2054 (42 percent decline), 0.36 million sq km (0.14 million sq mi) in 2070–2079 (64 percent decline), and 0.32 million sq km (0.12 million sq mi) in 2090–2099 (68 percent decline). After summer melt, most regions of the polar basin were projected to refreeze throughout the 21st century. Therefore, winter losses of polar bear habitat were more modest, from 1.7 million sq km (0.54 million sq mi) in 1985–1995 to 1.4 million sq km (0.55 million sq mi) in 2090–2099 (17 percent decline). Simulated and projected rates of habitat loss during the late 20th and early 21st centuries by many GCMs tend to be less than observed rates of loss during the past two decades; therefore, habitat losses based on GCM multi-model averages were considered to be conservative.

Large declines in optimal habitat are projected to occur in the Alaska-Eurasia region (Divergent ecoregion) where 60–80 percent of the polar bear’s historical area of spring and summer habitat may disappear by the end of the century (Durner et al. 2007). The Canada-Greenland region (Convergent ecoregion) has historically contained less total optimal habitat area, since it is geographically smaller than the Alaska-Eurasia region. In the Queen Elizabeth region, while there is a similar seasonal pattern to the projected loss of optimal habitat, the magnitude of habitat loss was much less because of the predicted stability of ice in this region (Durner et al. 2007, p. 13). The projected rates of habitat loss over the 21st century were not constant over time (Durner et al. 2007). Rates of loss tended to be greatest during the second and third quarters of the century and then diminish during the last quarter.

Losses in optimal habitat between 1985–1995 and 1996–2006 established an observed trajectory of change that was consistent with the GCM projections; however, the observed rate of change (established over a 10-year period), when extrapolated over the first half of the 21st century, resulted in more habitat lost than that projected by the GCM ensemble average (i.e., faster than projected) (Durner et al. 2007, p. 13).

The recent findings regarding the record minimum summer sea ice conditions for 2007 reported by the NSIDC in Boulder, Colorado, were not considered in the analysis of sea ice conditions reported by Durner et al. (2007) because the full 2007 data were not yet available when the analyses in Durner et al. (2007) were conducted. In 2007, sea ice losses in the Canadian Archipelago and the polar basin Convergent ecoregions were the largest observed to date; these areas had previously been observed to be relatively stable (Durner et al. 2007).

Durner et al. (2007, pp. 18–19) indicated that less available habitat will likely result in reduced polar bear populations, although the precise relationship between habitat loss and population demographics remains unknown. Other authors (Stirling and Parkinson 2006, pp. 271–272; Regehr et al. 2007, pp. 14–18; Hunter et al. 2007, pp. 14–18; Rode et al. 2007, pp. 5–8; Amstrup et al. 2007, pp. 19–31) present detailed information regarding demographic effects of loss of sea ice habitat. Durner et al. (2007, pp. 19–20) does hypothesize that density effects may become more important as polar bears make long distance annual migrations from traditional winter areas to remnant high-latitude summer areas already occupied by polar bears. Further, Durner et al. (2007, p. 19) indicate that declines and large seasonal swings in habitat availability and distribution may impose greater impacts on pregnant females seeking denning habitat or leaving dens with cubs than on males and other age groups. Durner et al. (2007, p. 19) found that although most winter habitats would be replenished annually, long distance retreat of summer habitat may ultimately preclude bears from seasonally returning to their traditional winter ranges. Please also see the section in this final rule entitled ‘‘Access to and Alteration of Denning Areas.’’

Polar Bear Population Projections—Southern Beaufort Sea

Recent demographic analyses and modeling of the Southern Beaufort Sea population have provided insight about the current and future status of this population (Hunter et al. 2007; Regehr et al. 2007b). This population occupies habitats similar to four other populations in the Divergent ecoregion (Barents, Chukchi, Kara and Laptev Seas), which together represent over one-third of the current worldwide polar bear population. Because these other populations have experienced more severe sea ice changes than the southern Beaufort Sea, this assessment may understate the severity of the demographic impact that polar bear populations face in the Divergent ecoregion.

Hunter et al. (2007, pp. 2–6) conducted a demographic analysis of the Southern Beaufort Sea population using a life-cycle model parameterized with vital rates estimated from capture-recapture data collected between 2001 and 2006 (Regehr et al. 2007b, pp. 12–

14). Population growth rates and resultant population sizes were projected both deterministically (i.e., assuming that environmental conditions remained constant over time) and stochastically (i.e., allowing for environmental conditions to vary over time).

The deterministic model produced positive point estimates of population growth rate under the conditions in 2001–2003, ranging from 1.02 to 1.08 (i.e., 2 to 8 percent growth per year), and negative point estimates of population growth rate under the conditions in 2004–2005 when the region was ice-free for much longer, ranging from 0.77 to 0.90 (i.e., 23 to 10 percent decline per year) (Hunter et al. 2007, p. 8). The overall growth rate estimate for the study period was about 0.997, i.e., a 0.3 percent decline per year. Population growth rate was most affected by adult female survival, with secondary effects from reduced breeding probability (Hunter et al. 2007, p. 8). A main finding of this analysis was that when there are more than 125 ice-free days over the continental shelf of the broad southern Beaufort Sea region, population growth rate declines precipitously.

The stochastic model incorporated environmental variability by partitioning observed data into ''good'' years (2001–2003, short ice-free period) and ''bad'' years (2004–2005, long ice-free period), and evaluating the effect of the frequency of bad years on population growth rate (Hunter et al. 2007, p. 6). Stochastic projections were made in two ways: (1) Assuming a variable environment with the probability of bad years equal to what has been observed recently (1979–2006); and (2) assuming a variable environment described by projections of sea ice conditions in outputs of 10 selected general circulation models, as described by DeWeaver (2007). In the first analysis, Hunter et al. (2007, pp. 12–13) found that the stochastic growth rate declined with an increase in frequency of bad years, and that if the frequency of bad years exceeded 17 percent the result would be population decline. The observed frequency of bad years since 1979 indicated a decline of about 1 percent per year for the Southern Beaufort Sea population. The average frequency of bad ice years from 1979–2006 was approximately 21 percent and from 2001–2005 was approximately 40 percent. In the second analysis, using outputs from 10 GCMs to determine the frequency of bad years, Hunter et al. (2007, p. 13) estimated a 55 percent probability of decline to 1 percent of current population size in 45 years using the non-covariate model set, and a 40 percent probability of decline to 0.1 percent of current population size in 45 years, also using the non-covariate model set. Under sea ice conditions predicted by each of the 10 GCMs, the Southern Beaufort Sea population was projected to experience a significant decline within the next century. The demographic analyses of Hunter et al. (2007, pp. 3–9) incorporated uncertainty arising from demographic parameter estimation, the short time-series of capture-recapture data, the form of the population model, environmental variation, and climate projections. Support for the conclusions come from the agreement of results from different statistical model sets, deterministic and stochastic models, and models with and without climate forcing.

Polar Bear Population Projections—Range-wide

Amstrup et al. (2007, pp. 5–6) used two modeling approaches to estimate the future status of polar bears in the 4 ecoregions they delineated (see section entitled ''Polar Bear Ecoregions'' and Figure 2 above). First, they used a deterministic Carrying Capacity Model (CM) that applied current polar bear densities to future GCM sea ice projections to estimate potential future numbers of polar bears in each of the 4 ecoregions. The second approach, a Bayesian Network Model (BM), included the same annual measure of sea ice area as well as measures of the spatial and temporal availability of sea ice. In addition, the BM incorporated numerous other stressors that might affect polar bear populations that were not incorporated in the carrying capacity model. The CM ''provided estimates of the maximum potential sizes of polar bear populations based on climate modeling projections of the quantity of their habitat—but in the absence of effects of any additional stressors * * *'' while the BM ''provided estimates of how the presence of multiple stressors * * * may affect polar bears'' (Amstrup et al. 2007, p. 5).

For both modeling approaches, the 19 polar bear populations were grouped into 4 ecoregions, which are defined by the authors on the basis of observed temporal and spatial patterns of ice formation and ablation (melting or evaporation), observations of how polar bears respond to these patterns, and projected future sea ice patterns (see ''Current Population Status and Trends'' section). The four ecoregions are: (1) the Seasonal Ice ecoregion (which occurs mainly at the southern extreme of the polar bear range); (2) the Archipelago ecoregion of the central Canadian Arctic; (3) the polar basin Divergent ecoregion; and (4) the polar Basin Convergent ecoregion (see Figure 2 above). The ecoregions group polar bear populations that share similar environmental conditions and are, therefore, likely to respond in a similar fashion to projected future conditions.

Carrying Capacity Model (CM)

The deterministic Carrying Capacity Model (CM) developed by Amstrup et al. (2007) was used to estimate present-day polar bear density in each ecoregion based on estimates of the number of polar bears and amount of sea ice in each ecoregion. These density estimates were defined as ''carrying capacities'' and applied to projected future sea ice availability scenarios using the assumption that current ''carrying capacities'' will apply to available habitat in the future. This density and habitat index, therefore, allows a straightforward comparison between the numbers of bears that are present now and the number of bears which might be present in the future.

Amstrup et al. (2007, p. 8) defined total available sea ice habitat in the Divergent and Convergent ecoregions as the 12-month sum of sea ice cover (in km2) over the continental shelves of the 2 polar basin ecoregions; in the Archipelago and Seasonal Ice ecoregions, all sea ice-covered areas were considered shelf areas and defined as available habitat (Amstrup et al. 2007, p. 9). In the Divergent and Convergent ecoregions, available sea ice habitat was further defined as either optimal (according to the definition of Durner et al. 2007, p. 9) or nonoptimal; this further subdivision was not applied in the Archipelago and Seasonal Ice ecoregions, which used the one measure of total available sea ice habitat. Projections of future sea ice availability for each ecoregion were derived from 10 General Circulation Models (GCMs) selected by DeWeaver (2007, p. 21). Projections of polar bear status based on habitat availability were determined for each of the four ecoregions for 4 time periods: the present (year 0); 45 years from the present (the decade of 2045–2055); 75 years from the present (2070–2080); and 100 years (2090–2100) from the present. For added perspective, the authors also looked at 10 years in the past (1985–1995). Three sea ice habitat availability estimates were derived for each time period, based on the minimum, mean, and maximum sea ice projections from the 10-model GCM ensemble. Changes in habitat were defined in terms of direction (contracting, stable or expanding) and magnitude (slow or none, moderate, or fast), while changes in carrying capacity were defined in terms of direction (decreasing, stable or increasing) and magnitude (low to none, moderate, or high) (Amstrup et al. 2007, pp. 10–12). ''Outcomes of habitat change and carrying capacity change were categorized into 4 composite summary categories to describe the status of polar bear populations: enhanced, maintained, decreased, or toward extirpation'' (Amstrup et al. 2007, p. 12).

The range of projected carrying capacities (numbers of bears potentially remaining assuming historic densities were maintained) varied by ecoregion and to whether maximum or minimum ice values were used. Table 1 below presents the range of projected change in carrying capacity of sea ice habitats for polar bears by ecoregion based on sea ice projections from GCMs. The range of percentages represents minimum and maximum projected changes in carrying capacity based on minimum and maximum projected changes in the total area of sea ice habitat at various times.

Table 1. Projected maximum and minimum percent changes in polar bear carrying capacity based on maximum and minimum projected changes in the total area of sea ice habitat at various times. Negative values indicate percent decrease in carrying capacity and positive values indicate percent increase in carrying capacity.

	Percent change in carrying capacity of sea ice habitats		
Ecoregion	Year 45	Year 75	Year 100
Seasonal Ice	-7 to -10	-21 to -32	-22 to -32
Archipelago	-3 to -14	-18 to -21	-21 to -24
Divergent Ice	-19 to -35	-29 to -43	-23 to -48
Convergent Ice	+4 to -24	-8 to -11	-3 to -25
Global	-10 to -22	-22 to -32	-20 to -37

All CM runs projected declines in polar bear carrying capacity in all four ecoregions (Amstrup et al. 2007, Figure 9). Some CM model runs project that polar bear carrying capacity will be trending ''toward extirpation'' (the term ''toward extirpation'' is defined as one of three combinations of habitat change and carrying capacity change (i.e., contracting moderate habitat change, decreasing fast carrying capacity change; contracting fast, decreasing moderate; contracting fast, decreasing high)) in some ecoregions at certain times, but that less severe carrying capacity changes will occur in other ecoregions (see Tables 2 and 6, and Figure 9 in Amstrup et al. 2007). Using the 4 composite summary categories of Amstrup et al. (2007, p. 12), the minimum sea ice extent model results project that a trend toward extirpation of polar bears will appear in the polar basin Divergent ecoregion by year 45 and in the Seasonal Ice ecoregion by year 75. Mean sea ice extent model results project that a trend toward extirpation of bears will appear in the polar basin Divergent ecoregion by year 75 and in the polar basin Convergent ecoregion by year 100. None of the model results project that a trend toward extirpation will appear in the Archipelago region by year 100. Likewise, none of the model results project that polar bear carrying capacity will increase or remain stable in any ecoregion beyond 45 years. Although the pattern of projected carrying capacity varied greatly among regions, the summary finding was for a range-wide decline in polar bear carrying capacity of between 10 and 22 percent by year 45 and between 22 and 32 percent by year 75 (Amstrup et al. 2007, p. 20). CM results provide a conservative view of the potential magnitude of change in bear carrying capacity over time and area, because these results are based solely on the area of sea ice present at a given point in time and do not consider the effects of other population stressors.

Bayesian Network Model (BM)

To address other variables in addition to sea ice habitat that may affect polar bears, Amstrup et al. (2007, pp. 5–6) developed a prototype Bayesian Network Model (BM). The BM incorporated empirical data and GCM projections of annual and seasonal sea ice availability, numerous other stressors, and expert judgment regarding known relationships between these stressors and polar bear demographics to obtain probabilistic estimates of future polar bear distributions and relative numbers. Anthropogenic stressors included human activities that could affect distribution or abundance of polar bears, such as hunting, oil and gas development, shipping, and direct bear-human interactions. Natural stressors included changes in the availability of primary and alternate prey and foraging areas, and occurrence of parasites, disease, and predation. Environmental factors included projected changes in total ice and optimal habitat, changes in the distance that ice retreats from traditional autumn or winter foraging areas, and changes in the number of months per year that ice is absent in the continental shelf regions. Habitat changes, natural and anthropogenic stressors, and environmental factors were evaluated for their potential effects on the density and distribution of polar bears and survival throughout their range. BM outcomes were defined according to their collective influence on polar bear population distribution and relative numbers with respect to current conditions (e.g., larger than now, the same as now, smaller than now, rare, or extinct) (Amstrup et al. 2007).

As a caveat to their results, the authors note that, because a BM combines expert judgment and interpretation with quantitative and qualitative empirical information, inputs from multiple experts are usually incorporated into the structure and parameterization of a ''final'' BM. Because the BM in Amstrup et al. (2007) incorporates the input of a single polar bear expert, the model should be viewed as an ''alpha'' level prototype (Marcot et al. 2006, cited in Amstrup et al. 2007, p.27) that would benefit from additional development and refinement. Given this caveat, it is extremely important, while interpreting model outcomes, to focus on the general direction and magnitude of the probabilities of projected outcomes rather than the actual numerical probabilities associated with each outcome. For example, situations with high probability of a particular outcome (e.g., of extinction) or consistent directional effect across sea ice scenarios suggest a higher likelihood of that outcome as opposed to situations where the probability is evenly spread across outcomes or where there is large disagreement among different sea ice scenarios. These considerations were central to the authors' interpretation of BM results (Amstrup et al. 2007).

The overall outcomes from the BM indicate that in each of the four ecoregions polar bear populations in the future are very likely to be smaller and have a higher likelihood of experiencing multiple stressors in comparison to the past or present. In the future, multiple natural and anthropogenic stressors will likely become important, and negative effects on all polar bear populations will be apparent by year 45 with generally increased effects through year 100.

In the Seasonal Ice ecoregion the dominant outcome of the BM was ''extinct'' at all future time periods under all three GCM scenarios used in the analysis, with low probabilities associated with alternative outcomes, except for the minimum GCM scenario at year 45 (when the probability of alternative outcomes was around 44 percent). The small probabilities for outcomes other than extinct suggest a trend in this ecoregion toward probable extirpation by the mid-21st century. In the polar basin Divergent ecoregion, ''extinct'' was also the predominant outcome, with very low probabilities associated with alternative outcomes (i.e., less then 15 percent probability of not becoming extinct). The small probabilities for outcomes other than extinct also suggest a trend in this ecoregion toward probable extirpation by the mid-21st century. In the polar basin Convergent ecoregion, population persistence at ''smaller in numbers'' or ''rare'' was the predominant outcome at year 45, but the probability of extinction came to predominate (i.e., was greater than 60 percent) at year 75 and year 100. In the Archipelago ecoregion, a smaller population was the most probable outcome at year 45 under all GCM scenarios. By year 75, the most probable outcome for this ecoregion (as in the other ecoregions) across all GCM ice scenarios was population persistence, albeit in lower numbers. Even late in the century, however, the probability of a smaller than present population in the Archipelago Ecoregion was relatively high. Therefore, Amstrup et al. (2007) concluded that polar bears, in reduced numbers, could occur in the Archipelago Ecoregion through the end of the century. The authors note that the projected changes in sea ice conditions could result in loss of approximately two-thirds of the world's current polar bear population by the mid-21st century. They further note that, because the observed trajectory of Arctic sea ice decline appears to be underestimated by currently available models, these projections may be conservative.

As part of the BM, Amstrup et al. (2007, pp. 29–31) conducted a sensitivity analysis to determine the influence of model inputs and found that the overall projected population outcome was greatly influenced by changes in sea ice habitat. The Bayesian sensitivity analysis found that 91 percent of the variation in the overall predicted population outcome was determined by six variables. Four of these six were sea ice related, including patterns of seasonal and spatial distribution. The fifth variable among these top six was the ecoregion being considered. Outcomes varied for ecoregions as a result of differences in their sea ice characteristics. The sixth ranked variable, with regard to overall population outcome, was the level of intentional takes or harvest (overutilization). The stressors that related to bear-human interactions, parasites and disease and predation, and other natural or man-made factors provided a nominal influence of less than 9 percent contribution to the status outcome.

Amstrup et al. (2007, pp. 22–24) characterize the types and implications of uncertainty inherent to the carrying capacity and BM modeling in their report. Analyses in this report contain three main categories of uncertainty: (1) uncertainty in our understandings of the biological, ecological, and climatological systems; (2) uncertainty in the representation of those understandings in models and statistical descriptions; and (3) uncertainty in model predictions. In addition, Amstrup et al. (2007) discussed potential consequences of and efforts to evaluate and minimize uncertainty in the analyses. We reiterate the caveat that a BM combines expert judgment and interpretation with quantitative and qualitative empirical information, therefore necessitating inputs from multiple experts (if available) before it can be considered final. We note again that because the BM presented in Amstrup et al. (2007) incorporates the input of a single polar bear expert, it should be viewed as a first-generation prototype (Marcot et al. 2006, cited in Amstrup et al. 2007, p.27) that would benefit from additional development.

Because the BM includes numerous qualitative inputs (including expert assessment) and requires additional development (Amstrup et al. 2007, p. 27), we are more confident in the general direction and magnitude of the projected outcomes rather than the actual numerical probabilities associated with each outcome, and we are also more confident in outcomes within the 45-year foreseeable future than in outcomes over longer timeframes (e.g., year 75 and year 100 in Amstrup et al. (2007)). We conclude that the outcomes of the BM are consistent with ''the increasing volume of data confirming negative relationships between polar bear welfare and sea ice decline'' (Amstrup et al. 2007, p. 31), and parallel other assessments of both the demographic parameter changes as well as trends in various factors that threaten polar bears as described by Derocher et al. (2004), and in the proposed rule to list polar bears as a threatened species (72 FR 1064). However, because of the preliminary nature of the BM and levels of uncertainty associated with the initial Bayesian Modeling efforts, we do not find that the projected outcomes derived from the BM to be as reliable as the data derived from the ensemble of climate models used by the Service to gauge the loss of sea ice habitat over the next 45 years. Both the proposed rule and the status assessment (*Range Wide Status Review of the Polar Bear* (*Ursus maritimus*), Schliebe et al. 2006a), underwent extensive peer review by impartial experts within the disciplines of polar bear ecology, climatology, toxicology, seal ecology, and traditional ecological knowledge, and thereby represent a consensus on the conclusions in these documents. The more recent projections from the BM exercise conducted by Amstrup et al. (2007) are consistent with conclusions reached in the earlier assessments that polar bear populations will continue to decline in the future.

Polar Bear Mortality

As changes in habitat become more severe and seasonal rates of change more rapid, catastrophic mortality events that have yet to be realized on a large scale are expected to occur. Observations of drownings and starved animals may be a prelude to such events. Populations experiencing compromised physical condition will be increasingly prone to sudden die-offs. While no information currently exists to evaluate such events, the possibility of other forms of unanticipated mortality are mentioned here because they have been observed in other species (e.g., canine distemper in Caspian seals (*Phoca caspica*) (Kuiken et al. 2006, p. 321) and phocine distemper virus in harbor seals (Heide-Jorgensen et al. 1992, cited in Goodman 1998).

Conclusion Regarding Current and Projected Demographic Effects of Habitat Changes on Polar Bears

Polar bears have evolved in a sea ice environment that serves as an essential platform from which they meet life functions. Polar bears currently are exposed to a rapidly changing sea ice platform, and in many regions of the Arctic already are being affected by these changes. Sea ice changes are projected to continue and positive feedbacks are expected to amplify changes in the arctic which will hasten sea ice retreat. These factors will likely negatively impact polar bears by increasing energetic demands of seeking prey. Remaining members of many populations will be redistributed, at least seasonally, into terrestrial or offshore habitats with marginal values for feeding, and increasing levels of negative bear-human interactions. Increasing nutritional stress will coincide with exposure to numerous other potential stressors. Polar bears in some regions already are demonstrating reduced physical condition, reduced reproductive success, and increased mortality. As changes in habitat become more severe and seasonal rates of change more rapid, catastrophic mortality events that have yet to be realized on a large scale are expected to occur. Observations of drownings and starved animals may be a prelude to such events. These changes will in time occur throughout the world-wide range of polar bears. Ultimately, these inter-related factors will result in range-wide population declines. Populations in different ecoregions will experience different rates of change and timing of impacts. Within the foreseeable future, however, all ecoregions will be affected.

Conclusion for Factor A

Rationale

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, 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. 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. Such events are interrelated and combine to decrease the extent and quality of sea ice as polar bear habitat during all seasons and particularly during the spring-summer period. Arctic sea ice will continue to be affected by climate change. Due to the long persistence time of certain GHGs in the atmosphere, the current and projected patterns of GHG emissions over the next few decades, and interactions among climate processes, climate changes for the next 40–50 years are already largely set (IPCC 2007, p. 749; J. Overland, NOAA, in litt. to the Service, 2007). Climate change effects on sea ice and polar bears will continue through this timeframe and very likely further into the future.

Changes in sea ice negatively impact polar bears by increasing the energetic demands of movement in seeking prey, causing seasonal redistribution of substantial portions of populations into marginal ice or terrestrial habitats with limited values for feeding, and increasing the susceptibility of bears to other stressors, some of which follow. As the sea ice edge retracts to deeper, less productive polar basin waters, polar bears will face increased competition for limited food resources, increased open water swimming with increased risk of drowning, increasing interaction with humans with negative consequences, and declining numbers that may be unable to sustain ongoing harvests.

Changes in sea ice will reduce productivity of most ice seal species, result in changes in composition of seal species indigenous to some areas, and eventually result in a decrease in seal abundance. These changes will decrease availability or timing of availability of seals as food for polar bears. Ringed seals will likely remain distributed in shallower, more productive southerly areas that are losing their seasonal sea ice and becoming characterized by vast expanses of open water in the spring-summer-fall period. As a result, the seals will remain unavailable as prey to polar bears during critical times of the year. These factors will, in turn, result in a steady decline in the physical condition of polar bears, which has proven to lead to population-level demographic declines in reproduction and survival.

The ultimate net effect of these inter-related factors will be that polar bear populations will decline or continue to decline. Not all populations will be affected evenly in the level, rate, and timing of effects, but we have determined that, within the foreseeable future, all polar bear populations will be negatively affected. This determination is broadly supported by results of the USGS studies, and within the professional community, including a majority of polar bear experts who peer reviewed the proposed rule. The PBSG evaluated potential impacts to the polar bear, and determined that the observed and projected changes in sea ice habitat would negatively affect the species (Aars et al. 2006, p. 47). The IUCN, based on the PBSG assessment, reclassified polar bears as ‘‘vulnerable.’’ Similarly, their justification for the classification was the projected change in sea ice, effect of climate change on polar bear condition, and corresponding effect on reproduction and survival, which have been associated with a steady and persistent decline in abundance.

A series of analyses of the best available scientific information on the ecology and demography of polar bears were recently undertaken by the USGS at the request of the Secretary of the Interior. These include additional analyses of some specific populations (Southern Beaufort Sea, Northern Beaufort Sea, Southern Husdon Bay), analysis of optimal polar bear habitat and projections of optimal habitat through the 21st century, projections of the status of populations into the future, and information from a pilot study regarding the increase in travel distance for pregnant females to reach denning areas on the North Slope of Alaska with insights to potential consequences. Results of the analyses are detailed within this final rule. This significant effort enhanced and reaffirmed our understanding of the interrelationships of ecological factors and the future status of polar bear populations.

The USGS report by Amstrup et al. (2007) synthesized historical and recent scientific information and conducted two modeling exercises to provide a range-wide assessment of the current and projected future status of polar bears occupying four ecoregions. In this effort, using two approaches and validation processes, the authors described four ''ecoregions'' based on current and projected sea ice conditions and developed a suite of population projections by ecoregion. This assessment helps inform us on the future fate of polar bear populations subject to a rapidly changing sea ice environment. In summary, polar bear populations within all ecoregions were not uniformly impacted, but all populations within ecoregions declined, with the severity of declines depending on the sea ice projections (minimal, mean, maximum), season of the year, and area. Amstrup et al. (2007, p. 36) forecasts the extirpation of populations in the Seasonal Ice, and polar basin Divergent ecoregions by the mid-21st century. Because the BM presented in the report be viewed as a first-generation prototype (Marcot et al. 2006, cited in Amstrup et al. 2007, p.27) that would benefit from additional development, and because the BM includes numerous qualitative inputs (including expert assessment), we are more confident in the general direction and magnitude of the projected outcomes rather than the actual numerical probabilities associated with each outcome, and we are also more confident in outcomes within the 45-year foreseeable future.

In the southerly populations (Seasonal Ice ecoregion) of Western Hudson Bay, Southern Hudson Bay, Foxe Basin, Davis Strait, and Baffin Bay, polar bears already experience stress from seasonal fasting due to early sea ice retreat, and have or will be affected earliest (Stirling and Parkinson 2006, p. 272; Obbard et al. 2006, pp. 6–7; Obbard et al. 2007, p. 14). Populations in the Divergent ecoregion, including the Chukchi Sea, Barents Sea, Southern Beaufort Sea, Kara Sea, and Laptev Sea will, or are currently, experiencing initial effects of changes in sea ice (Rode et al. 2007, p. 12; Regehr et al. 2007b, pp. 18–19; Hunter et al. 2007, p. 19; Amstrup et al. 2007, p. 36). 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. Polar bear populations inhabiting the central island archipelago of Canada (Archipelago ecoregion) will also be affected but to lesser degrees and later in time. These more northerly populations (Norwegian Bay, Lancaster Sound, M'Clintock Channel, Viscount Melville Sound, Kane Basin, and the Gulf of Boothia) are expected to be affected last due to the buffering effects of the island archipelago complex, which lessens effects of oceanic currents and seasonal retractions of ice and retains a higher proportion of heavy, more stable, multi-year sea ice. A caution in this evaluation is that historical record minimum summer ice conditions in September 2007 resulted in vast ice-free areas that encroached into the area of permanent polar sea ice in the central Arctic Basin, and the Northwest Passage was open for the first time in recorded history. The record low sea ice conditions of 2007 are an extension of an accelerating trend of minimum sea ice conditions and further support the concern that current sea ice models may be conservative and underestimate the rate and level of change expected in the future.

Although climate change may improve conditions for polar bears in some high latitude areas where harsh conditions currently prevail, these improvements will only be transitory. Continued warming will lead to reduced numbers and reduced distribution of polar bears range-wide (Regehr et al. 2007b, p. 18; Derocher et al. 2004, p. 19; Hunter et al. 2007, p. 14; Amstrup et al. 2007, p. 36). Projected declines in the sea ice for most parts of the Arctic are long-term, severe, and occurring at a pace that is unprecedented (Comiso 2003; ACIA 2004; Holland et al. 2006, pp. 1–5); therefore, the most northerly polar bear populations will experience declines in demographic parameters similar to those observed in the Western Hudson Bay population, along with changes in distribution and other currently unknown ecological responses (Derocher et al. 2004, p. 171; Aars et al. 2006, p. 47). Ultimately, all polar bear populations will be affected within the foreseeable future, and the species will likely become in danger of extinction throughout all of its range.

It is possible, even with the total loss of summer sea ice, that a small number of polar bears could survive, provided there is adequate seasonal ice cover to serve as a platform for hunting opportunities, and that sea ice is present for a period of time adequate for replenishment of body fat stores and condition. However, this possibility is difficult to evaluate. As a species, polar bears have survived at least two warming periods, the Last Interglacial (140,000—115,000 years Before Present (BP)), and the Holocene Thermal maximum (ca 12,000—4,000 BP) (Dansgaard et al. 1993, p. 218; Dahl-Jensen et al. 1998, p. 268). Greenland ice cores revealed that the climate was much more variable in the past, and some of the historical shifts between the warm and cold periods were rapid, suggesting that the recent relative climate stability seen during the Holocene may be an exception (Dansgaard et al. 1993, p. 218). While the precise impacts of these warming periods on polar bears and the Arctic sea ice habitat are unknown, the ability of polar bears to adapt to alternative food sources seems extremely limited given the caloric requirements of adult polar bears and the documented effects of nutritional stress on reproductive success.

In addition to the effects of climate change on sea ice, we have also evaluated changes to habitat in the Arctic as a result of increased pressure from human activities. Increased human activities include a larger footprint from the number of people resident to the area, increased levels of oil and gas exploration and development and expanding areas of interest, and potential increases in shipping. Cumulatively, these activities may result in alteration of polar bear habitat. Any potential impact from these activities would be additive to other factors already or potentially affecting polar bears and their habitat. We acknowledge that the sum total of documented direct impacts from these activities in the past have been minimal. We also acknowledge, as discussed further under the Factor D analysis in this final rule, that national and local concerns for these activities has resulted in the development and implementation of multi-layered regulatory programs to monitor and eliminate or minimize potential effects. Regarding potential shipping activities within the Arctic, increased future monitoring is necessary to enhance the understanding of potential effects from this activity.

Determination for Factor A

We have evaluated the best available scientific and commercial information on polar bear habitat and the current and projected effects of various factors (including climate change) on the quantity and distribution of polar bear habitat, and have determined that the polar bear is threatened throughout its entire range by ongoing and projected changes in sea ice habitat (i.e., the species is likely to become endangered throughout all of its range within the foreseeable future due to habitat loss).

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Use of polar bears for commercial, recreational, scientific, and educational purposes is generally low, with the exception of harvest. Use for nonlethal scientific purposes is highly regulated and does not pose a threat to populations. Similarly, the regulated, low-level use for educational purposes through placement of cubs or orphaned animals into zoos or public display facilities or through public viewing is not a threat to populations. Sport harvest of polar bears in Canada is discussed in the harvest section below. For purposes of population assessment, no distinction is made between harvest uses for sport or subsistence. Take associated with defense of life, scientific research, illegal take, and other forms of take are generally included in harvest management statistics, so this section also addresses all forms of take, including bear-human interactions.

Overview of Harvest

Polar bears historically have been, and continue to be, an important renewable resource for coastal communities throughout the Arctic (Lentfer 1976, p. 209; Amstrup and DeMaster 1988, p. 41; Servheen et al. 1999, p. 257, Table 14.1; Schliebe et al. 2006a, p. 72). Polar bears and polar bear hunting remain an important part of indigenous peoples' culture, and polar bear hunting is a source of pride, prestige, and accomplishment. Polar bears provide a source of meat and raw materials for handicrafts, including functional clothing such as mittens, boots (mukluks), parka ruffs, and pants (Nageak et al. 1991, p. 6).

Prior to the 1950s, most hunting was by indigenous people for subsistence purposes. Increased sport hunting in the 1950s and 1960s resulted in population declines (Prestrud and Stirling 1994, p. 113). International concern about the status of polar bears resulted in biologists from the five polar bear range nations forming the Polar Bear Specialist Group (PBSG) within the IUCN SSC (Servheen et al. 1999, p. 262). The PBSG was largely responsible for the development and ratification of the 1973 International Agreement on the Conservation of Polar Bears (1973 Polar Bear Agreement) (Prestrud and Stirling 1994, p. 114) (see detailed discussion under Factor D, ''Inadequacy of Existing Regulatory Mechanisms'' below). The 1973 Polar Bear Agreement and the actions of the member nations are credited with the recovery of polar bears following the previous period of overexploitation.

Harvest Management by Nation

Canada

Canada manages or shares management responsibility for 13 of the world's 19 polar bear populations (Kane Basin, Baffin Bay, Davis Strait, Foxe Basin, Western Hudson Bay, Southern Hudson Bay, Gulf of Boothia, Lancaster Sound, Norwegian Bay, M'Clintock Channel, Viscount Melville Sound, Northern Beaufort Sea, and Southern Beaufort Sea). Wildlife management is a shared responsibility of the Provincial and Territorial governments. The Federal government (Canadian Wildlife Service) has an ongoing research program and is involved in management of wildlife populations shared with other jurisdictions, especially ones with other nations (e.g., where a polar bear stock ranges across an international boundary). To facilitate and coordinate management of polar bears, Canada has formed the Federal Provincial Technical Committee for Polar Bear Research and Management (PBTC) and the Federal Provincial Administrative Committee for Polar Bear Research and Management (PBAC). These committees include Provincial, Territorial, and Federal representatives who meet annually to review research and management activities.

Polar bears are harvested in Canada by native residents and by sport hunters employing native guides. All human-caused mortality (i.e., hunting, defense of life, and incidental kills) is included in a total allowable harvest. Inuit people from communities in Nunavut, Northwest Territories (NWT), Manitoba, Labrador, Newfoundland, and Quebec conduct hunting. In Ontario, the Cree and the Inuit can harvest polar bears. In Nunavut and NWT, each community obtains an annual harvest quota that is based on the best available scientific information and monitored through distribution of harvest tags to local hunter groups, who work with scientists to set quotas. Native hunters may use their harvest tags to guide sport hunts. The majority of sport hunters in Canada are U.S. citizens. In 1994 the MMPA was amended to allow these hunters to import their trophies into the United States if the bears had been taken in a legal manner from sustainably managed populations.

The Canadian system places tight controls on the size and design of harvest limits and harvest reporting. Quotas are reduced in response to population declines (Aars et al. 2006, p. 11). In 2004, existing polar bear harvest practices caused concern when Nunavut identified quota increases for 8 populations, 5 of which are shared with other jurisdictions (Lunn et al. 2005, p. 3). Quota increases were largely based on indigenous knowledge (the Nunavut equivalent of traditional ecological knowledge) and the perception that some populations were increasing from historic levels. Nunavut did not coordinate these changes with adjacent jurisdictions that share management responsibility. This action resulted in an increase in the quota of allowable harvest from 398 bears in 2003–2004 to 507 bears in 2004–2005 (Lunn et al. 2005, p. 14, Table 6). Discussions between jurisdictions, designed to finalize cooperative agreements regarding the shared quotas, continue.

Greenland

The management of polar bear harvest in Greenland is through a system introduced in 1993 that allows only full-time hunters living a subsistence lifestyle to hunt polar bears. Licenses are issued annually for a small fee contingent upon reporting harvest during the prior 12 months. Until 2006, no quotas were in place, but harvest statistics were collected through Piniarneq, a local reporting program (Born and Sonne 2005, p. 137). In January 2006, a new harvest monitoring and quota system was implemented (Lønstrup 2005, p. 133). Annual quotas are determined in consideration of international agreements, biological advice, user knowledge, and consultation with the Hunting Council. However, for the Baffin Bay and Kane Basin populations, which are shared with Canada, evaluation of quota levels, harvest levels for shared populations occurring in other jurisdictions, and best available estimates of population numbers indicate that the quotas and combined jurisdictions harvest levels are not sustainable and the enforcement of harvest quotas may not be effective

(Aars et al. 2006). These populations are thought to be reduced and the trend is thought to be declining. Greenland is considering the allocation of part of the quota for sport hunting (Lønstrup 2005, p. 133).

Norway

Norway and Russia share jurisdiction over the Barents Sea population of polar bears. Management in Norway is the responsibility of the Ministry of the Environment (Wiig et al. 1995, p. 110). The commercial, subsistence, or sport hunting of polar bears in Norway is prohibited (Wiig et al. 1995, p. 110). Bears may only be killed in self-defense or protection of property, and all kills, including ''mercy'' kills, must be reported and recorded (Gjertz and Scheie 1998, p. 337).

Russia

The commercial, subsistence, or sport hunting of polar bears in Russia is prohibited. Some bears are killed in defense of life, and a small number of cubs (1 or 2 per year) have been taken in the past for zoos. Despite the 1956 ban on hunting polar bears, illegal harvest is occurring in the Chukchi Sea region and elsewhere where there is limited monitoring or enforcement (Aars et al. 2007, p. 9; Belikov et al. 2005, p. 153). The level of illegal harvest in Russian populations is unknown. There is a significant interest in reopening subsistence hunting by indigenous people. The combined ongoing illegal hunting in Russia and legal subsistence harvest in Alaska is a concern for the Chukchi Sea population, which may be in decline (USFWS 2003, p. 1). This mutual concern resulted in the United States and Russia signing the ''Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population'' (Bilateral Agreement) on October 16, 2000. On January 12, 2007, the President of the United States signed into law the ''Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006.'' This Act added Title V to the MMPA, which implements the Bilateral Agreement. On September 22, 2007, the governments of the United States and Russian Federation exchanged instruments of ratification. Full implementation of the Bilateral Agreement is intended to address overharvest, but implementation has not yet occurred (Schliebe et al. 2005, p. 75). In the United States, Presidential appointment of Commissioners necessary to implement the Bilateral Agreement is pending. Accordingly, we have not relied on implementation of the Bilateral Agreement in our assessment of the threat of overutilization of polar bears (see ''International Agreements and Oversight'' section under Factor D below).

United States

Polar bear subsistence hunting by coastal Alaska Natives has occurred for centuries (Lentfer 1976, p. 209). Polar bear hunting and the commercial sale of skins took on increasing economic importance to Alaskan Natives when whaling began in the 1850s, and a market for pelts emerged (Lentfer 1976, p. 209). Trophy hunting using aircraft began in the late 1940s. In the 1960s, State of Alaska hunting regulations became more restrictive, and in 1972 aircraft-assisted hunting was stopped altogether (Lentfer 1976, p. 209). Between 1954 and 1972, an average of 222 polar bears was harvested annually, resulting in a population decline (Amstrup et al. 1986, p. 246).

Passage of the MMPA in 1972 established a moratorium on the sport or commercial hunting of polar bears in Alaska. However, the MMPA exempts harvest, conducted in a nonwasteful manner, of polar bears by coastal dwelling Alaska Natives for subsistence and handicraft purposes. The MMPA and its implementing regulations also prohibit the commercial sale of any marine mammal parts or products except those that qualify as authentic articles of handicrafts or clothing created by Alaska Natives. The Service cooperates with the Alaska Nanuuq Commission, an Alaska Native organization that represents Native villages in North and Northwest Alaska on matters concerning the conservation and sustainable subsistence use of the polar bear, to address polar bear subsistence harvest issues. In addition, for the Southern Beaufort Sea population, hunting is regulated voluntarily and effectively through an agreement between the Inuvialuit of Canada and the Inupiat of Alaska (Brower et al. 2002, p. 371) (see ''International Agreements and Oversight'' section under Factor D below). The harvest is monitored by the Service's marking and tagging program. Illegal take or trade is monitored by the Service's law enforcement program.

The MMPA was amended in 1994 to allow for the import into the United States of sport-hunted polar bear trophies legally taken by the importer in Canada. Prior to issuing a permit for import of such trophies, the Service must have found that Canada has a monitored and enforced sport-hunting program consistent with the purposes of the 1973 Polar Bear Agreement, and that the program is based on scientifically sound quotas ensuring the maintenance of the population at a sustainable level. Six populations were approved for import of polar bear trophies (62 FR 7302, 64 FR 1529, 66 FR 50843) under regulations implementing section 104(c)(5) of the MMPA (50 CFR 18.30). However, as of the effective date of the threatened listing, authorization for the import of sport hunted polar bear trophies is no longer available under section 104(c)(5) of the MMPA.

Harvest Summary

A thorough review and evaluation of past and current harvest, including other forms of removal, for all populations has been described in the *Polar Bear Status Review* (Schliebe *et al.* 2006a, pp. 108–127). The Status Review is available on our Marine Mammal website (*http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm*). Table 2 of the Status Review provides a summary of harvest statistics from the populations and is included herein as a reference. The total harvest and other forms of removal were considered in the summary analysis.

Five populations (including four that are hunted) have no estimate of potential risk from overharvest, since adequate demographic information necessary to conduct a population viability analysis and risk assessment are not available (see Table 1 below). For one of the populations, Chukchi Sea, severe overharvest is suspected to have occurred during the past 10–15 years, and anecdotal information suggests the population is in decline (Aars et al. 2006, pp. 34–35). The Chukchi Sea, Baffin Bay, Kane Basin, and Western Hudson Bay populations may be overharvested (Aars et al. 2006, pp. 40, 44–46). In other populations, including East Greenland and Davis Strait, substantial harvest occurs annually in the absence of scientifically derived population estimates (Aars et al. 2006, pp. 39, 46). Considerable debate has occurred regarding the recent changes in population estimates based on indigenous or local knowledge (Aars et al. 2006, p. 57) and subsequent quota increases for some populations in Nunavut (Lunn et al. 2005, p. 20). The PBSG (Aars et al. 2006, p. 57), by resolution, recommended that ''polar bear harvest can be increased on the basis of local and traditional knowledge only if supported by scientifically collected information.'' Increased polar bear observations along the coast may be attributed to changes in bear distribution due to lack of suitable ice habitat rather than to increased population size (Stirling and Parkinson 2006, p. 266). Additional data are needed to reconcile these differing interpretations.

As discussed in Factor A, Amstrup et al. (2007, p.30) used a first-generation BM model to forecast the range-wide status of polar bears during the 21st century, factoring in a number of stressors, including intentional take or harvest. The authors conducted a sensitivity analysis to determine the importance and influence of the stressors on the population forecast. Their analysis indicated that intentional take was the 4th ranked .potential stressor, and could exacerbate the effects of habitat loss in the future. Because of the preliminary nature of the BM results, we are more confident in the general direction and magnitude of the projected outcomes rather than the actual numerical probabilities associated with each outcome. Nonetheless, the relatively high ranking for this stressor indicates that effective management of hunting and evaluation of sustainable harvest levels will continue to be important to minimize effects for populations experiencing increased stress.

Table 2. Polar Bear Harvest Statistics, adapted from the PBTC status table

	Aerial Survey/M-R Analysis		5 yr mean kill		3 yr mean kill		1 yr mean kill					
Population	Number (year of estimate)	±2 SE	Actual removals	Likelihood of decline (next 10 years)[a]	Actual removals	Likelihood of decline (next 10 years)[a]	Actual removals	Likelihood of decline (next 10 years)[a]	Identified Permitted Harvest[b]	Estimated Maximum Sustainable Yield[c]	Observed or Predicted Trend[d]	Status[e]
Southern Beaufort Sea	1500 (2006)	1000 - 2000	57 8	No Estimate	59 3	No Estimate	44	No Estimate	81	84	Decline	Reduced
Northern Beaufort Sea	980 (2007)	825-1135	36 2	No Estimate	38	No Estimate	36	No Estimate	65	56	Stable	Not reduced
Viscount Melville	161 (1992)	121 - 201	4 4	5 6%	4 7	6 5%	5	6 8%	7	10	Increase	Severely reduced
Norwegian Bay	190 (1998)	102 - 278	2 6	70 5%	2 7	73 1%	4	84 4%	4	9	Decline	Not reduced
Lancaster Sound	2541 (1998)	1759 - 3323	74	67 0%	79	74 0%	87	80 6%	85	119	Stable	Not reduced
M'Clintock Channel	284 (2000)	166 - 402	3	2 5%	1	1 0%	2	1 8%	3	13	Increase	Severely reduced
Gulf of Boothia	1528 (2000)	953 - 2093	45 8	3 3%	48 3	4 3%	66	12 9%	74	72	Increase	Not reduced
Foxe Basin	2197 (1994)	1677 - 2717	97 2	14 0%	96	12 1%	97	13 1%	106 + Quebec	108	Stable	Not reduced
Western Hudson Bay	935 (2004)	791 - 1079	44 8	99 9%	46 3	99 9%	43	99.9%	62	44	Decline	Reduced
Southern Hudson Bay	681 (2007)	784 - 1216	36 6	0 1%	36.7	0 1%	27	0 1%	25 + Ontario, Quebec	47	Stable	Not reduced
Kane Basin	164 (1998)	94 -234	10 8	99 9%	10 3	99 9%	11	99 9%	5 + Greenland	8	Decline	Reduced
Baffin Bay	2074 (1988)	1544 - 2604	216 8	99 9%	251 7	99 9%	252	99 9%	105 + Greenland	72	Decline	Reduced
Davis Strait			64 8	12 9%	67.3	17 1%	70	18 9%	46 + Greenland, Quebec,	77	Stable	Not reduced
East Greenland	Unknown		70	No Estimate					50	No Estimate	Data Deficient	Data Deficient
Barents Sea	3000 (2004)										Data Deficient	Data Deficient
Kara Sea											Data Deficient	Data Deficient
Laptev Sea	800-1200 (1993)										Data Deficient	Data Deficient
Chukchi Sea	2000 (1993)		43- AK Unk # in Chukotka	No Estimate	Unknown	No Estimate	43++	No Estimate	Unknown	Unknown	Data Deficient	Data Deficient

[a] Presented is the proportion of simulation runs using the RISKMAN model and vital rates presented in natural survival and recruitment tables resulting in any decline after 10 years of simulation, assuming minimum 2M 1F in the harvest. One-minus this value represents the proportion of simulations resulting in population increase after 10 years

[b] The identified permitted harvest includes the maximum harvest that is presently allowed by jurisdictions with an identified quota.

[c] The estimated maximum sustainable yield (MSY) is based on a meta-analysis of the 1990s that assumed mean reproduction and survival for polar bears across their range in Canada (given information available at the time) MSY = N * 0 0156/Pr[F], where N = total population number, 0 0156 is a constant derived from a meta-analysis to estimate survival and recruitment rates for Canadian polar bears,

[d] Observed or predicted status as suggested by PVA results and, where vital rates are not sufficient for analysis, anectodatal information

[e] Current status relative to probable historic numbers

Bear-Human Interactions

Polar bears come into conflict with humans when they scavenge for food at sites of human habitation, and also because they occasionally prey or attempt to prey upon humans (Stirling 1988, p. 182). "Problem bears," the bears most associated with human conflicts, are most often subadult bears that are inexperienced hunters and, therefore, that scavenge more frequently than adult bears (Stirling 1988, p. 182). Following subadults, females with cubs are most likely to interact with humans, because females with cubs are likely to be thinner and hungrier than single adult bears, and starving bears are more likely to interact with humans in their pursuit of food (Stirling 1988, p. 182). For example, in Churchill, Manitoba, Canada, an area of high polar bear use, the occurrence of females with cubs feeding at the town's garbage dump in the fall increased during years when bears came ashore in poorer condition (Stirling 1988, p. 182). Other factors that may influence bear-human encounters include increased land use activities, increased human populations in areas of high polar bear activity, increased polar bear concentrations on land, and earlier polar bear departure from ice habitat to terrestrial habitats.

Increased bear-human interactions and defense-of-life kills may occur under predicted climate change scenarios where more bears are on land and in contact with human settlements (Derocher et al. 2004, p. 169). Direct interactions between people and bears in Alaska have increased markedly in recent years, and this trend is expected to continue (Amstrup 2000, p. 153). Since the late 1990s, the timing of complete ice formation in the fall has occurred later in November or early December than it formerly did (September and October), resulting in an increased amount of time polar bears spend on land. This consequently increases the probability of bear-human interactions occurring in coastal villages. Adaptive management programs that focus on the development of community or ecotourism based polar bear-human interaction plans (that include polar bear patrols, deterrent and hazing programs, efforts to manage and minimize sources of attraction, and education about polar bear behavior and ecology) are ongoing in a number of Alaska North Slope communities and should be expanded or further developed for other communities in the future. In four Canadian populations-Western Hudson Bay, Foxe Basin, Baffin Bay, and Davis Strait-Inuit hunters reported seeing more bears in recent years around settlements, hunting camps, and sometimes locations where they had not (or only rarely) been seen before, resulting in an increase in threats to human life and damage to property (Stirling and Parkinson 2006, p. 262).

As discussed in Factor A, Amstrup et al. (2007, p.30) used a first-generation BM model to forecast the range-wide status of polar bears during the 21st century, factoring in a number of stressors, including bear-human interactions. The authors conducted a sensitivity analysis to determine the importance and influence of the stressors on the population forecast. Their analysis indicated that bear-human interactions ranked 7th of potential stressors. Because of the preliminary nature of the BM results, we are more confident in the general direction and magnitude of the projected outcomes rather than the actual numerical probabilities associated with each outcome. Although this factor's singular contribution to a declining population trend was relatively small, it could operate with other mortality factors (such as harvest) in the future to exacerbate the effects of habitat loss. Thus, bear-human interactions should be monitored, and may require additional management actions in the future.

Conclusion for Factor B

Rationale

Polar bears are harvested in Canada, Alaska, Greenland, and Russia. Active harvest management or reporting programs are in place for populations in Canada, Greenland, and Alaska. Principles of sustainable yield are instituted through harvest quotas or guidelines for a number of Canadian populations. Other forms of removal, such as defense-of-life take are considered through management actions by the responsible jurisdictions. Hunting or killing polar bears is illegal in Russia, although an unknown level of harvest occurs, and harvest impacts on Russian populations are generally unknown. While overharvest is occurring for some populations, laws and regulations for most management programs have been instituted and are flexible enough to allow adjustments in order to ensure that harvests are sustainable. These actions are largely viewed as having succeeded in reversing widespread overharvests by many jurisdictions that resulted in population depletion during the period prior to signing of the multilateral 1973 Polar Bear Agreement (Prestrud and Stirling 1994) see additional discussion under Factor D below). For the internationally-shared populations in the Chukchi Sea, Baffin Bay, Kane Basin, and Davis Strait, conservation agreements have been developed (United States-Russia) or are in development (Canada-Greenland), but in making our finding we have not relied on agreements that have not been implemented.

We realize that management agencies will be challenged in the future with managing populations that are declining and under stress from loss of sea ice. We also note that the sensitivity anlaysis conducted by Amstrup et al. (2007, pp. 35, 58) suggests that, for some populations, the effects of habitat and environmental changes will far outweigh the effects of harvest, and consequently, that harvest regulation may have little effect on the ultimate population outcome. For other populations affected to a lesser degree by environmental changes and habitat impacts, effective implementation of existing regulatory mechanisms is necessary to address issues related to overutilization.

Determination for Factor B

We have evaluated the best available scientific and commercial information on the utilization of polar bears for commercial, recreational, scientific, or educational purposes. Harvest, increased bear-human interaction levels, defense-of-life take, illegal take, and take associated with scientific research live-capture programs are occurring for several populations. We have determined that harvest is likely exacerbating the effects of habitat loss in several populations. In addition, polar bear mortality from harvest and negative bear-human interactions may in the future approach unsustainable levels for several populations, especially those experiencing nutritional stress or declining population numbers as a consequence of habitat change. The PBSG (Aars et al. 2006, p. 57), through resolution, urged that a precautionary approach be instituted when setting harvest limits in a warming Arctic environment. Continued efforts are necessary to ensure that harvest or other forms of removal do not exceed sustainable levels. We find, however, that overutilization does not currently threaten the polar bear throughout all or a significant portion of its range.

Factor C. Disease and Predation

Disease

The occurrence of diseases and parasites in polar bears is rare compared to other bears, with the exception of the presence of *Trichinella* larvae, *Trichinella* has been documented in polar bears throughout their range, and, although infestations can be quite high, they are normally not fatal (Rausch 1970, p. 360; Dick and Belosevic 1978, p. 1,143; Larsen and Kjos-Hanssen 1983, p. 95; Taylor et al. 1985, p. 303; Forbes 2000, p. 321). Although rabies is commonly found in Arctic foxes, there has been only one documented case in polar bears (Taylor et al. 1991, p. 337). Morbillivirus has been documented in polar bears from Alaska and Russia (Garner et al. 2000, p. 477; C. Kirk, University of Alaska, Fairbanks, pers. comm. 2006). Antibodies to the protozoan parasite, *Toxoplasma gondii,* were found in Alaskan polar bears; whether this is a health concern for polar bears is unknown (C. Kirk, University of Alaska, Fairbanks, pers. comm. 2006).

Whether polar bears are more susceptible to new pathogens due to their lack of previous exposure to diseases and parasites is also unknown. Many different pathogens and viruses have been found in seal species that are polar bear prey (Duignan et al. 1997, p. 7; Measures and Olson 1999, p. 779; Dubey et al. 2003, p. 278; Hughes-Hanks et al. 2005, p. 1,226), so the potential exists for transmission of these diseases to polar bears. . As polar bears become more nutritionally stressed, they may eat more of the intestines and internal organs of their prey than they presently do, thus increasing potential exposure to parasites and viruses (Derocher et al. 2004, p. 170; Amstrup et al. 2006b, p. 3). In addition, new pathogens may expand their range northward from more southerly areas under projected climate change scenarios (Harvell et al. 2002, p. 60). A warming climate has been associated with increases in pathogens in other marine organisms (Kuiken et al. 2006, p. 322).

Amstrup et al. (2007, p. 87) considered a host of potential stressors, including diseases and parasites, in their status evaluation of polar bears. The influence of parasites and disease agents evaluated in the sensitivity analysis ranked 8th, and made very minor contributions to the projected population status. The authors note, however, that the potential effect of disease and parasites on polar bears would likely increase if the climate continues to warm (Amstrup et al. 2007, p. 21). Parasitic agents that have developmental stages outside the bodies of warm-blooded hosts (e.g., nematodes) will likely benefit from the warmer and wetter weather projected for the Arctic (Macdonald et al. 2005). Significant impacts from such parasites on some Arctic ungulates have been noted. Improved conditions for such parasites already have had significant impacts on some terrestrial mammals (Kutz et al. 2001, p. 771; Kutz et al. 2004). Bacterial parasites also are likely to benefit from a warmer and wetter Arctic. Although increases in disease and parasite agents have not yet been reported in polar bears, they are anticipated, if temperatures continue to warm as projected. Amstrup et al. (2007, p. 31) also indicated that diseases and parasites could operate to exacerbate the effects of habitat loss. Continued monitoring of pathogens and parasites in polar bears is appropriate.

Intraspecific Predation

Intraspecific killing has been reported among all North American bear species (Derocher and Wiig 1999, p. 307; Amstrup et al. 2006b, p. 1). Reasons for intraspecific predation in bear species are poorly understood but thought to include nutrition, and enhanced breeding opportunities in the case of predation on cubs. Although occurrences of infanticide by male polar bears have been well documented (Hansson and Thomassen 1983, p. 248; Larsen 1985, p. 325; Taylor et al. 1985, p. 304; Derocher and Wiig 1999, p. 307), this activity accounts for a small percentage of the cub mortality.

Cannibalism has also been documented in polar bears (Derocher and Wiig 1999, p. 307; Amstrup et al. 2006b, p. 1). Amstrup et al. (2006b, p. 1) observed three instances of cannibalism in the southern Beaufort Sea during the spring of 2004; two involved adult females (one an unusual mortality of a female in a den) and third involved a yearling. This is notable because, throughout a combined 58 years of research, there are no similar observations recorded. Active stalking or hunting preceded the attacks, and all three of the killed bears were wholly or partly consumed. Adult males were believed to be the predator in both attacks. Amstrup et al. (2006b, p. 43) indicated that in general a greater proportion of polar bears in the area where the predation events occurred were in poorer physical condition compared to bears captured in other areas. The authors hypothesized that large adult males may be the first to show effects of nutritional stress which is expected to occur first in more southerly areas, due to significant ice retreat (Skinner et al. 1988, p. 3; Comiso and Parkinson 2004, p. 43; Stroeve et al. 2005, p. 1) . Adult males may be the first to show the effects of nutritional stress because they feed little during the spring mating season and enter the summer in poorer condition than other sex/age classes. Derocher and Wiig (1999, p. 308) documented a similar intraspecific killing and consumption of another polar bear in Svalbard, Norway, which was attributed to relatively high population densities and food shortages. Taylor et al. (1985, p. 304) documented that a malnourished female killed and consumed her own cubs, and Lunn and Stenhouse (1985, p. 1,516) found an emaciated male consuming an adult female polar bear. The potential importance of cannibalism and infanticide for polar bear population regulation is unknown. However, given our current knowledge of disease and predation, we do not believe that these factors are currently having population-level effects.

Another form of intraspecific stress is cross-breeding, or hybridization. The first documented instance of cross-breeding in the wild was reported in the spring of 2006. Rhymer and Simberloff (1996, pp. 83–84) express concerns for cross-breeding in the wild, noting that habitat modification contributing to cross breeding may cause the break-down of reproductive isolation between native species, leading to mixing of gene pools and potential loss of genotypically distinct populations. The authors generally viewed hybridization through introgression (defined as gene flow between populations through hybridization when hybrids cross back to one of the parental populations) as a threat to plant and animal taxa, particularly for morphologically well-defined and evolutionarily isolated taxa. Cross-breeding in the wild is thought to be extremely rare, but cross-breeding may pose additional concerns for population and species viability in the future should the rate of occurrence increase.

Conclusion for Factor C

Rationale

Disease pathogen titers are present in polar bears; however, no epizootic outbreaks have been detected. In addition, forms of intraspecific stress and cannibalism are known to be present with bear species and within polar bears. For polar bears, there is no indication that these stressors have operated to influence population levels in the past. Cannibalism is an indication of intraspecific stress, however we do not believe it has resulted in population level effects.

Determination for Factor C

We have evaluated the best available scientific information on disease and predation, and have determined that disease and predation (including intraspecific predation) do not threaten the species throughout all or any significant portion of its range. Potential for disease outbreaks, an increased possibility of pathogen exposure from changed diet or the occurrence of new pathogens that have moved northward with a warming environment, and increased mortality from cannibalism all warrant continued monitoring and may become more significant threat factors in the future for polar bear populations experiencing nutritional stress or declining population numbers.

Factor D. Inadequacy of Existing Regulatory Mechanisms

Regulatory mechanisms directed specifically at managing many of the threats to polar bears, such as overharvest or disturbance, exist in all of the countries states where the species occurs, as well as between (bilateral and multilateral) range countries.

IUCN/SSC Polar Bear Specialist Group

The Polar Bear Specialist Group (PBSG) is not a regulatory authority nor do they provide any regulatory mechanisms. However, the PBSG contributed significantly to the negotiation and development of the International Agreement on the Conservation of Polar Bears (1973 Polar Bear Agreement), and has been instrumental in monitoring the worldwide status of polar bear populations. Therefore, we believe a discussion of the PBSG is relevant to a current understanding of the status of polar bears worldwide. We did not rely on the PBSG or any actions of the PBSG for determining the status of the polar bear under the Act.

The PBSG operates under the IUCN Species Survival Commission (SSC), and was formed in 1968. The PBSG meets periodically at 3-to 5-year intervals in compliance with Article VII of the 1973 Polar Bear Agreement; said article instructs member parties to conduct national research programs on polar bears, particularly research relating to the conservation and management of the species and, as appropriate, coordinate such research with the research carried out by other parties, consult with other parties on management of migrating polar bear populations, and exchange information on research and management programs, research results, and data on bears taken. The PBSG first evaluated the status of all polar bear populations in 1980. In 1993, 1997, and 2001, the PBSG conducted circumpolar status assessments of polar bear populations, and the results of those assessments were published as part of the proceedings of the relevant PBSG meeting. The PBSG conducted its fifth polar bear status assessment in June 2005.

The PBSG also evaluates the status of polar bears under the IUCN Red List criteria. Previously, polar bears were classified under the IUCN Red List program as: ‘‘Less rare but believed to be threatened/requires watching’’ (1965); ‘‘Vulnerable’’ (1982, 1986, 1988, 1990, 1994); and ‘‘Lower Risk/Conservation Dependent’’ (1996). During the 2005 PBSG working group meeting, the PBSG re-evaluated the status of polar bears and unanimously agreed that a status designation of ‘‘Vulnerable’’ was warranted.

International Agreements and Oversight

International Agreement on the Conservation of Polar Bears

Canada, Denmark (on behalf of Greenland), Norway, the Russian Federation, and the United States are parties to the Agreement on the Conservation of Polar Bears (1973 Polar Bear Agreement) signed in 1973; by 1976, the Agreement was ratified by all parties. The 1973 Polar Bear Agreement requires the parties to take appropriate action to protect the ecosystem of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and to manage polar bear populations in accordance with sound conservation practices based on the best available scientific data. The 1973 Polar Bear Agreement relies on the efforts of each party to implement conservation programs and does not preclude a party from establishing additional controls (Lentfer 1974, p. 1).

The 1973 Polar Bear Agreement is viewed as a success in that polar bear populations recovered from excessive harvests and severe population reductions in many areas (Prestrud and Stirling 1994). At the same time, implementation of the terms of the 1973 Polar Bear Agreement varies across the member parties. Efforts are needed to improve current harvest management practices, such as restricting harvest of females and cubs, establishing sustainable harvest limits, and controlling illegal harvests (Derocher et al. 1998, pp. 47–48). In addition, a lack of protection of key habitats by member parties, with few notable exceptions for some denning areas, is a weakness (Prestrud and Stirling 1994, p. 118).

Inupiat-Inuvialuit Agreement for the Management of Polar Bears of the Southern Beaufort Sea

In January 1988, the Inuvialuit of Canada and the Inupiat of Alaska, groups that both harvest polar bears for cultural and subsistence purposes, signed a management agreement for polar bears of the southern Beaufort Sea. This agreement, based on the understanding that the two groups harvested animals from a single population shared across the international boundary, provides a joint responsibility for conservation and harvest practices (Treseder and Carpenter 1989, p. 4; Nageak et al. 1991, p. 341). Provisions of the agreement include: annual quotas (which may include problem kills); hunting seasons; protection of bears in dens or while constructing dens, and protection of females accompanied by cubs and yearlings; collection of specimens from killed bears to facilitate monitoring of the sex and age composition of the harvest; agreement to meet annually to exchange information on research and management and to set priorities; agreement on quotas for the coming year; and prohibition of hunting with aircraft or large motorized vessels and of trade in products taken in violation of the agreement. In Canada, recommendations and decisions from the Commissioners are then implemented through Community Polar Bear Management Agreements, Inuvialuit Settlement Region Community Bylaws, and NWT Big Game Regulations. In the United States, this agreement is implemented at the local level. Adherence to the agreement's terms in Alaska is voluntary, and levels of compliance may vary. There are no Federal, State, or local regulations that limit the number or type (male, female, cub) of polar bear that may be taken. Brower et al. (2002) analyzed the effectiveness of the Inupiat-Inuvialuit Agreement, and found that it had been successful in maintaining the total harvest and the proportion of females in the harvest within sustainable levels. The authors noted the need to improve harvest monitoring in Alaska and increase awareness of the need to prevent overharvest of females for both countries.

Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population

On October 16, 2000, the United States and the Russian Federation signed a bilateral agreement for the conservation and management of polar bear populations shared between the two countries. The Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population (Bilateral Agreement) expands upon the progress made through the multilateral 1973 Polar Bear Agreement by implementing a unified conservation program for this shared population. The Bilateral Agreement reiterates requirements of the 1973 Polar Bear Agreement and includes restrictions on harvesting denning bears, females with cubs or cubs less than 1 year old, and prohibitions on the use of aircraft, large motorized vessels, and snares or poison for hunting polar bears. The Bilateral Agreement does not allow hunting for commercial purposes or commercial uses of polar bears or their parts. It also commits the parties to the conservation of ecosystems and important habitats, with a focus on conserving polar bear habitats such as feeding, congregating, and denning areas. The Russian government indicates that it is prepared to implement the Bilateral Agreement. On December 9, 2006, the Congress of the United States passed the ''United States—Russia Polar Bear Conservation and Management Act of 2006.'' This Act provides the necessary authority to regulate and manage the harvest of polar bears from the Chukchi Sea population, an essential conservation measure. Ratification documents have been exchanged between the countries, but the United States has yet to designate representatives to the Commission, and we did not rely on this treaty in our assessment as it is not formally implemented. Implementation of the Act will provide numerous conservation benefits for this population, however it does not provide authority or mechanisms to address ongoing loss of sea ice.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty aimed at protecting species at risk from international trade. The CITES regulates international trade in animals and plants by listing species in one of its three appendices. The level of monitoring and regulation to which an animal or plant species is subject depends on the appendix in which the species is listed. Appendix I includes species threatened with extinction that are or may be affected by trade; trade of Appendix I species is only allowed in exceptional circumstances. Appendix II includes species not necessarily now threatened with extinction, but for which trade must be regulated in order to avoid utilization incompatible with their survival. Appendix III includes species that are subject to regulation in at least one country, and for which that country has asked other CITES Party countries for assistance in controlling and monitoring international trade in that species.

Polar bears were listed in Appendix II of CITES on July 7, 1975. As such, CITES parties must determine, among other things, that any polar bear, polar bear part, or product made from polar bear was legally obtained and that the export will not be detrimental to the survival of the species, prior to issuing a permit authorizing the export of the animal, part, or product. The CITES does not itself regulate take or domestic trade of polar bears; however, through its process of monitoring trade in wildlife species and requisite findings prior to allowing international movement of listed species and monitoring programs, the CITES is effective in ensuring that the international movement of listed species does not contribute to the detriment of wildlife populations. All polar bear range states are members to the CITES and have in place the CITES-required Scientific and Management Authorities. The Service therefore has determined that the CITES is effective in regulating the international trade in polar bear, or polar bear parts or products, and provides conservation measures to minimize those potential threats to the species.

Domestic Regulatory Mechanisms

United States

Marine Mammal Protection Act of 1972, as amended

The Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.) (MMPA) was enacted to protect and conserve marine mammals so that they continue to be significant functioning elements of the ecosystem of which they are a part. The MMPA set forth a national policy to prevent marine mammal species or population stocks from diminishing to the point where they are no longer a significant functioning element of the ecosystems.

The MMPA places an emphasis on habitat and ecosystem protection. The habitat and ecosystem goals set forth in the MMPA include: (1) Management of marine mammals (including of polar bears) to ensure they do not cease to be a significant element of the ecosystem to which they are a part; (2) protection of essential habitats, including rookeries, mating grounds, and areas of similar significance ''from the adverse effects of man's action''; (3) recognition that marine mammals ''affect the balance of marine ecosystems in a manner that is important to other animals and animal products,'' and that marine mammals and their habitats should therefore be protected and conserved; and (4) direction that the primary objective of marine mammal management is to maintain ''the health and stability of the marine ecosystem.'' Congressional intent to protect marine mammal habitat is also reflected in the definitions section of the MMPA. The terms ''conservation'' and ''management'' of marine mammals are specifically defined to include habitat acquisition and improvement.

The MMPA established a general moratorium on the taking and importing of marine mammals and a number of prohibitions, which are subject to a number of exceptions. Some of these exceptions include take for scientific purposes, for purposes of public display, for subsistence use by Alaska Natives, and unintentional incidental take coincident with conducting otherwise lawful activities. The Service, prior to issuing a permit authorizing the taking or importing of a polar bear, or a polar bear part or product, for scientific or public display purposes submits each request to a rigorous review, including an opportunity for public comment and consultation with the U.S. Marine Mammal Commision (MMC), as described at 50 CFR 18.31. In addition, in 1994, Congress amended the MMPA to allow for the import of polar bear trophies taken in Canada for personal use providing certain requirements are met. Import permits may only be issued to hunters that are citizens of the United States for trophies they have legally taken from those Canadian polar bear populations the Service has approved as meeting the MMPA requirements, as described at 50 CFR 18.30. The Service has determined that there is sufficient rigor under the regulations at 50 CFR 18.30 and 18.31 to ensure that any activities so authorized are consistent with the conservation of this species and are not a threat to the species.

Take is defined in the MMPA to include the ''harassment'' of marine mammals. ''Harassment'' includes any act of pursuit, torment, or annoyance that ''has the potential to injure a marine mammal or marine mammal stock in the wild'' (Level A harassment), or ''has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering'' (Level B harassment).

The Secretaries of Commerce and of the Interior have primary responsibility for implementing the MMPA. The Department of Commerce, through the National Oceanic and Atmospheric Administration (NOAA), has authority with respect to whales, porpoises, seals, and sea lions. The remaining marine mammals, including polar bears, walruses, sea otters, dugongs, and manatees are managed by the Department of the Interior through the U.S. Fish and Wildlife Service. Both agencies are ''* * * responsible for the promulgation of regulations, the issuance of permits, the conduct of scientific research, and enforcement as necessary to carry out the purposes of [the MMPA].''

Citizens of the United States who engage in a specified activity other than commercial fishing (which is specifically and separately addressed under the MMPA) within a specified geographical region may petition the Secretary of the Interior to authorize the incidental, but not intentional, taking of small numbers of marine mammals within that region for a period of not more than five consecutive years (16 U.S.C. 1371(a)(5)(A)). The Secretary ''shall allow'' the incidental taking if the Secretary finds that ''the total of such taking during each five-year (or less) period concerned will have no more than a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.'' If the Secretary makes the required findings, the Secretary also prescribes regulations that specify (1) permissible methods of taking, (2) means of affecting the least practicable adverse impact on the species, their habitat, and their availability for subsistence uses, and (3) requirements for monitoring and reporting. The regulatory process does not authorize the activities themselves, but authorizes the incidental take of the marine mammals in conjunction with otherwise legal activities.

Similar to promulgation of incidental take regulations, the MMPA also established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals where the take will be limited to harassment (16 U.S.C. 1371(a)(5)(D)). These authorizations are limited to one year and as with incidental take regulations, the Secretary must find that the total of such taking during the period will have no more than a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses. The Service refers to these authorizations as Incidental Harassment Authorizations.

Examples and descriptions of how the Service has analyzed the effects of oil and gas activities and applied the general provisions of the MMPA described above to polar bear conservation programs in the Beaufort and Chukchi Seas are decribed in the *Range Wide Status Review of the Polar Bear* (*Ursus maritimus*) (Schliebe et al. 2006a). These regulations include an evaluation of the cumulative effects of oil and gas industry activities on polar bears from noise, physical obstructions, human encounters, and oil spills. The likelihood of an oil spill occurring and the risk to polar bears is modeled quantitatively and factored into the evaluation. The results of previous industry monitoring programs, and the effectiveness of past detection and deterrent programs that have a beneficial record of protecting polar bears, as well as providing for the safety of oil field workers, are also considered. Based on the low likelihood of an oil spill occurring and the effectiveness of industry mitigation measures within the Beaufort Sea region, the Service has found that oil and gas industry activities have not affected the rates of recruitment or survival for the polar bear populations over the period of the regulations.

General operating conditions in specific authorizations include the following: (1) Protection of pregnant polar bears during denning activities (den selection, birthing, and maturation of cubs) in known and confirmed denning areas; (2) restrictions on industrial activities, areas, time of year; and (3) development of a site-specific plan of operation and a site-specific polar bear interaction plan. Additional requirements may include: pre-activity surveys (e.g., aerial surveys, infra-red thermal aerial surveys, or polar bear scent-trained dogs) to determine the presence or absence of dens or denning activity and, in known denning areas, enhanced monitoring or flight restrictions, such as minimum flight elevations. These and other safeguards and coordination with industry have served to minimize industry effects on polar bears.

Outer Continental Shelf Lands Act

The Outer Continental Shelf Lands Act (43 U.S.C. 1331 et seq.) (OCSLA) established Federal jurisdiction over submerged lands on the Outer Continental Shelf (OCS) seaward of the State boundaries (3-mile limit) in order to expedite exploration and development of oil/gas resources on the OCS in a manner that minimizes impact to the living natural resources within the OCS. Implementation of OCSLA is delegated to the Minerals Management Service (MMS) of the Department of the Interior. The OCS projects that could adversely impact the Coastal Zone are subject to Federal consistency requirements under terms of the Coastal Zone Management Act, as noted below. The OCSLA also mandates that orderly development of OCS energy resources be balanced with protection of human, marine, and coastal environments. The OCSLA does not itself regulate the take of polar bears, although through consistency determinations it helps to ensure that OCS projects do not adversely impact polar bears or their habitats.

Oil Pollution Act of 1990

The Oil Pollution Act of 1990 (33 U.S.C. 2701) established new requirements and extensively amended the Federal Water Pollution Control Act (33 U.S.C. 1301 et. seq.) to provide enhanced capabilities for oil spill response and natural resource damage assessment by the Service. It requires us to consult on developing a fish and wildlife response plan for the National Contingency Plan, input to Area Contingency Plans, review of Facility and Tank Vessel Contingency Plans, and to conduct damage assessments associated with oil spills.

Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.) (CZMA) was enacted to ''preserve, protect, develop, and where possible, to restore or enhance the resources of the Nation's coastal zone.'' The CZMA provides for the submission of a State program subject to Federal approval. The CZMA requires that Federal actions be conducted in a manner consistent with the State's CZM plan to the maximum extent practicable. Federal agencies planning or authorizing an activity that affects any land or water use or natural resource of the coastal zone must provide a consistency determination to the appropriate State agency. The CZMA applies to polar bear habitats of northern and western Alaska. The North Slope Borough and Alaska Coastal Management Programs assist in protection of polar bear habitat through the project review process. The CZMA does not itself regulate the take of polar bears, and, overall, is not determined to be effective at this time in addressing the threats identified in the five factor analysis.

Alaska National Interest Lands Conservation Act

The Alaska National Interest Lands Conservation Act of 1980 (16 U.S.C. 3101 et seq.) (ANILCA) created or expanded National Parks and National Wildlife Refuges in Alaska, including the expansion of the Arctic National Wildlife Refuge (NWR). One of the establishing purposes of the Arctic NWR is to conserve polar bears. Section 1003 of ANILCA prohibits production of oil and gas in the Arctic NWR, and no leasing or other development leading to production of oil and gas may take place unless authorized by an Act of Congress. Most of the Arctic NWR is a federally designated Wilderness, but the coastal plain of Arctic NWR, which provides important polar bear denning habitat, does not have Wilderness status. The ANILCA does not itself regulate the take of polar bears, although through its designations it has provided recognition of, and various levels of protection for, polar bear habitat. In the case of polar bear habitat, the Bureau of Land Management (BLM) is responsible for vast land areas on the North Slope, including the National Petroleum Reserve, Alaska (NPRA). Habitat suitable for polar bear denning and den sites have been identified within NPRA. The BLM considers fish and wildlife values under its multiple use mission in evaluating land use authorizations and prospective oil and gas leasing actions. Provisions of the MMPA regarding the incidental take of polar bears on land areas and waters within the jurisdiction of the United States continue to apply to activities conducted by the oil and gas industry on BLM lands.

Marine Protection, Research and Sanctuaries Act

The Marine Protection, Research and Sanctuaries Act (33 U.S.C. 1401 et seq.) (MPRSA) was enacted in part to ‘‘prevent or strictly limit the dumping into ocean waters of any material that would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.’’ The MPRSA does not itself regulate the take of polar bears. There are no designated marine sanctuaries within the range of the polar bear.

Canada

Canada’s constitutional arrangement specifies that the Provinces and Territories have the authority to manage terrestrial wildlife, including the polar bear, which is not defined as a marine mammal in Canada. The Canadian Federal Government is responsible for CITES-related programs and provides both technical (long-term demographic, ecosystem, and inventory research) and administrative (Federal-Provincial Polar Bear Technical Committee (PBTC), Federal-Provincial Polar Bear Administrative Committee (PBAC), and the National Database) support to the Provinces and Territories. The Provinces and Territories have the ultimate authority for management, although in several areas, the decision-making process is shared with aboriginal groups as part of the settlement of land claims. Regulated hunting by aboriginal people is permissible under Provincial and Territorial statutes (Derocher et al. 1998, p. 32) as described in Factor B.

In Manitoba, most denning areas have been protected by inclusion within the boundaries of Wapusk National Park. In Ontario, some denning habitat and coastal summer sanctuary habitat are included in Polar Bear Provincial Park. Some polar bear habitat is included in the National Parks and National Park Reserves and territorial parks in the Northwest Territories, Nunavut, and Yukon Territory (e.g., Herschel Island). While these parks and preserves provide some protection for terrestrial habitat, subsistence hunting activities are allowed in these areas. Additional habitat protection measures in Manitoba include restrictions on harassment and approaching dens and denning bears, and a land use permit review that considers potential impacts of land use activities on wildlife (Derocher et al. 1998, p. 35). The measures adopted by the Government of Manitoba have been effective on a site-specific basis. In addition, the Government of Manitoba has recently listed the polar bear as a threatened species in that province; however, we have no information on whether this designation provides any additional regulatory protection for the species.

Species at Risk Act

Canada’s Species at Risk Act (SARA) became law on December 12, 2002, and went into effect on June 1, 2004 (Walton 2004, p. M1–17). Prior to SARA, Canada’s oversight of species at risk was conducted through the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) which continues to function under SARA and through the Ministry of Environment. COSEWIC evaluates species status and provides recommendations to the Minister of the Environment, who makes final listing decisions and identifies species-specific management actions. The SARA provides a number of protections for wildlife species placed on the List of Wildlife Species at Risk, or ‘‘Schedule 1’’ (SARA Registry 2005). The listing criteria used by COSEWIC are based on the 2001 IUCN Red List assessment criteria (Appendix 3). Currently, under SARA the polar bear is designated as a Schedule 3 species, ‘‘Species of Special Concern,’’ awaiting re-assessment and public consultation for possible up-listing to Schedule 1 (Environment Canada 2005). A Schedule 3 listing under SARA does not include protection measures, whereas a Schedule 1 listing under SARA may include protection measures. We did not rely on this potential in our analysis as the action has not yet occurred.

Intra-jurisdiction Polar Bear Agreements Within Canada

Polar bears occur in the Northwest Territories (NWT), Nunavut, Yukon Territory, and in the Provinces of Manitoba, Ontario, Quebec, Newfoundland, and Labrador (see Figure 1 above). All 13 Canadian polar bear populations lie within or are shared with the NWT or Nunavut. The NWT and Nunavut geographical boundaries include all Canadian lands and marine environment north of the 60th parallel (except the Yukon Territory), and all islands and waters in Hudson Bay and Hudson Strait up to the low water mark of Manitoba, Ontario, and Quebec. The offshore marine areas along the coast of Newfoundland and Labrador are under Federal jurisdiction. Although Canada manages each of the 13 populations of polar bear as separate units, there is a complex sharing of responsibilities. While wildlife management has been delegated to the Provincial and Territorial Governments, the Federal Government (Environment Canada’s Canadian Wildlife Service) has an active research program and is involved in management of wildlife populations shared with other jurisdictions, especially ones with other nations. In the NWT, Native Land Claims resulted in Co-management Boards for most of Canada’s polar bear populations. Canada formed the PBTC and PBAC to ensure a coordinated management process consistent with internal and international management structures and the International Agreement. The committees meet annually to review research and management of polar bears in Canada and have representation from all Provincial and Territorial jurisdictions with polar bear populations and the Federal Government. Beginning in 1984, the Service and biologists from Norway and Denmark have, with varying degrees of frequency, participated in annual PBTC meetings. The annual meetings of the PBTC provide for continuing cooperation between jurisdictions and for recommending management actions to the PBAC (Calvert et al. 1995, p. 61).

The NWT Polar Bear Management Program (GNWT) manages polar bears in the Northwest Territories. A 1960 ‘‘Order-in-Council’’ granted authority to the Commissioner in Council (NWT) to pass ordinances to protect polar bears, including the establishment of a quota system. The Wildlife Act, 1988, and Big Game Hunting Regulations provide supporting legislation which addresses each polar bear population. The Inuvialuit and Nunavut Land Claim

Agreements supersede the Northwest Territories Act (Canada) and the Wildlife Act. The Government of Nunavut passed a new Wildlife Act in 2004 and has management and enforcement authority for polar bears in their jurisdiction. Under the umbrella of this authority, polar bears are now co-managed through wildlife management boards made up of Land Claim Beneficiaries and Territorial and Federal representatives. The Boards may develop Local Management Agreements (LMAs) between the communities that share a population of polar bears. Management agreements are in place for all Nunavut populations. The LMAs are signed between the communities, regional wildlife organizations, and the Government of Nunavut (Department of Environment) but can be over-ruled by the Nunavut Wildlife Management Board (NWMB).

In the case of populations that Nunavut shares with Quebec and Ontario, the management agreement is not binding upon residents of communities outside of Nunavut jurisdiction. Similarly, in the case of populations that Nunavut shares with Manitoba, or Newfoundland and Labrador, the management agreement is not binding upon residents of communities outside of Nunavut jurisdiction. Regulations implementing the LMAs specify who can hunt, season timing and length, age and sex classes that can be hunted, and the total allowable harvest for a given population. The Department of Environment in Nunavut and the Department of Environment and Natural Resources in the NWT have officers to enforce the regulations in most communities of the NWT. The officers investigate and prosecute incidents of violation of regulations, kills in defense of life, or exceeding a quota (USFWS 1997). Canada's inter-jurisdictional requirements for consultation and development of LMAs and oversight through the PBTC and PBAC have resulted in conservation benefits for polar bear populations. Although there are some localized instances where changes in management agreements may be necessary, these arrangements and provisions have operated to minimize the threats of overharvest to the species.

The Service analyzed the overall efficacy of Canada's management of polar bears in 1997 (62 FR 7302) and 1999 (64 FR 1529) and determined, at those times, that the species was managed by Canada using sound scientific principles and in such a manner that existing populations would be sustained. We continue to believe that, in general, Canada manages polar bears in an effective and sustainable manner. However, as discussed above (see ''Harvest Management by Nation''), the Territory of Nunavut has recently adopted changes to polar bear management, including some increased harvest quotas, that may place a greater significance on indigenous knowledge than on scientific data and analysis. Management improvements may be desirable for some Canadian populations. The Service will continue to monitor polar bear management in Canada and actions taken by the Nunavut Government. This is particularly important for populations that are currently in decline or may decline in the near future.

Russian Federation

Polar bears are listed in the second issue of the Red Data Book of the Russian Federation (2001). The Red Data Book establishes official policy for protection and restoration of rare and endangered species in Russia. Polar bear populations inhabiting the Barents Sea and part of the Kara Sea (Barents-Kara population) are designated as Category IV (uncertain status); polar bears in the eastern Kara Sea, Laptev Sea, and the western Eastern Siberian Sea (Laptev population) are listed as Category III (rare); and polar bears inhabiting the eastern part of the Eastern Siberian Sea, Chukchi Sea, and the northern portion of the Bering Sea (Chukchi population) are listed as Category V (restoring). The main government body responsible for management of species listed in the Red Data Book is the Ministry of Natural Resources of the Russian Federation. Russia Regional Committees of Natural Resources are responsible for managing polar bear populations consistent with Federal legislation (Belikov et al. 2002, p. 86).

Polar bear hunting has been totally prohibited in the Russian Arctic since 1956 (Belikov et al. 2002, p. 86). The only permitted take of polar bears is catching cubs for public zoos and circuses. There are no data on illegal trade of polar bears, and parts and products derived from them, although considerable concern persists for unquantified levels of illegal harvest that is occurring (Belikov et al. 2002, p. 87).

In the Russian Arctic, Natural Protected Areas (NPAs) have been established that protect marine and associated terrestrial ecosystems, including polar bear habitats. Wrangel and Herald Islands have high concentrations of maternity dens and polar bears, and were included in the Wrangel Island State Nature Reserve (zapovednik) in 1976. A 1997 decree by the Russian Federation Government established a 12-nautical mile (nm) (22.2 km) marine zone to the Wrangel Island State Nature Reserve; the marine zone was extended an additional 24-nm (44.4-km) to a total of 36-nm (66.7-km) by a decree from the Governor of Chukotsk Autonomous Okruga (Belikov et al. 2002, p. 87). The Franz Josef Land State Nature Refuge was established in 1994. In 1996, a federal nature reserve (zakaznik) was established on Severnaya Zemlya archipelago. In Chukotka, efforts are underway to establish new protected areas where polar bears aggregate seasonally; other special protected areas are proposed for the Russian High Arctic including the Novosibirsk Islands, Severnaya Zemlya, and Novaya Zemlya. However, because they have not yet been designated, protections that may be afforded the polar bear under these designations have not been considered in our evaluation of the adequacy of existing regulatory mechanisms. Within these protected areas, conservation and restoration of terrestrial and marine ecosystems, and plant and animal species (including the polar bear), are the main goals. In 2001, the Nenetskiy State Reserve, which covers 313,400 ha (774,428 ac), and includes the mouth of the Pechora River and adjacent waters of the Barents Sea, was established.

In May 2001, the Federal law ''Concerning territories of traditional use of nature by small indigenous peoples of North, Siberia, and Far East of the Russian Federation'' was passed. This law established areas for traditional use of nature (TTUN) within NPAs of Federal, regional, and local levels to support traditional life styles and traditional subsistence use of nature resources for indigenous peoples. This law and the law ''Concerning natural protected territories'' (1995) regulate protection of plants and animals on the TTUNs. The latter also regulates organization, protection and use of other types of NPAs: State Nature Reserves (including Biosphere Reserves), National Parks, Natural Parks, and State Nature Refuges. Special measures on protection of polar bears or other resources may be governed by specific regulations of certain NPAs.

Outside NPAs, protection and use of marine renewable natural resources are regulated by Federal legislation; Acts of the President of the Russian Federation; regulations of State Duma, Government, and Federal Senate of the Russian Federation; and regulations issued by appropriate governmental departments. The most important Federal laws for nature protection are: ''About environment protection'' (2002), ''About animal world'' (1995), ''About continental shelf of the Russian Federation'' (1995), ''About exclusive economical zone of the Russian Federation'' (1998), and ''About internal sea waters, territorial sea, and adjacent zone of the Russian Federation'' (1998) (Belikov et al. 2002, p. 87). The effectiveness of laws protecting marine and nearshore environments is unknown.

Norway

According to the Svalbard Treaty of February 9, 1920, Norway exercises full and unlimited sovereignty over the Svalbard Archipelago. Polar bears have complete protection from harvest under the Svalbard Treaty (Derocher et al. 2002b, p. 75), which is effectively implemented. The Svalbard Treaty applies to all the islands situated between 10 degree and 35 degrees East longitude and between 74 degrees and 81 degrees North latitude, and includes the waters up to 4 nm offshore. Beyond this zone, Norway claims an economic zone to the continental shelf areas to which Norwegian law applies. Under Norwegian Game Law, all game, including polar bears, are protected unless otherwise stated (Derocher et al. 2002b, p. 75). The main responsibility for the administration of Svalbard lies with the Norwegian Ministry of Justice. Norwegian civil and penal laws and various other regulations are applicable to Svalbard. The Ministry of Environment deals with matters concerning the environment and nature conservation. The Governor of Svalbard (Sysselmannen), who has management responsibilities for freshwater fish and wildlife, pollution and oil spill protection, and environmental monitoring, is the cultural and environmental protection authority in Svalbard (Derocher et al. 2002b, p. 75).

Approximately 65 percent of the land area of Svalbard is totally protected, including all major regions of denning by female bears; however, protection of habitat is only on land and to 4 nm offshore. Marine protection was increased in 2004, when the territorial border of the existing protected areas was increased to 12 nm (Aars et al. 2006, p. 145). Norway claims control of waters out to 200 nm and regards polar bears as protected within this area.

In 2001, the Norwegian Parliament passed a new Environmental Act for Svalbard which went into effect in July 2002. This Act was designed to ensure that wildlife, including polar bears, is protected, although hunting of some other species is allowed. The only permitted take of polar bears is for defense of life. The regulations included specific provisions on harvesting, motorized traffic, remote camps and camping, mandatory leashing of dogs, environmental pollutants, and environmental impact assessments in connection with planning development or activities in or near settlements. Some of these regulations were specific to the protection of polar bears, e.g., through enforcement of temporal and spatial restrictions on motorized traffic and through provisions on how and where to camp to ensure adequate bear security (Aars et al. 2006, p. 145).

In 2003, Svalbard designated six new protected areas, two nature reserves, three national parks and one ''biotope protection area.'' The new protected areas are mostly located around Isfjord, the most populated fjord on the west side of the archipelago. Another protected area, Hopen, is an important denning area (Aars et al. 2006, p. 145). Kong Karls Land is the main denning area and has the highest level of protection under the Norwegian land management system. These new protected areas cover 4,449 sq km (1,719 sq mi) which is 8 percent of the Archipelago's total area (*http://www.norway.org/News/archive/2003/200304svalbard.htm*), and increase the total area under protection to 65 percent of the total land area.

Denmark/Greenland

Under terms of the Greenland Home Rule (1979), the government of Greenland is responsible for management of all renewable resources, including polar bears. Greenland is also responsible for providing scientific data for sound management of polar bear populations and for compliance with terms of the 1973 Polar Bear Agreement. Regulations for the management and protection of polar bears in Greenland that were introduced in 1994 have been amended several times (Jensen 2002, p. 65). Hunting and reporting regulations include who can hunt polar bears (residents who live off the land), protection of family groups with cubs of the year, prohibition of trophy hunting, mandatory reporting requirements, and regulations on permissible firearms and means of transportation (Jensen 2002, p. 65). In addition, there are specific regulations that apply to traditional take within the National Park of North and East Greenland and the Melville Bay Nature Reserve. A large amount of polar bear habitat occurs within the National Park of North and East Greenland. One preliminary meeting between Greenland Home Rule Government and Canada (with the participation of the government of Nunavut) has occurred to discuss management of shared populations. Greenland introduced a quota system that took effect on January 1, 2006 (L°nstrup 2005, p. 133), although no scientifically supportable quotas have yet been developed. Some reconsideration to allow a limited sport hunt is under discussion within the Greenland governmental organizations. We have no information upon which to base a finding that Greenland is managing polar bear hunting activities in a manner that provides for sustainable populations.

Regulatory Mechanisms to Limit Sea Ice Loss

Although there are regulatory mechanisms for managing many of the threats to polar bears in all countries where the species occurs, as well as among range countries through bilateral and multilateral agreements, there are no known regulatory mechanisms that are directly and effectively addressing reductions in sea ice habitat at this time.

National and international regulatory mechanisms to comprehensively address the causes of climate change are continuing to be developed. International efforts to address climate change globally began with the United Nations Framework Convention on Climate Change (UNFCCC), adopted in May 1992. The stated objective of the UNFCCC is the stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Kyoto Protocol, negotiated in 1997, became the first additional agreement added to the UNFCCC to set GHG emissions targets. The Kyoto Protocol entered into force in February 2005 for signatory countries.

Domestic U.S. efforts relative to climate change focus on implementation of the Clean Air Act, and continued studies programs, support for developing new technologies and use of incentives for supporting reductions in emissions.

The recent publication by Canadell et al. (2007) underscores the current deficiencies of regulatory mechanisms in addressing root causes of climate change. This paper, in the *Proceedings of the National Academy of Sciences,* indicates that the growth rate of atmospheric carbon dioxide (CO_2), the largest anthropogenic source of GHGs, is increasing rapidly. Increasing atmospheric CO_2 concentration is consistent with the results of climate-carbon cycle models, but the magnitude of the observed CO_2 concentration is larger than that estimated by models. The authors suggest that these changes ''characterize a carbon cycle that is generating stronger-than-expected and sooner-than-expected climate forcing'' (Canadell et al. 2007).

Conclusion for Factor D

Rationale

Our review of existing regulatory mechanisms at the national and international level has led us to determine that potential threats to polar bears from direct take, disturbance by humans, and incidental or harassment take are, for the most part, adequately addressed through international agreements, national, State, Provincial or Territorial legislation, and other regulatory mechanisms.

As described under Factor A, the primary threat to the survival of the polar bear is loss of sea ice habitat and its consequences to polar bear populations. Our review of existing regulatory mechanisms has led us to determine that, although there are some existing regulatory mechanisms to address anthropogenic causes of climate change, there are no known regulatory mechanisms in place at the national or international level that directly and effectively address the primary threat to polar bears-the rangewide loss of sea ice habitat.

Determination for Factor D

After evaluating the best available scientific information, we have determined that existing regulatory mechanisms at the national and international level are adequate to address actual and potential threats to polar bears from direct take, disturbance by humans, and incidental or harassment take.

We note that GHG loading in the atmosphere can have a considerable lag effect on climate, so that what has already been emitted will have impacts out to 2050 and beyond (IPCC 2007, p. 749; J. Overland, NOAA, in litt. to the Service, 2007)). This is reflected in the similarity of low, medium, and high SRES emissions scenarios out to about 2050 (see Figure 5). As noted above, the publication of Canadell et al. (2007) underscores the current deficiencies of regulatory mechanisms in addressing root causes of climate change. This paper indicates that the growth rate of atmospheric carbon dioxide (CO_2), the largest anthropogenic source of GHGs, is increasing rapidly. Increasing atmospheric CO_2 concentration is consistent with the results of climate-carbon cycle models, but the magnitude of the observed CO_2 concentration is larger than that estimated by models (Canadell et al. 2007). We have determined that there are no known regulatory mechanisms in place at the national or international level that directly and effectively address the primary threat to polar bears-the rangewide loss of sea ice habitat within the foreseeable future. We also acknowledge that there are some existing regulatory mechanisms to address anthropogenic causes of climate change, and these mechanisms are not expected to be effective in counteracting the worldwide growth of GHG emissions within the foreseeable future.

Factor E. Other Natural or Manmade Factors Affecting the Polar Bear's Continued Existence

Contaminants

Understanding the potential effects of contaminants on polar bears in the Arctic is confounded by the wide range of contaminants present, each with different chemical properties and biological effects, and the differing geographic, temporal, and ecological exposure regimes impacting each of the 19 polar bear populations. Further, contaminant concentrations in polar bear tissues differ with polar bears' age, sex, reproductive status, and other factors. Contaminant sources and transport; geographical, temporal patterns and trends; and biological effects are detailed in several recent Arctic Monitoring and Assessment Program (AMAP) publications (AMAP 1998; AMAP 2004a; AMAP 2004b; AMAP 2005). Three main groups of contaminants in the Arctic are thought to present the greatest potential threat to polar bears and other marine mammals: petroleum hydrocarbons, persistent organic pollutants (POPS), and heavy metals.

Petroleum Hydrocarbons

The principal petroleum hydrocarbons in the Arctic include crude oil, refined oil products, polynuclear aromatic hydrocarbons, and natural gas and condensates (AMAP 1998, p. 661). Petroleum hydrocarbons come from both natural and anthropogenic sources. The primary natural source is oil seeps. AMAP (2007, p. 18) notes that ''natural seeps are the major source of petroleum hydrocarbon contamination in the Arctic environment.'' Anthropogenic sources include activities associated with exploration, development, and production of oil (well blowouts, operational discharges), ship- and land-based transportation of oil (oil spills from pipelines, accidents, leaks, and ballast washings), discharges from refineries and municipal waste water, and combustion of wood and fossil fuels. In addition to direct contamination, petroleum hydrocarbons are transported from more southerly areas to the Arctic via long range atmospheric and oceanic transport, as well as by north-flowing rivers (AMAP 1998, p. 671).

Polar bears are particularly vulnerable to oil spills due to their inability to effectively thermoregulate when their fur is oiled, and to poisoning that may occur from ingestion of oil while from grooming or eating contaminated prey (St. Aubin 1990, p. 237). In addition, polar bears are curious and are likely to investigate oil spills and oil-contaminated wildlife. Under some circumstances polar bears are attracted to offshore drilling platforms (Stirling 1988, p. 6; Stirling 1990, p. 230). Whether healthy polar bears in their natural environment would avoid oil spills and contaminated seals is unknown; hungry polar bears are likely to scavenge contaminated seals, as they have shown no aversion to eating and ingesting oil (St. Aubin 1990, p. 237; Derocher and Stirling 1991, p. 56). Polar bears are generally known to be attracted to various refined hydrocarbon products such as anti-freeze, hydraulic fluids, etc., and may consume them, which in some instances has resulted in death (Amstrup et al. 1989).

The most direct exposure of polar bears to petroleum hydrocarbons would come from direct contact with and ingestion of oil from acute and chronic oil spills. Polar bears' range overlaps with many active and planned oil and gas operations within 40 km (25 mi) of the coast or offshore. In the past, no large volume major oil spills of more than 3,000 barrels have occurred in the marine environment within the range of polar bears. Oil spills associated with terrestrial pipelines have occurred in the vicinity of polar bear habitat, including denning areas (e.g., Russian Federation, Komi Republic, 1994 oil spill, *http://www.american.edu/ted/KOMI.HTM*). Despite numerous safeguards to prevent spills, smaller spills do occur. An average of 70 oil and 234 waste product spills per year occurred between 1977 and 1999 in the North Slope oil fields (71 FR 14456). Many spills are small (less than 50 barrels) by oil and gas industry standards, but larger spills (greater than or equal to 500 barrels) account for much of the annual volume. The largest oil spill to date on the North Slope oil fields in Alaska (estimated volume of approximately 4,786 barrels) occurred on land in March 2006, and resulted from an undetected leak in a corroded pipeline (see State of Alaska Prevention and Emergency Response web site (*http://www.dec.state.ak.us/spar/perp/*

response/sum_fy06/060302301/060302301_index.htm).

The MMS (2004, pp. 10, 127) 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. The Minerals Management Service (MMS) prepared an EIS on the *Chukchi Sea Planning Area; Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea;* they determined that polar bears could be affected by both routine activities and a large oil spill (MMS 2007, pp. ES 1–10). Regarding routine activities, the EIS determined that small numbers of polar bears could be affected by ''noise and other disturbance caused by exploration, development, and production activities'' (MMS 2007, p. ES–4). In addition, the EIS evaluated events that would be possible over the life of the hypothetical development and production that could follow the lease sale, and estimated that ''the chance of a large spill greater than or equal to 1,000 barrels occurring and entering offshore waters is within a range of 33 to 51 percent.'' If a large spill were to occur, the analysis conducted as part of the EIS process identified potentially significant impacts to polar bears occurring in the area affected by the spill; the evaluation was done without regard to the effect of mitigating measures (MMS 2007, p. ES–4).

Oil spills in the fall or spring during the formation or break-up of sea ice present a greater risk because of difficulties associated with clean up during these periods, and the presence of bears in the prime feeding areas over the continental shelf. Amstrup et al. (2000a, p. 5) concluded that the release of oil trapped under the ice from an underwater spill during the winter could be catastrophic during spring break-up if bears were present. During the autumn freeze-up and spring break-up periods, any oil spilled in the marine environment would likely concentrate and accumulate in open leads and polynyas, areas of high activity for both polar bears and seals (Neff 1990, p. 23). This would result in an oiling of both polar bears and seals (Neff 1990, pp. 23–24; Amstrup et al. 2000a, p. 3; Amstrup et al. 2006a, p. 9).

The MMS operating regulations require that Outer Continental Shelf (OCS) activities are carried out in a safe and environmentally sound manner to prevent harm, damage or waste of, any natural resources any life (including marine mammals such as the polar bear), property, or the marine, coastal, or human environment. Regulations for exploration, development, and production operations on the OCS are specified in 30 CFR part 250. These regulations provide measures for pollution prevention and control, including drilling procedures specific to individual wells, redundant safety and pollution prevention equipment, blowout preventers and subsurface safety valves, training of the drilling crews, and structural and safety system review of production facilities. Regulations related to oil-spill prevention and response are specified in 30 CFR part 254.

As previously discussed in the ''Oil and Gas Exploration, Development, and Production'' section, the actual history of oil and gas activities in the Beaufort and Chukchi Seas demonstrate that operations have been done safely and with a negligible effect on wildlife and the environment. On the Beaufort and Chukchi OCS, 35 exploratory wells have been drilled. During this drilling period, approximately 26.7 barrels of petroleum product have been spilled, and, of those 26.7 barrels, approximately 24 barrels were recovered or cleaned up. MMS and industry standards require strict protection measures during production of energy resources. For example, although it is located in State of Alaska waters, the shared State/Federal Northstar production facility used a specially-fabricated pipe that was buried 7–11 ft below the sea floor to prevent damage from ice keels, is pigged (the practice of using pipeline inspection gauges or 'pigs' to perform various operations on a pipeline without stopping the flow of the product in the pipeline), and has several different monitoring systems to detect spills.

In addition, NOAA and the Service require monitoring and avoidance measures for marine mammals during critical times during exploration and production. The Marine Mammal Observers (MMO) are required by NOAA and the Service to be on deck watching for animals. Depending on the activity and the particular circumstances, operations may be temporarily halted or modified. In some circumstances, hazing may be used to keep the polar bears away from operations. There are specific guidelines the MMO follow for observing and hazing. Hazing is only used to protect the safety of humans or the marine mammal.

Prior to any exploration, development, or production activities, companies must submit an Exploration Plan or a Development/Production Plan to MMS for review and approval. In Alaska, MMS provides a copy of all such plans to the Service for review. Prior to conducting drilling operations, the operator must also obtain approval for an Application for Permit to Drill (APD). The APD requires detailed information on the seafloor and shallow seafloor conditions for the drill site from shallow geophysical and, if necessary, archaeological and biological surveys. The APD requires detailed information about the drilling program to allow evaluation of operational safety and pollution-prevention measures. The lessee must use the best available and safest technology to minimize the potential for uncontrolled well flow, through the use of blowout preventers. For example, the operator also must identify procedures to curtail operations during critical ice or weather conditions.

In addition, the MMS identifies additional protection measures for the polar bear through the use of Information to Lessees (ITL). Lessees are advised that incidental take of marine mammals is prohibited unless authorization is received under the MMPA. For example, for Sale 193 in the Chukchi Sea, potential lessees were advised to obtain MMPA authorizations from FWS and to consult with the Service, local Native communities and the Alaska Nanuuq Commission during exploration, production and spill response planning, to assure adequate protection for the polar bear. Lessees are specifically advised to conduct their activities in a way that will limit potential encounters and interaction between lease operations and polar bears.

For production, the lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to ensure their structural integrity for the safe conduct of operations at specific locations. All tubing installations open to hydrocarbon-bearing zones below the surface must be equipped with safety devices that will shut off the flow from the well in the event of an emergency, unless the well is incapable of flowing. All surface production facilities must be designed, installed, and maintained in a manner that provides for efficiency, safety of operations, and protection of the environment, including marine mammals.

Pipeline-permit applications to MMS include the pipeline location drawing, profile drawing, safety schematic drawing, pipe-design data to scale, a shallow-hazard-survey report, and an archaeological report. The MMS evaluates the design and fabrication of the pipeline. No pipeline route will be approved by MMS if any bottom-disturbing activities (from the pipeline itself or from the anchors of lay barges and support vessels) encroach on any biologically sensitive areas. The operators are required to monitor and inspect pipelines by methods prescribed by MMS for any indication of pipeline leakage.

MMS conducts onsite inspections to ensure compliance with plans and with the MMS pollution prevention regulations. It has been practice in Alaska to have an MMS inspector onboard drilling vessels during key drilling procedures.

In compliance with 30 CFR part 254, all owners and operators of oil-handling, oil-storage, or oil-transportation facilities located seaward of the coastline must submit an Oil Spill Response Plan to MMS for approval. Owners or operators of offshore pipelines are required to submit a plan for any pipeline that carries oil, condensate that has been injected into the pipeline, or gas and naturally occurring condensate.

Increases in circumpolar Arctic oil and gas development, coupled with increases in shipping and/or development of offshore and land-based pipelines, increase the potential for an oil spill to negatively affect polar bears and/or their habitat. Future declines in the Arctic sea ice may result in increased tanker traffic in high bear use areas (Frantzen and Bambulyak 2003, p. 4), which would increase the chances of an oil spill from a tanker accident, ballast discharge, or discharges during the loading and unloading of oil at the ports. Amstrup et al. (2007, p. 31) assumed that human activities related to oil and gas exploration and development are likely to increase with disappearance of sea ice from many northern areas. At the same time, less sea ice will facilitate an increase in offshore developments. More offshore development will increase the probability of hydrocarbon discharges into polar bear habitat (Stirling 1990, p. 228). The record of over 30 years of predominantly terrestrial oil and gas development in Alaska suggests that with proper management, potential negative effects of these activities on polar bears can be minimized (Amstrup 1993, p. 250; Amstrup 2000, pp. 150–154; Amstrup 2003, pp. 597, 604; Amstrup et al. 2004, p. 23) (for details see the ‘‘Oil and Gas Exploration, Development, and Production’’ section of this final rule). Increased industrial activities in the marine environment will require additional monitoring.

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 (e.g., 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. (2006a, p.21) 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. 2006a, pp. 7, 22; 65 FR 16833). The sustainable harvest yield per year for the Southern Beaufort Sea 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, p. 107). 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 population-level effects.

The number of polar bears affected by an oil spill could be substantially higher if the spill spread to areas of seasonal polar bear concentrations, such as the area near Kaktovik, Alaska, in the fall, and could have a significant impact to the Southern Beaufort Sea polar bear population. It seems likely that an oil spill would affect ringed seals the same way the Exxon Valdez oil spill affected harbor seals (Frost et al. 1994a, pp. 108–110; Frost et al. 1994b, pp. 333–334, 343–344, 346–347; Lowry et al. 1994, pp. 221–222; Spraker et al. 1994, pp. 300–305). As with polar bears, the number of animals killed would vary depending upon the season and spill size (NRC 2003, pp. 168–169). Oil spills remain a concern for polar bears throughout their range. Increased industrial activities in the marine environment will require additional monitoring. Oil and gas exploration, development, and production effects on polar bears and their habitat are discussed under Factor A.

Persistent Organic Pollutants (POPs)

Contamination of the Arctic and sub-Arctic regions through long-range transport of persistent organic pollutants has been recognized for over 30 years (Bowes and Jonkel 1975, p. 2,111; de March et al. 1998, p. 184; Proshutinsky and Johnson 2001, p. 68; MacDonald et al. 2003, p. 38). These compounds are transported via large rivers, air, and ocean currents from the major industrial and agricultural centers located at more southerly latitudes (Barrie et al. 1992; Li et al. 1998, pp. 39–40; Proshutinsky and Johnson 2001, p. 68; Lie et al. 2003, p. 160). The presence and persistence of these contaminants within the Arctic is dependent on many factors, including transport routes, distance from source, and the quantity and chemical composition of the releases. Climate change may increase long-range marine and atmospheric transport of contaminants (Macdonald et al. 2003, p. 5; Macdonald et al 2005, p.15). For example, increased rainfall in northern regions has increased river discharges into the Arctic marine environment. Many north-flowing rivers originate in heavily industrialized regions and carry heavy contaminant burdens (Macdonald et al. 2005, p. 31).

The Arctic ecosystem is particularly sensitive to environmental contamination due to the slower rate of breakdown of persistent organic pollutants, including organochlorine (OC) compounds, the relatively simple food chains, and the presence of long-lived organisms with low rates of reproduction and high lipid levels. The persistence and tendency of OCs to reside and concentrate in fat tissues of organisms increases the potential for bioaccumulation and biomagnification at higher trophic levels (Fisk et al. 2001, pp. 225–226). Polar bears, because of their position at the top of the Arctic marine food chain, have some of the highest concentrations of OCs of any Arctic mammals (Braune et al. 2005, p. 23). Considering the potential for increases in both local and long-range transport of contaminants to the Arctic, with warmer climate and less sea ice, the influence these activities have on polar bears is likely to increase.

The most studied POPs in polar bears include polychlorinated biphenyls (PCBs), chlordanes (CHL), DDT and its metabolites, toxaphene, dieldrin, hexachloroabenzene (HCB), hexachlorocyclohexanes (HCHs), and chlorobenzenes (ClBz). Overall, the relative proportion of the more recalcitrant compounds, such as PCB 153 and β-HCH, appears to be increasing in polar bears (Braune et al. 2005, p. 50).

Although temporal trend information is lacking, newer compounds, such as polybrominated diphenyl ethers (PBDEs), polychlorinated naphthalenes (PCNs), perflouro-octane sulfonate (PFOsS), perfluoroalkyl acids (PFAs), and perflourocarboxylic acids (PFCAs), have been recently found in polar bears (Braune et al. 2005, p. 5). Of this relatively new suite of compounds, there is concern that both PFOsS, which are increasing rapidly, and PBDEs are a potential risk to polar bears (Ikonomou et al. 2002, p. 1,886; deWit 2002, p. 583; Martin et al. 2004, p. 373; Braune et al. 2005, p. 25; Smithwick et al. 2006, p. 1,139).

Currently, polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and dioxin-like PCBs are at relatively low concentrations in polar bears (Norstrom et al. 1990, p. 14). The highest PCB concentrations have been found in polar bears from the Russian Arctic (Franz Joseph Land and the Kara Sea), with decreasing concentrations to the east and west (Andersen et al. 2001, p. 231). Overall, there is evidence of declines in PCBs for most polar bear populations. The pattern of distribution for most other chlorinated hydrocarbons and metabolites generally follows that of PCBs, with the highest concentrations of DDT-related compounds and CHLs in Franz Joseph Land and the Kara Sea, followed by East Greenland, Svalbard, the eastern Canadian Arctic populations, the western Canadian populations, the Siberian Sea, and finally the lowest concentrations in Alaska populations (Bernhoft et al. 1997; Norstrom et al. 1998, p. 361; Andersen et al. 2001, p. 231; Kucklick et al. 2002, p. 9; Lie et al. 2003, p. 159; Verreault et al. 2005, pp. 369–370; Braune et al. 2005, p. 23).

The polybrominated diphenyl ethers (PBDEs) share similar physical and chemical properties with PCBs (Wania and Dugani 2003, p. 1,252; Muir et al. 2006, p. 449), and are thought to be transported to the Arctic by similar pathways. Muir et al. (2006, p. 450) analyzed archived samples from Dietz et al. (2004) and Verreault et al. (2005) for PBDE concentrations, finding the highest mean PBDE concentrations in female polar bear adipose tissue from East Greenland and Svalbard. Lower concentrations of PBDEs were found in adipose tissue from the Canadian and Alaskan populations (Muir et al. 2006, p. 449). Differences between the PBDE concentrations and composition in liver tissue between the Southern Beaufort Sea and the Chukchi Seas populations in Alaska suggest differences in the sources of PBDEs exposure (Kannan et al. 2005, p. 9057). Overall, the sum of the PBDE concentrations are much lower and less of a concern compared to PCBs, oxychlordane, and some of the more recently discovered perflouorinated compounds. PBDEs are metabolized to a high degree in polar bears and thus do not bioaccumulate as much as PCBs (Wolkers et al. 2004, p. 1,674).

Although baseline information on contaminant concentrations is available, determining the biological effects of these contaminants in polar bears is difficult. Field observations of reproductive impairment in females and males, lower survival of cubs, and increased mortality of females in Svalbard, Norway, however, suggest that high concentrations of PCBs may have contributed to population level effects in the past (Wiig 1998, p. 28; Wiig et al. 1998, p. 795; Skaare et al. 2000, p. 107; Haave et al. 2003, pp. 431, 435; Oskam et al. 2003, p. 2134; Derocher et al. 2003, p. 163). At present, however, PCB concentrations are not thought to be resulting population level effects on polar bears. Organochlorines may adversely affect the endocrine system as metabolites of these compounds are toxic and some have demonstrated endocrine disrupting activity (Letcher et al. 2000; Braune et al. 2005, p. 23). High concentrations of organochlorines may also affect the immune system, resulting in a decreased ability to produce antibodies (Lie et al. 2004, pp. 555–556).

Despite the regulatory steps taken to decrease the production or emissions of toxic chemicals, increases in some relatively new compounds are cause for concern. Some of these compounds have increased in the last decade (Ikonomou et al. 2002, p. 1,886; Muir et al. 2006, p. 453).

Metals

Numerous essential and non-essential elements have been reported on for polar bears and the most toxic or abundant elements in marine mammals are mercury, cadmium, selenium, and lead. Of these, mercury is of greatest concern because of its potential toxicity at relatively low concentrations, and its ability to biomagnify and bioaccumulate in the food web. Polar bears from the western Canadian Arctic and southwest Melville Island, Canada (Braune et al. 1991, p. 263; Norstrom et al. 1986, p. 195; AMAP 2005, pp. 42, 62, 134), and ringed seals from the western Canadian Arctic (Wagemann et al. 1996, p. 41; Deitz et al. 1998, p. 433; Dehn et al. 2005, p. 731; Riget et al. 2005, p. 312), have some of the highest known mercury concentrations. Wagemann et al. (1996, pp. 51, 60) observed an increase in mercury from eastern to western Canadian ringed seal populations and attributed this pattern to a geologic gradient in natural mercury deposits.

Although the contaminant concentrations of mercury found in marine mammals often exceed those found to cause effects in terrestrial mammals (Fisk et al. 2003, p. 107), most marine mammals appear to have evolved effective biochemical mechanisms to tolerate high concentrations of mercury (AMAP 2005, p.123). Polar bears are able to break down methylmercury and accumulate higher levels than their terrestrial counterparts without detrimental effects (AMAP 2005, p. 123). Evidence of mercury poisoning is rare in marine mammals, but Dietz et al. (1990, p. 49) noted that sick marine mammals often have higher concentrations of methylmercury, suggesting that these animals may no longer be able to detoxify methylmercury. Hepatic mercury concentrations are well below those expected to cause biological effects in most polar bear populations (AMAP 2005, p. 118). Only two polar bear populations have concentrations of mercury close to the biological threshold levels of 60 micrograms wet weight reported for marine mammals (AMAP 2005, p. 121): the Viscount Melville population (southwest Melville Sound), Canada, and the Southern Beaufort Sea population (eastern Beaufort Sea) (Dietz et al. 1998, p. 435, Figure 7–52).

Shipping and Transportation

Observations over the past 50 years show a decline in Arctic sea ice extent in all seasons, with the most prominent retreat in the summer. Climate models project an acceleration of this trend with periods of extensive melting in spring and autumn, thus opening new shipping routes and extending the period that shipping is practical (ACIA 2005, p. 1,002). Notably, the navigation season for the Northern Sea Route (across northern Eurasia) is projected to increase from 20–30 days per year to 90–100 days per year. Russian scientists cite increasing use of a Northern Sea Route for transit and regional development as a major source of disturbance to polar bears in the Russian Arctic (Wiig et al. 1996, pp. 23–24; Belikov and Boltunov 1998, p. 113; Ovsyanikov 2005, p. 171). Commercial navigation on the Northern Sea Route could disturb polar bear feeding and other behaviors, and would increase the risk of oil spills (Belikov et al. 2002, p. 87).

Increased shipping activity may disturb polar bears in the marine environment, adding additional energetic stresses. If ice-breaking activities occur, they may alter habitats used by polar bears, possibly creating ephemeral lead systems and concentrating ringed seals within the refreezing leads. This, in turn, may allow for easier access to ringed seals and may have some beneficial values. Conversely, this may cause polar bears to use areas that may have a higher likelihood of human encounters as well as increased likelihood of exposure to oil, waste products, or food wastes that are intentionally or accidentally released into the marine environment. If shipping involved the tanker transport of crude oil or oil products, there would be some increased likelihood of small to large volume spills and corresponding oiling of polar bears, as well as potential effects on seal prey species (AMAP 2005, pp. 91, 127).

The PBSG (Aars et al. 2006, pp. 22, 58, 171) recognized the potential for increased shipping and marine transportation in the Arctic with declining seasonal sea ice conditions. The PBSG recommended that the parties to the 1973 Polar Bear Agreement take appropriate measures to monitor, regulate, and mitigate ship traffic impacts on polar bear populations and habitats (Aars et al. 2006, p. 58).

Ecotourism

Properly regulated ecotourism will likely not have a negative effect on polar bear populations, although increasing levels of ecotourism and photography in polar bear viewing areas and natural habitats may lead to increased polar bear-human conflicts. Ecotourists and photographers may inadvertently displace bears from preferred habitats or alter natural behaviors (Lentfer 1990, p.19; Dyck and Baydack 2004, p. 344). Polar bears are inquisitive animals and often investigate novel odors or sights. This trait can lead to polar bears being killed at cabins and remote stations where they investigate food smells (Herrero and Herrero 1997, p. 11). Conversely, ecotourism has the effect of increasing the worldwide constituency of people with an interest in polar bears and their conservation.

Conclusion for Factor E

Rationale

Contaminant concentrations are not presently thought to have population level effects on most polar bear populations. However, increased exposure to contaminants has the potential to operate in concert with other factors, such nutritional stress from loss or degradation of the sea ice habitat or decreased prey availability and accessibility, to lower recruitment and survival rates that ultimately would have negative population level effects. Despite the regulatory steps taken to decrease the production or emissions of toxic chemicals, use of some relatively new compounds has increased recently in the last decade (Ikonomou et al. 2002, p. 1,886; Muir et al. 2006, p. 453). Several populations, such as the Svalbard, East Greenland, and Kara Sea populations, that currently have some of the highest contaminant concentrations may be affected, but we do not believe these effects will be significant within the foreseeable future. Increasing levels of ecotourism and shipping may lead to greater impacts on polar bears. The potential extent of impact is related to changing sea ice conditions and resulting changes to polar bear distribution.

Determination for Factor E

We have evaluated the best available scientific information on other natural or manmade factors that are affecting polar bears, and have determined that contaminants, ecotourism, and shipping do not threaten the polar bear throughout all or any significant portion of its range. Some of these, particularly contaminants and shipping, may become more significant threats in the future for polar bear populations experiencing declines related to nutritional stress brought on by sea ice and environmental changes.

Finding

We have carefully considered all available scientific and commercial information past, present, and future threats faced by the polar bear. We reviewed the petition, information available in our files, scientific journals and reports, and other published and unpublished information submitted to us during the public comment periods following our February 9, 2006 (71 FR 6745) 90-day petition finding, the January 9, 2007 (72 FR 1064), 12-month Finding and proposed rule, and during public hearings held in Washington, DC and Alaska. In addition, at the request of the Secretary of the Interior, the USGS analyzed and integrated a series of studies on polar bear population dynamics, range-wide habitat use and changing sea ice conditions in the Arctic, and provided the Service with nine scientific reports on the results of their studies. We carefully evaluated these new reports and other published and unpublished information submitted to us following the public comment period on these reports, initially opened for 15 days (September 20, 2007; 72 FR 53749), but then extended until October 22, 2007 (72 FR 56979).

In accordance with our policy published on July 1, 1994 (59 FR 34270), we solicited and received expert opinions on both the *Range Wide Status Review of the Polar Bear* (*Ursus maritimus*) (Schliebe et al. 2006a), and subsequently on the 12-month finding and proposed rule (72 FR 1064). We received reviews of the draft Status Review from 10 independent experts and on the proposed rule from 14 independent experts in the fields of polar bear ecology, contaminants and physiology, climatic science and physics, Arctic ecology, pinniped (seal) ecology, and traditional ecological knowledge (TEK). We also consulted with recognized polar bear experts and other Federal, State, and range country resource agencies.

In making this finding, we recognize that polar bears evolved in the ice-covered waters of the circumpolar Arctic, and are reliant on sea ice as a platform to hunt and feed on ice-seals, to seek mates and breed, to move to feeding sites and terrestrial maternity denning areas, and for long-distance movements. The rapid retreat of sea ice in the summer and overall diminishing sea ice throughout the year in the Arctic is unequivocal and extensively documented in scientific literature. Further extensive recession of sea ice is projected by the majority of state-of-the-art climate models, with a seasonally ice-free Arctic projected by the middle of the 21st century by many of those models. Sea ice habitat will be subjected to increased temperatures, earlier melt periods, increased rain-on-snow events, and shifts in atmospheric and marine circulation patterns.

Under Factor A (''Present or Threatened Destruction, Modification, or Curtailment of its habitat or range''), we have determined that ongoing and projected loss of the polar bear's crucial sea ice habitat threatens the species throughout all of its range. Productivity, abundance, and availability of ice seals, the polar bear's primary prey base, would be diminished by the projected loss of sea ice, and energetic requirements of polar bears for movement and obtaining food would increase. Access to traditional denning areas would be affected. In turn, these factors would cause declines in the condition of polar bears from nutritional stress and reduced productivity. As already evidenced in the Western Hudson Bay and Southern Beaufort Sea populations, polar bears would experience reductions in survival and recruitment rates. The eventual effect is that polar bear populations would decline. The rate and magnitude of decline would vary among populations, based on differences in the rate, timing, and magnitude of impacts. However, within the foreseeable future, all populations would be affected, and the species is likely to become in danger of extinction throughout all of its range due to declining sea ice habitat.

Under Factor B (''Overutilization for Commercial, Recreational, Scientific, or Educational Purposes'') we note that polar bears are harvested in Canada, Alaska, Greenland, and Russia, and we acknowledge that harvest is the consumptive use of greatest importance and potential effect to polar bear. Further we acknowledge that forms of removal other than harvest (such as defense-of-life take) have been considered in this analysis. While overharvest occurs for some populations, laws and regulations for most management programs have been instituted to provide sustainable harvests over the long term. As the status of populations declines, it may be necessary for management entitites to implement harvest reductions in order to limit the potential effect of harvest. This capability has a proven track record in Canada, and is adaptive to future needs. Further, bilateral agreements or conservation agreements have been developed to address issues of overharvest. Conservation benefits from agreements that are in development or have not yet been implemented are not considered in our evaluation. We also acknowledge that increased levels of bear-human encounters are expected in the future and that encounters may result in increased mortality to bears at some unknown level. Adaptive management programs, such as implementing polar bear patrols, hazing programs, and efforts to minimize attraction of bears to communities, to address future bear-human interaction issues, including on-the-land ecotourism activities, are anticipated.

Harvest is likely exacerbating the effects of habitat loss in several populations. In addition, continued harvest and increased mortality from bear-human encounters or other forms of mortality may become a more significant threat factor in the future, particularly for populations experiencing nutritional stress or declining population numbers as a consequence of habitat change. Although harvest, increased bear-human interaction levels, defense-of-life take, illegal take, and take associated with scientific research live-capture programs are occurring for several populations, we have determined that overutilization does not currently threaten the species throughout all or a significant portion of its range.

Under Factor C (''Disease and Predation'') we acknowledge that disease pathogens are present in polar bears; no epizootic outbreaks have been detected; and intra-specific stress through cannibalism may be increasing; however, population level effects have not been documented. Potential for disease outbreaks, an increased possibility of pathogen exposure from changed diet or the occurrence of new pathogens that have moved northward with a warming environment, and increased mortality from intraspecific predation (cannibalism) may become more significant threat factors in the future for polar bear populations experiencing nutritional stress or declining population numbers. We have determined that disease and predation (including intraspecific predation) do not threaten the species throughout all or a significant portion of its range.

Under Factor D (''Inadequacy of Existing Regulatory Mechanisms''), we have determined that existing regulatory mechanisms at the national and international level are generally adequate to address actual and potential threats to polar bears from direct take, disturbance by humans, and incidental or harassment take. We have determined that there are no known regulatory mechanisms in place at the national or international level that directly and effectively address the primary threat to polar bears—the rangewide loss of sea ice habitat within the foreseeable future.

We acknowledge that there are some existing regulatory mechanisms to address anthropogenic causes of climate change, and these mechanisms are not expected to be effective in counteracting the worldwide growth of GHG emissions in the foreseeable future.

Under Factor E (''Other Natural or Manmade Factors Affecting the Polar Bear's Continued Existence'') we reviewed contaminant concentrations and find that, in most populations, contaminants have not been found to have population level effects. We further evaluated increasing levels of ecotourism and shipping that may lead to greater impacts on polar bears. The extent of potential impact is related to changing ice conditions, polar bear distribution changes, and relative risk for a higher interaction between polar bears and ecotourism or shipping. Certain factors, particularly contaminants and shipping, may become more significant threats in the future for polar bear populations experiencing declines related to nutritional stress brought on by sea ice and environmental changes. We have determined, however, that contaminants, ecotourism, and shipping do not threaten the polar bear throughout all or a significant portion of its range.

On the basis of our thorough evaluation of the best available scientific and commercial information regarding present and future threats to the polar bear posed by the five listing factors under the Act, we have determined that the polar bear is threatened throughout its range by habitat loss (i.e., sea ice recession). We have determined that there are no known regulatory mechanisms in place at the national or international level that directly and effectively address the primary threat to polar bears—the rangewide loss of sea ice habitat. We have determined that overutilization does not currently threaten the species throughout all or a significant portion of its range, but is exacerbating the effects of habitat loss for several populations and may become a more significant threat factor within the foreseeable future. We have determined that disease and predation, in particular intraspecific predation, and contaminants do not currently threaten the species throughout all or a significant portion of its range, but may become more significant threat factors for polar bear populations, especially those experiencing nutritional stress or declining population levels, within the foreseeable future.

Distinct Population Segment (DPS) and Significant Portion of the Range (SPR) Evaluation

The Act defines an endangered species as a species in danger of extinction throughout all or a significant portion of its range, and a threatened species as a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

In our analysis for this final rule we initially evaluated the status of and threats to the species throughout its entire range. The polar bear is broadly distributed throughout the circumpolar Arctic, occurring in five countries and numbering from 20,000–25,000 in total population. The species has been delineated into 19 populations for management purposes by the PBSG (Aars et al. 2006, p. 33), and these populations have been aggregated into four ecoregions for population and habitat modeling exercises by Amstrup et al. (2007). In our evaluation of threats to the polar bear, we determined that populations are being affected, and will continue being affected, at different times, rates, and magnitudes depending on where they occur. Some of these differential effects can be distinguished at the ecoregional level, as demonstrated by Amstrup et al. (2007). On the basis of this evaluation, we determined that the entire species meets the definition of threatened under the Act due to the loss of sea ice habitat. The basis of this determination is captured within the analysis of each of the five listing factors, and the ''Finding'' immediately preceding this section.

Recognizing the differences in the timing, rate, and magnitude of threats, we evaluated whether there were any specific areas or populations that may be disproportionately threatened such that they currently meet the definition of an endangered species versus a threatened species. We first considered whether listing one or more Distinct Population Segments (DPS) as endangered may be warranted. We then considered whether there are any significant portions of the polar bear's range (SPR) where listing the species as endangered may be warranted. Our DPS and SPR analyses follow.

Our ''Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Act'' (61 FR 4725; February 7, 1996) outlines three elements that must be considered with regard to the potential recognition of a DPS as endangered or threatened: (1) Discreteness of the population segment in relation to the remainder of the species to which it belongs; (2) significance of the population segment in relation to the remainder of the taxon; and (3) conservation status of the population segment in relation to the Act's standards for listing (i.e., when treated as if it were a species, is the population segment endangered or threatened?).

Under our DPS Policy, a population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions: (1) It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors (quantitative measures of genetic or morphological discontinuity may provide evidence of this separation); or (2) it is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

Genetic studies of polar bears have documented that within-population genetic variation is similar to black and grizzly bears (Amstrup 2003, p. 590), but that among populations, genetic structuring or diversity is low (Paetkau et al. 1995, p. 347; Cronin et al. 2006, pp. 658–659). The latter has been attributed to extensive population mixing associated with large home ranges and movement patterns, as well as the more recent divergence of polar bears in comparison to grizzly and black bears (Talbot and Shields 1996a, p. 490; Talbot and Shields 1996b, p. 574; Paetkau et al. 1999, p. 1580). Genetic analyses support delineated boundaries between some populations (Paetkau et al. 1999, p. 1,571; Amstrup 2003, p. 590), while confirming the existence of overlap and mixing among others (Paetkau et al. 1999, p. 1,571; Cronin et al. 2006, p. 655). We have concluded that these small genetic differences are not sufficient to distinguish population segments under the DPS Policy. Moreover, there are no morphological or physiological differences across the range of the species that may indicate adaptations to environmental variations. Although polar bears within different populations or ecoregions (as defined by Amstrup et al. 2007) may have minor differences in demographic parameters, behavior, or life history strategies, in general polar bears have a similar dependence upon sea ice habitats, rely upon similar prey, and exhibit similar life history characteristics throughout their range.

Consideration might be given to utilizing international boundaries to satisfy the discreteness portion of the DPS Policy. However, each range country shares populations with other range countries, and many of the shared populations are also co-managed. Given that the threats to the polar bear's sea ice habitat is global in scale and not limited to the confines of a single country, and that populations are being managed collectively by the range countries (through bi-lateral and multi-lateral agreements), we do not find that differences in conservation status or management for polar bears across the range countries is sufficient to justify the use of international boundaries to satisfy the discreteness criterion of the DPS Policy. Therefore, we conclude that there are no population segments that satisfy the discreteness criterion of the DPS Policy. As a consequence, we could not identify any geographic areas or populations that would qualify as a DPS under our 1996 DPS Policy (61 FR 4722).

Having determined that the polar bear meets the definition of a threatened species rangewide and that there are no populations that meet the discreteness criteria under our DPS policy (and, therefore, that there are no Distinct Population Segments for the polar bear), we then considered whether there are any significant portions of its range where the species is in danger of extinction.

On March 16, 2007, a formal opinion was issued by the Solicitor of the Department of the Interior, ''The Meaning of 'In Danger of Extinction Throughout All or a Significant Portion of Its Range''' (USDI 2007c). We have summarized our interpretation of that opinion and the underlying statutory language below. A portion of a species' range is significant if it is part of the current range of the species and it contributes substantially to the representation, resiliency, or redundancy of the species. The contribution must be at a level such that its loss would result in a decrease in the ability to conserve the species.

Some may argue that lost historical range should be considered by the Service when evaluating effects posed to a significant portion of the species' range. While we disagree with this argument, we note that the polar bear currently occupies its entire historical range.

In determining whether a species is threatened or endangered in a significant portion of its range, we first identify any portions of the range of the species that warrant further consideration. The range of a species can theoretically be divided into portions in an infinite number of ways. However, there is no purpose to analyzing portions of the range that are not reasonably likely to be significant and threatened or endangered. To identify those portions that warrant further consideration, we determine whether there is substantial information indicating that (i) the portions may be significant and (ii) the species may be in danger of extinction there or likely to become so within the foreseeable future. In practice, a key part of this analysis is whether the threats are geographically concentrated in some way. If the threats to the species are essentially uniform throughout its range, no portion is likely to warrant further consideration. Moreover, if any concentration of threats applies only to portions of the range that are unimportant to the conservation of the species, such portions will not warrant further consideration.

If we identify any portions that warrant further consideration, we then determine whether in fact the species is threatened or endangered in any significant portion of its range. Depending on the biology of the species, its range, and the threats it faces, it may be more efficient for the Service to address the significance question first, or the status question first. Thus, if the Service determines that a portion of the range is not significant, the Service need not determine whether the species is threatened or endangered there. If the Service determines that the species is not threatened or endangered in a portion of its range, the Service need not determine if that portion is significant. If the Service determines that both a portion of the range of a species is significant and the species is threatened or endangered there, the Service will specify that portion of the range as threatened or endangered pursuant to section 4(c)(1) of the Act.

The terms ''resiliency,'' ''redundancy,'' and ''representation'' are intended to be indicators of the conservation value of portions of the range. Resiliency of a species allows the species to recover from periodic disturbance. A species will likely be more resilient if large populations exist in high-quality habitat that is distributed throughout the range of the species in such a way as to capture the environmental variability found within the range of the species. In addition, the portion may contribute to resiliency for other reasons—for instance, it may contain an important concentration of certain types of habitat that are necessary for the species to carry out its life-history functions, such as breeding, feeding, migration, dispersal, or wintering. Redundancy of populations may be needed to provide a margin of safety for the species to withstand catastrophic events. This does not mean that any portion that provides redundancy is a significant portion of the range of a species. The idea is to conserve enough areas of the range such that random perturbations in the system act on only a few populations. Therefore, each area must be examined based on whether that area provides an increment of redundancy that is important to the conservation of the species. Adequate representation ensures that the species' adaptive capabilities are conserved. Specifically, the portion should be evaluated to see how it contributes to the genetic diversity of the species. The loss of genetically based diversity may substantially reduce the ability of the species to respond and adapt to future environmental changes. A peripheral population may contribute meaningfully to representation if there is evidence that it provides genetic diversity due to its location on the margin of the species' habitat requirements.

To determine whether any portions of the range of the polar bear warrant further consideration as possible endangered significant portions of the range, we reviewed the entire supporting record for this final listing determination with respect to the geographic concentration of threats and the significance of portions of the range to the conservation of the species. As previously mentioned, we evaluated whether substantial information indicated that (i) the portions may be significant and (ii) the species in that portion may currently be in danger of extinction. We recognize that the level, rate, and timing of threats are uneven across the Arctic and, thus, that polar bear populations will be affected at different rates and magnitudes depending on where they occur and the resiliency of each specific population. On this basis, we determined that some portions of the polar bear's range might warrant further consideration as possible endangered significant portions of the range.

To determine which areas may warrant further consideration, we initially evaluated the four ecoregions defined by Amstrup et al. (2007), each of which consists of a subset of the 19 IUCN-defined management populations, plus a new population—the Queen Elizabeth Islands—created by the authors. The four ecoregions are: (1) the Seasonal Ice ecoregion; (2) the Archipelago ecoregion of the central Canadian Arctic; (3) the polar basin Divergent ecoregion; and (4) the polar basin Convergent ecoregion. On the basis of observational results from long-term studies of polar bear populations and sea ice conditions, plus projections from GCM climate simulations and the results of preliminary Carrying Capacity and Bayesian Network modeling exercises by Amstrup et al. (2007), we have determined that there is substantial information that polar bear populations in the Seasonal Ice and polar basin Divergent ecoregions may face a greater level of threat than populations in the Archipelago and polar basin Convergent ecoregions (see detailed discussion under Factor A). The large geographic area included in each of these ecoregions, plus the substantial proportion of the total polar bear population inhabiting those ecoregions, also indicate that they may be significant portions of the range. Having met these two initial tests, a further evaluation was deemed necessary to determine if these two portions of the range are both significant and endangered (that analysis follows below). We determined that the Archipelago and polar Convergent ecoregions do not satisfy the two initial tests, because there is not substantial information to suggest that the species in those portions may currently be in danger of extinction.

After reviewing the four ecoregions, we proceeded to an evaluation of the 19 populations delineated for management purposes by the IUCN PBSG (Aars et al. 2006, p. 33) plus the Queen Elizabeth Island population created by Amstrup et al. (2007). For fourteen of the PBSG-defined populations, population status is considered stable, increasing, or data deficient, and there is not substantial information indicating that they may currently be in danger of extinction. We eliminated these populations from further consideration. We also eliminated the Queen Elizabeth Island population because there is no current evidence of decline in the population, and because it occurs in the polar basin Convergent ecoregion where sea ice is projected to persist longest into the future (along with the Archipelago ecoregion). Thus, there is not substantial information indicating that this population may currently be in danger of extinction. For the remaining five populations, there is some information indicating actual or projected population declines according to the most recent subpopulation viability analysis conducted by the PBSG (i.e., Southern Beaufort Sea, Norwegian Bay, Western Hudson Bay, Kane Basin, Baffin Bay) (Aars et al. 2006, pp. 34–35). Two of these populations—Norwegian Bay and Kane Basin—occur within the Archipelago ecoregion, and are small both in terms of geographic area included within their boundaries and number of polar bears in the population. Even if these two populations are considered together, the overall geographic area they occupy and overall population size are still small. On this basis we determined that these two populations do not satisfy one portion of the initial test, because there is not substantial information to suggest that these areas are significant portions of the range. In addition, the two populations occur in the Archipelago ecoregion, where sea ice is projected to persist the longest into the future. In addition, available population estimates for these two populations are less reliable because they are older (circa 1998) and are based on limited years and incomplete coverage of sampling. Because of the projected persistence of sea ice in this area throughout the foreseeable future, and the lack of reliable information on population trends, we have determined that there is not substantial information to indicate that these populations are currently in danger of extinction. Having not satisfied either of the two initial tests, we have determined that these two populations do not warrant any further consideration in this analysis.

The relatively larger area and population size of each of the three remaining populations—Southern Beaufort Sea, Western Hudson Bay, Baffin Bay—indicate that they may be significant portions of the range. For these three populations there is information indicating actual or potential population declines according to the most recent subpopulation viability analysis conducted by the PBSG (Baffin Bay) and other recent studies (Regehr et al. 2007a for Western Hudson Bay; Regehr et al. 2007b for Southern Beaufort Sea), as well as projected population declines based on recent modeling exercises (Hunter et al. 2007; Amstrup et al. 2007). Having met these two initial tests, a further evaluation was deemed necessary to determine if these three populations are both significant and endangered (that analysis follows below). Based on our review of the record, we did not find substantial information indicating that any other portions of the polar bear's range might be considered significant and qualify as endangered.

Having identified the five portions of the range that warrant further consideration (two ecoregions and three populations), we then proceeded to determine whether any of those portions are both significant and endangered. We initially discuss our evaluation of the two ecoregions identified above, and then proceed to discuss our evaluation of the three populations identified above.

On an ecoregional level, the most significant results suggesting that the two ecoregions may be endangered comes from the results of Bayesian network modeling (BM) exercises by Amstrup et al. (2007). In particular, the BM exercise results suggest that polar bear populations in the Seasonal Ice and polar basin Divergent ecoregions may be lost by the mid-21st century given rates of sea ice recession projected in the 10-GCM ensemble used by the authors. As previously discussed above under the heading ''Bayesian Network Model'' within Factor A, we believe that this initial effort has several limitations that reduce our confidence in the actual numerical probabilities associated with each outcome of the BM, as opposed to the general direction and magnitude of the projected outcomes. The BM analysis is a preliminary effort that requires additional development (Amstrup et al. 2007, p. 27). The current prototype is based on qualitative input from a single expert, and input from additional polar bear experts is needed to advance the model beyond the alpha prototype stage. There are also uncertainties associated with statistical estimation of various parameters such as the extent of sea ice or size of polar bear populations (Amstrup et al. 2007, p. 23). In addition, the BM needs further refinement to develop variance estimates to go with its outcomes. Because of these uncertainties associated with the complex BM, it is more appropriate to focus on the general direction and magnitude of the projected outcomes rather than the actual numerical probabilities associated with each outcome. Because of these limitations, we have determined that the BM model outcomes are not a sufficient basis, in light of the other available scientific information, to find that threats to polar bears currently warrant a determination of endangered status for the two ecoregions. However, despite these limitations, we also recognize that the BM results are a useful contribution to the overall weight of evidence and likelihood regarding changing sea ice, population stressors, and effects. We believe that the results are consistent with other available scientific information, including results of the CM (see discussion under ''Carrying Capacity Model'' under Factor A), and quantitative evidence of the gradual rate of population decline in three populations within the ecoregions. We further note that, although these Seasonal Ice and polar basin Divergent ecoregions face differential threats, both ecoregions currently are estimated to have large numbers of polar bears, and there is no evidence of any population currently undergoing a precipitous decline. Therefore, we find that the polar bear is not currently in danger of extinction in either the Seasonal Ice ecoregion or the polar basin Divergent ecoregion.

The three populations identified above as actually or potentially declining are the Western Hudson Bay, Southern Beaufort Sea, and Baffin Bay populations. Over an 18-year period, Regehr et al. (2007, p. 2,673) documented a statistically significant decline in the Western Hudson Bay polar bear population of 22 percent. For this period, the mean annual growth rate was 0.986 (with a 95 percent confidence interval of 0.978–0.995), indicative of a gradual population decline. The decline has been attributed primarily to the effects of climate change (earlier break-up of sea ice in the spring), with harvest also playing a role (see discussion of ''Western Hudson Bay'' under Factor A). A reduction in harvest quota in this population (from 54 to 38) for the 2007–2008 harvest season might begin to reduce the effect of harvest; however, we expect continued population declines from earlier and earlier break-up of sea ice and corresponding longer fasting periods of bears on land (Stirling and Parkinson 2006). Nonetheless, we note that the Western Hudson Bay population remains greater than 900 bears, and that reproduction and recruitment are still occurring in the population (Regehr et al. 2006). Because the current rate of decline for the Western Hudson Bay population is gradual rather than precipitous, reproduction and recruitment are still occurring, and the current size of the population remains reasonably large, we have determined that the population is not currently in danger of extinction, but is likely to become so within the foreseeable future.

The apparent decline in the Southern Beaufort Sea population, documented over a 20-year period, has not been demonstrated to be statistically significant. However, available information indicates that there will be a statistically-significant population decline in the coming decades. Hunter et al. (2007) conducted a sophisticated demographic analysis of the Southern Beaufort Sea population using both deterministic and stochastic demographic models, and parameters estimated from capture-recapture data collected between 2001 and 2006. The authors focused on measures of long-term population growth rate and on projections of population size over the next 100 years. Taking the average observed frequency of bad sea ice years (0.21), they predicted a gradual population decline of about one percent per year (similar to the rate of decline observed in Western Hudson Bay), and an extinction probability of around 35–40 percent at year 45 (see Figure 14 of Hunter et al. 2007). However, the precision of vital rates used in the analysis (estimated by Regehr et al. (2007b, pp. 17–18)) was subject to large degrees of sampling and model selection uncertainty (Hunter et al. 2007, p. 6), the length of the study period (5 years) was short, and the spatial resolution of the GCMs at the scale of the southern Beaufort Sea is less reliable than at the scale of the entire range of the polar bear. These sources of uncertainty lead us to have greater confidence in the general direction and magnitude of the trend of the model outcomes in Hunter et al. (2007) than in the specific percentages associated with each outcome. In addition, we note that the Southern Beaufort Sea population remains fairly large, that reproduction and recruitment is still occurring in the population, and that changes in the sea ice have not yet been associated with changes in the size of the population (Regehr et al. 2007, p. 2). These results all indicate that this population is not currently in danger of extinction but is likely to become so in the foreseeable future.

As regards Baffin Bay, the recent population estimates of 2,074 bears in 1998 and 1,546 bears in 2004 have limited reliability because of the population survey methods used. There is clear evidence that the population has been overharvested (Aars et al. 2006). Although the PBSG subpopulation viability analysis projects a declining trend, most likely as a result of overharverst, there is no reliable estimate of population trend based on valid population survey results. In recent years, some efforts have been made to reduce harvest of the Baffin Bay population. Greenland put a quota system in place for Baffin Bay in 2006; its current quota is 75 bears. Stirling and Parkinson (2006, p. 268) have documented earlier spring sea ice break-up dates in Baffin Bay since 1978 (i.e., ice breakup has been occurring 6 to 7 days earlier per decade since late 1978). Earlier breakup is likely to lead to longer periods of fasting onshore, with concomitant effects on bear body condition as documented in other populations. However, there are no data on body condition of polar bears or the survival of cubs or subadults from Baffin Bay (Stirling and Parkinson 2006, p. 269) that would allow an analysis of the relationship between changes in body condition and changes in sea ice habitat. In terms of projecting sea ice trends in Baffin Bay in the foreseeable future, Overland and Wang (2007) evaluated a suite of the 12 most applicable GCMs, and found that, ''according to these models, Baffin Bay does not show significant ice loss by 2050.'' These results are at apparent odds with observed sea ice trends, which further complicates projecting future effects of sea ice loss on polar bears. Without statistically reliable indices of declines in survival, body condition indices, or population size, and with evidence of earlier spring breakup dates but equivocal information on future sea ice conditions, we cannot conclude that the species is currently in danger of extinction in Baffin Bay, but can conclude it is likely to become so in the foreseeable future.

Therefore, on the basis of the discussion presented in the previous three paragraphs, we find that the polar bear populations of Western Hudson Bay, Southern Beaufort Sea, and Baffin Bay are not currently in danger of extinction, but are likely to become so in the foreseeable future.

As a result, while the best scientific data available allows us to make a determination as to the rangewide status of the polar bear, we have determined that when analyzed on a population or even an ecoregion level, the available data show that there are no significant portions of the range in which the species is currently in danger of extinction. Because we find that the polar bear is not endangered in the five portions of the range that we previously determined to warrant further consideration (two ecoregions and three populations), we need not address the question of significance for those five portions.

Critical Habitat

Critical habitat is defined in section 3(5) of the Act as: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. ''Conservation'' is defined in section 3(3) of the Act as meaning the use of all methods and procedures needed to bring the species to the point at which listing under the Act is no longer necessary. The primary regulatory effect of critical habitat is the requirement, under section 7(a)(2) of the Act, that Federal agencies shall ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of designated critical habitat.

Section 4(a)(3) of the Act and implementing regulations (50 CFR 424.12) require that, to the maximum extent prudent and determinable, we designate critical habitat at the time a species is determined to be endangered or threatened. Critical habitat may only be designated within the jurisdiction of the United States, and may not be designated for jurisdictions outside of the United States (50 CFR 424(h)). Our regulations (50 CFR 424.12(a)(1)) state that designation of critical habitat is not prudent when one or both of the following situations exist: (1) the species is threatened by taking or other activity and the identification of critical habitat can be expected to increase the degree of threat to the species; or (2) such designation of critical habitat would not be beneficial to the species. Our regulations (50 CFR 424.12(a)(2)) further state that critical habitat is not determinable when one or both of the following situations exist: (1) Information sufficient to perform required analysis of the impacts of the designation is lacking; or (2) the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

Delineation of critical habitat requires, within the geographical area occupied by the polar bear, identification of the physical and biological features essential to the conservation of the species. In general terms, physical and biological features essential to the conservation of the polar bear may include (1) annual and perennial marine sea ice habitats that serve as a platform for hunting, feeding, traveling, resting, and to a limited extent, for denning, and (2) terrestrial habitats used by polar bears for denning and reproduction for the recruitment of new animals into the population, as well as for seasonal use in traveling or resting. The most important polar bear life functions that occur in these habitats are feeding (obtaining adequate nutrition) and reproduction. These habitats may be influenced by several factors and the interaction among these factors, including: (1) water depth; (2) atmospheric and oceanic currents or events; (3) climatologic phenomena such as temperature, winds, precipitation and snowfall; (4) proximity to the continental shelf; (5) topographic relief (which influences accumulation of snow for denning); (6) presence of undisturbed habitats; and (7) secure resting areas that provide refuge from extreme weather or other bears or humans. Unlike some other marine mammal species, polar bears generally do not occur at high-density focal areas such as rookeries and haulout sites. However, certain terrestrial areas have a history of higher use, such as core denning areas, or are experiencing an increasing tendancy of use for resting, such as coastal areas during the fall open water phase for which polar bear use has been increasing in duration for additional and expanded areas. During the winter period, when energetic demands are the greatest, nearshore lead systems (linear openings or cracks in the sea ice) and emphemeral or recurrent polynyas (areas of open sea surrounded by sea ice) are areas of importance for seals and, correspondingly for polar bears that hunt seals for nutrition. During the spring period, nearshore lead systems continue to be important habitat for bears for hunting seals and feeding. Also the shorefast ice zone where ringed seals construct subnivean birth lairs for pupping is an important feeding habitat during this season. In northern Alaska, while denning habitat is more diffuse than in other areas where core, high-density denning has been identified, certain areas such as barrier islands, river bank drainages, much of the North Slope coastal plain (including the Arctic NWR), and coastal bluffs that occur at the interface of mainland and marine habitat receive proportionally greater use for denning than other areas. Habitat suitable for the accumulation of snow and use for denning has been delineated on the North Slope.

While information regarding important polar bear life functions and habitats associated with these functions has expanded greatly in Alaska during the past 20 years, the identification of specific physical and biological features and specific geographic areas for consideration as critical habitat is complicated, and the future values of these habitats may change in a rapidly changing environment. Arctic sea ice provides a platform for critical life-history functions, including hunting, feeding, travel, and nuturing cubs. That habitat is projected to be significantly reduced within the next 45 years, and some models project complete absence of sea ice during summer months in shorter timeframes.

A careful assessment of the designation of marine areas as critical habitat will require additional time to fully evaluate physical and biological features essential to the conservation of the polar bear and how those features are likely to change over the foreseeable future. In addition, near-shore and terrestrial habitats that may qualify for designation as critical habitat will require a similar thorough assessment and evaluation in light of projected climate change and other threats. Additionally, we have not gathered sufficient economic and other data on the impacts of a critical habitat designation. These factors must be considered as part of the designation procedure. Thus, we find that critical habitat is not determinable at this time.

Available Conservation Measures

The Service will continue to work with other countries that have jurisdiction in the Arctic, the IUCN/SSC Polar Bear Specialist Group, U.S. government agencies (e.g., NASA, NOAA), species experts, Native organizations, and other parties as appropriate to consider new information as it becomes available to track the status of polar bear populations over time, to develop a circumpolar monitoring program for the species, and to develop management actions to conserve the polar bear. Using current ongoing and future monitoring programs for the 19 IUCN-designated populations we will continue to evaluate the status of the species in relation to its listing under the Act. In addition, status of domestic populations will continue to be evaluated as required under the MMPA.

Conservation measures provided to species listed as endangered or threatened under the Act include recognition of the status, increased priority for research and conservation funding, recovery actions, requirements for Federal protection, and prohibitions against certain activities. Recognition through listing results in public awareness and conservation actions by Federal, State, and local agencies, private organizations, and individuals. The Act provides for possible land acquisition and cooperation with the States, and for conservation actions to be carried out for listed species.

The listing of the polar bear will lead to the development of a recovery plan for this species in Alaska. The recovery plan will bring together international, Federal, State, and local agencies, and private efforts, for the conservation of this species. A recovery plan for Alaska will establish a framework for interested parties to coordinate activities and to cooperate with each other in conservation efforts. The plan will set recovery priorities, identify responsibilities, and estimate the costs of the tasks necessary to accomplish the priorities. Under section 6 of the Act, we would be able to grant funds to the State of Alaska for management actions promoting the conservation of the polar bear.

Additionally, the Service will pursue conservation strategies among all countries that share management of polar bears. The existing multilateral agreement provides an international framework to pursue such strategies, and the outcome of the June 2007 meeting of polar bear range countries (held at the National Conservation Training Center in West Virginia) clearly documents the shared interest by all to pursue such an effort. Range-wide strategies will be particularly important as the sea ice habitat likely to persist the longest is not in U.S. jurisdiction and collaborative efforts to support ongoing research and management actions for purposes of restoring or supplementing the most dramatically affected population will be important. The PBSG is recognized as the technical advisor for the 1973 Agreement for the Conservation of Polar Bears and provides recommendations to each of the range states on conservation and management; recommendations from this group will be sought throughout the entire process.

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is listed as endangered or threatened and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. For threatened species such as the polar bear, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species. If a Federal action may affect a polar bear, the responsible Federal agency must consult with us under the provisions of section 7(a)(2) of the Act.

Several Federal agencies are expected to have involvement under section 7 of the Act regarding the polar bear. The National Marine Fisheries Service may become involved, such as if a joint rulemaking for the incidental take of marine mammals is undertaken. The EPA may become involved through its permitting authority under the Clean Water Act and Clean Air Act for activities conducted in Alaska. The U.S Army Corps of Engineers may become involved through its responsibilities and permitting authority under section 404 of the Clean Water Act and through future development of harbor projects. The MMS may become involved through administering their programs directed toward offshore oil and gas development, and the BLM for onshore activities in NPRA. The Denali Commission may be involved through its potential funding of fuel and power generation projects. The U.S. Coast Guard may become involved through their deployment of icebreakers in the Arctic Ocean.

Much of Alaska oil and gas development occurs within the range of polar bears, and the Service has worked effectively with the industry for a number of years to minimize impacts to polar bears through implementation of the incidental take program authorized under the MMPA. Under the MMPA, incidental take cannot be authorized unless the Service finds that any take that is reasonably likely to occur will have no more than a negligible impact on the species. Incidental take authorization has been in place for the Beaufort Sea region since 1993 and for the Chukchi Sea in 2006 and 2007. New MMPA incidental take authorization covering oil and gas exploration activities in the Chukchi Sea was proposed in June 2007. Mitigation measures required under these authorizations minimize potential impacts to polar bears and ensure that any take remains at the negligible level; these measures are implemented on a case-by-case basis through Letters of Authorization (LOAs) under the MMPA. Because the MMPA negligible impact standard is a tighter management standard than ensuring that an activity is not likely to jeopardize the continued existence of the species under section 7 of the Act, we do not anticipate that any entity holding incidental take authorization for polar bears under the MMPA and in compliance with all mitigation measures under that authorization will be required to implement further measures under the section 7 consultation process.

Regulatory Implications for Consultations under Section 7 of the Act

When a species is listed as threatened under the Act, section 7(a)(2) provides that Federal agencies must insure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, under the authority of section 4(d), the Secretary shall establish regulatory provisions on the take of threatened species that are ‘‘necessary and advisable to provide for the conservation of the species’’ (16 U.S.C. 1533(d)).

The coverage of the section 9 taking prohibition is much broader than a simple prohibition against killing an individual of the species. Section 3(19) of the Act defines the term ‘‘take’’ as ‘‘* * * harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.’’ Federal regulations promulgated by the Service (50 CFR 17.3) define the terms ‘‘harm’’ and ‘‘harass’’ as:

Harass in the definition of ‘‘take’’ in the Act means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. This definition, when applied to captive wildlife does not include generally accepted: (1) animal husbandry practices that meet or exceed the minimum standards for facilities and care under the Animal Welfare Act, (2) breeding procedures, or (3) provisions of veterinary care for confining, tranquilizing, or anesthetizing, when such practices, procedures, or provisions are not likely to result in injury to the wildlife.

Harm in the definition of ‘‘take’’ in the Act means an act that actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behaviorial patterns, including breeding, feeding, or sheltering.

Certain levels of incidental take may be authorized through provisions under section 7(b)(4) and (o)(2) (incidental take statements for Federal agency actions) and section 10(a)(1)(B) (incidental take permits).

In making a determination to authorize incidental take under section 7 or section 10, the Service must assess the effects of the proposed action to evaluate the potential negative and positive impacts that are expected to occur as a result of the action. Under Section 7, this would be done through a consultation between the Service and the Federal agency on a specific proposed agency action. Section 7 consultation regulations generally limit the Service’s review of the effects of the proposed action to the direct and indirect effects of the action and any activities that are interrelated or interdependent with the proposed action. ‘‘Indirect’’ effects are caused by the proposed action, later in time, and are ‘‘reasonably certain to occur.’’ Essentially, the Service evaluates those effects that would not occur ‘‘but for’’ the action under consultation and that are also reasonably certain to occur. Cumulative effects, which are the effects of future non-Federal actions that are also reasonably certain to occur within the action area of the proposed action, must also be taken into consideration. The direct, indirect, and cumulative effects are then analyzed along with the status of the species and the environmental baseline to determine whether the action under consultation is likely to reduce appreciably both the survival and recovery of the listed species or result in the destruction or adverse modification of critical habitat. If the Service determines that the action is not likely to jeopardize the continued existence of a listed species, a ‘‘no jeopardy’’ opinion will be issued, along with an incidental take statement. The purpose of the incidental take statement is to identify the amount or extent of take that is reasonably likely to result from the proposed action and to minimize the impact of any take through reasonable and prudent measures (RPMs). The regulations require, however, that any RPM’s be only a ‘‘minor change’’ to the proposed action. If the Federal agency and any applicant comply with the terms and conditions of the incidental take statement, then section 7(o)(2) of the Act provides an exception to the take prohibition.

The 9th Circuit Court of Appeals has determined that the Service cannot use the consultation process or the issuance of an Incidental Take Statement as a form of regulation limiting what are otherwise legal activities by action agencies, if no incidental take is reasonably likely to occur as a result of the Federal action (*Arizona Cattle Growers’ Association* v. *U.S. Fish and Wildlife Service,* 273 F.3d 1229 (9th Cir. 2001)). In that case, the court reviewed several biological opinions that were the result of consultations on numerous grazing permits. The 9th Circuit analyzed the Service’s discussion of effects and the incidental take statements for several specific grazing allotments. The court found that the Service, in some allotments, assumed there would be ‘‘take’’ without explaining how the agency action (in this case, cattle grazing) would cause the take of specific individuals of the listed species. Further, for other permits the court did not see evidence or argument to demonstrate how cattle grazing in one part of the permit area would take listed species in another part of that permit area. The court concluded that the Service must ‘‘connect the dots’’ between its evaluation of effects of the action and its assessment of take. That is, the Service cannot simply speculate that take may occur. The Service must first articulate the causal connection between the effects of the action under consultation and the anticipated take. It must then demonstrate that the take is reasonably likely to occur.

The significant cause of the decline of the polar bear, and thus the basis for this action to list it as a threatened species, is the loss of arctic sea ice that is expected to continue to occur over the next 45 years. The best scientific information available to us today, however, has not established a causal connection between specific sources and locations of emissions to specific impacts posed to polar bears or their habitat.

Some commenters to the proposed rule suggested that the Service should require other agencies (e.g., the Environmental Protection Agency) to regulate emissions from all sources, including automobile and power plants. The best scientific information available today would neither allow nor require the Service to take such action.

First, the primary substantive mandate of section 7(a)(2)—the duty to avoid likely jeopardy to an endangered or threatened species—rests with the Federal action agency and not with the Service. The Service consults with the Federal action agency on proposed Federal actions that may affect an endangered or threatened species, but its consultative role under section 7 does not allow for encroachment on the Federal action agency's jurisdiction or policy-making role under the statutes it administers.

Second, the Federal action agency decides when to initiate formal consultation on a particular proposed action, and it provides the project description to the Service. The Service may request the Federal action agency to initiate formal consultation for a particular proposed action, but it cannot compel the agency to consult, regardless of the type of action or the magnitude of its projected effects.

Recognizing the primacy of the Federal action agency's role in determining how to conform its proposed actions to the requirements of section 7, and taking into account the requirement to examine the ''effects of the action'' through the formal consultation process, the Service does not anticipate that the listing of the polar bear as a threatened species will result in the initiation of new section 7 consultations on proposed permits or licenses for facilities that would emit GHGs in the conterminous 48 States. Formal consultation is required for proposed Federal actions that ''may affect'' a listed species, which requires an examination of whether the direct and indirect effects of a particular action meet this regulatory threshold. GHGs that are projected to be emitted from a facility would not, in and of themselves, trigger formal section 7 consultation for a particular licensure action unless it is established that such emissions constitute an ''indirect effect'' of the proposed action. To constitute an ''indirect effect,'' the impact to the species must be later in time, must be caused by the proposed action, and must be ''reasonably certain to occur'' (50 CFR 402.02 (definition of ''effects of the action'')). As stated above, the best scientific data available today are not sufficient to draw a causal connection between GHG emissions from a facility in the conterminous 48 States to effects posed to polar bears or their habitat in the Arctic, nor are there sufficient data to establish that such impacts are ''reasonably certain to occur'' to polar bears. Without sufficient data to establish the required causal connection—to the level of ''reasonable certainty''—between a new facility's GHG emissions and impacts to polar bears, section 7 consultation would not be required to address impacts to polar bears.

A question has also been raised regarding the possible application of section 7 to effects posed to polar bears that may arise from oil and gas development activities conducted on Alaska's North Slope or in the Chukchi Sea. It is clear that any direct effects from oil and gas development operations, such as drilling activities, vehicular traffic to and from drill sites, and other on-site operational support activities, that pose adverse effects to polar bears would need to be evaluated through the section 7 consultation process. It is also clear that any ''indirect effects'' from oil and gas development activities, such as impacts from the spread of contaminants (accidental oil spills, or the unintentional release of other contaminants) that result from the oil and gas development activities and that are ''reasonably certain to occur,'' that flow from the ''footprint'' of the action and spread into habitat areas used by polar bears would also need to be evaluated through the section 7 consultation process.

However, the future effects of any emissions that may result from the consumption of petroleum products refined from crude oil pumped from a particular North Slope drilling site would not constitute ''indirect effects'' and, therefore, would not be considered during the section 7 consultation process. The best scientific data available to the Service today does not provide the degree of precision needed to draw a causal connection between the oil produced at a particular drilling site, the GHG emissions that may eventually result from the consumption of the refined petroleum product, and a particular impact to a polar bear or its habitat. At present there is a lack of scientific or technical knowledge to determine a relationship between an oil and gas leasing, development, or production activity and the effects of the ultimate consumption of petroleum products (GHG emissions). There are discernible limits to the establishment of a causal connection, such as uncertainties regarding the productive yield from an oil and gas field; whether any or all of such production will be refined for plastics or other products that will not be burned; what mix of vehicles or factories might use the product; and what mitigation measures would offset consumption. Furthermore, there is no traceable nexus between the ultimate consumption of the petroleum product and any particular effect to a polar bear or its habitat. In short, the emissions effects resulting from the consumption of petroleum derived from North Slope or Chukchi Sea oil fields would not constitute an ''indirect effect'' of any federal agency action to approve the development of that field.

Other Provisions of the Act

Section 9 of the Act, except as provided in sections 6(g)(2) and 10 of the Act, prohibits take (within the United States and on the high seas) and import into or export out of the United States of endangered species. The Act defines take to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. However, the Act also provides for the authorization of take and exceptions to the take prohibitions. Take of endangered wildlife species by non-Federal property owners can be permitted through the process set forth in section 10 of the Act. The Service has issued regulations (50 CFR 17.31) that generally afford to fish and wildlife species listed as threatened the prohibitions that section 9 of the Act establishes with respect to species listed as endangered.

The Service may also develop a special rule specifically tailored to the conservation needs of a threatened species instead of applying the general threatened species regulations. In today's **Federal Register** we have published a special rule for the polar bear that generally adopts existing conservation regulatory requirements under the MMPA and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as the appropriate regulatory provisions for this threatened species.

Section 10(e) of the Act provides an exemption for any Indian, Aleut, or Eskimo who is an Alaskan Native and who resides in Alaska to take a threatened or endangered species if such taking is primarily for subsistence purposes and the taking is not accomplished in a wasteful manner. Non-native permanent residents of an Alaska native village are also covered by this exemption, but since such persons are not covered by the similar exemption under the MMPA, take of polar bears for subsistence purposes by non-native permanent residents of an Alaskan native village would not be lawful. While the collaborative co-management mechanisms to institute sustainable harvest levels are in place, the challenges of managing harvest for declining populations are new and will require extensive dialogue with the Alaska Native hunting community and their leadership organizations. Development of risk assessment models that describe the probability and effect of a range of harvest levels interrelated to demographic population life tables are needed. Any future consideration of harvest regulation will be done with the full involvement of the subsistence community through the Alaska Nanuuq Commission and North Slope Borough and should build upon the co-management approach to harvest management that we have developed through the Inupiat-Inuvialuit Agreement and which we will work to expand through the United States-Russia Bilateral Agreement. The Inupiat-Inuvialuit Agreement is a voluntary harvest agreement between the native peoples of Alaska and Canada who share access to the Southern Beaufort Sea polar bear population. The agreement includes harvest restrictions, including a quota. A 10-year review of the agreement published in 2002 revealed high compliance rates and support for the agreement. The United States-Russia Bilateral Agreement calls for the active involvement of the United States, Russian Federation, and native people of both countries in managing subsistence harvest. The Service is currently developing recommendations for the Bilateral Commission that will direct research and establish sustainable and enforceable harvest limits needed to address current potential population declines due to overharvest of the stock. Development of population estimates and harvest monitoring protocols must be developed in a cooperative bilateral manner. The Alaska Nanuuq Commission, the North Slope Borough, USGS, and the Alaska Department of Fish and Game (ADF&G) have indicated support for these future efforts and wish to be a part of implementation of this agreement.

Under the section 10(e) exemption, nonedible byproducts of species taken pursuant to this section may be sold in interstate commerce when made into authentic native articles of handicrafts and clothing. It is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Further, it is illegal for any person to commit, to solicit another person to commit, or cause to be committed, any of these acts. Certain exceptions to the prohibitions apply to our agents and State conservation agencies. See our special rule published in today's edition of the **Federal Register** that would align allowable activities with authentic native articles of handicrafts and clothing made from polar bear parts with existing provisions under the MMPA.

Under the general threatened species regulations at 50 CFR 17.32, permits to carry out otherwise prohibited activities may be issued for particular purposes, including scientific purposes, enhancement of the propagation or survival of the species, zoological exhibitions, educational purposes, incidental take in the course of otherwise lawful activities, or special purposes consistent with the purposes of the Act. However, see today's **Federal Register** for our rule that presents provisions specifically tailored to the conservation needs of the polar bear that generally adopts provisions of the MMPA and CITES. Requests for copies of the regulations that apply to the polar bear and inquiries about prohibitions and permits may be addressed to the Endangered Species Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503.

It is our policy, published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify, to the maximum extent practicable at the time a species is listed, those activities that would or would not likely constitute a violation of regulations at 50 CFR 17.31. The intent of this policy is to increase public awareness of the effects of the listing on proposed and ongoing activities within a species' range.

For the polar bear we have not yet determined which, if any, provisions under section 9 would apply, provided these activities are carried out in accordance with existing regulations and permit requirements. Some permissible uses or actions have been identified below. Note that the special rule for polar bears (see the special rule published in today's **Federal Register**) affects certain activities otherwise regulated under the Act.

(1) Possession and noncommercial interstate transport of authentic native articles of handicrafts and clothing made from polar bears taken for subsistence purposes in a nonwasteful manner by Alaska Natives;

(2) Any action authorized, funded, or carried out by a Federal agency that may affect the polar bear, when the action is conducted in accordance with the terms and conditions of authorizations under section 101(a)(5) of the MMPA and the terms and conditions of an incidental take statement issued by us under section 7 of the Act;

(3) Any action carried out for scientific purposes, to enhance the propagation or survival of polar bears, for zoological exhibitions, for educational purposes, or for special purposes consistent with the purposes of the Act that is conducted in accordance with the conditions of a permit issued by us under 50 CFR 17.32; and

(4) Any incidental take of polar bears resulting from an otherwise lawful activity conducted in accordance with the conditions of an incidental take permit issued under 50 CFR 17.32. Non-Federal applicants may design a habitat conservation plan (HCP) for the species and apply for an incidental take permit. HCPs may be developed for listed species and are designed to minimize and mitigate impacts to the species to the greatest extent practicable. See also requirements for incidental take of a polar bear under (3) above.

We believe the following activities could potentially result in a violation of the special rule for polar bears; however, possible violations are not limited to these actions alone:

(1) Unauthorized killing, collecting, handling, or harassing of individual polar bears;

(2) Possessing, selling, transporting, or shipping illegally taken polar bears or their parts;

(3) Unauthorized destruction or alteration of denning, feeding, or resting habitats, or of habitats used for travel, that actually kills or injures individual polar bears by significantly impairing their essential behavioral patterns, including breeding, feeding, or sheltering; and

(4) Discharge or dumping of toxic chemicals, silt, or other pollutants (i.e., sewage, oil, pesticides, and gasoline) into the marine environment that actually kills or injures individual polar bears by significantly impairing their essential behavioral patterns, including breeding, feeding, or sheltering.

We will review other activities not identified above on a case-by-case basis to determine whether they may be likely to result in a violation of 50 CFR 17.31. We do not consider these lists to be exhaustive and provide them as information to the public. You may direct questions regarding whether specific activities may constitute a violation of the Act to the Field Supervisor, U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, 101 12th Avenue, Box 110, Fairbanks, Alaska 99701.

Regarding ongoing importation of sport-hunted polar bear trophies from Canada, under sections 101(a)(3)(B) and 102(b) of the MMPA, it is unlawful to import into the United States any marine mammal that has been designated as a depleted species or stock unless the importation is for the purpose of scientific research or enhancement of the survival or recovery of the species. Under the MMPA, the polar bear will be a depleted species as of the effective date of the rule. Under sections 102(b) and 101(a)(3)(B) of the MMPA therefore, as a depleted species, polar bears and their parts cannot be imported into the United States except for scientific research or enhancement. Therefore, sport-hunted polar bear trophies from Canada cannot be imported after the effective date of this listing rule. Nothing in the special rule for polar bears published in today's **Federal Register** affects these provisions under the MMPA.

Future Opportunities

Earlier in the preamble to this final rule, we determined that polar bear habitat—principally sea ice—is declining throughout the species' range, that this decline is expected to continue for the foreseeable future, and that this loss threatens the species throughout all of its range. We also determined that there are no known regulatory mechanisms in place, and none that we are aware of that could be put in place, at the national or international level, that directly and effectively address the rangewide loss of sea ice habitat within the foreseeable future. We also acknowledged that existing regulatory mechanisms to address anthropogenic causes of climate change are not expected to be effective in counteracting the worldwide growth of GHG emissions within the foreseeable future, as defined in this rule.

Fully aware of the current situation and projected trends within the foreseeable future, and recognizing the great challenges ahead of us, we remain optimistic that the future can be a bright one for the polar bear. The root causes and consequences of the loss of Arctic sea ice extend well beyond the five countries that border the Arctic and comprise the range of the polar bear, and will extend beyond the foreseeable future as determined in this rule. This is a global issue and will be resolved as the global community comes together and acts in concert to achieve that resolution. Polar bear range countries are working, individually and cooperatively, to conserve polar bears and alleviate stressors on polar bear populations that may exacerbate the threats posed by sea ice loss. The global community is also beginning to act more cohesively, by developing national and international regulatory mechanisms and implementing measures to mitigate the anthropogenic causes of climate change.

In December 2007, the United States joined other Nations at the United Nations (UN) Climate Change Conference in Bali to launch a comprehensive ''roadmap'' for global climate negotiations. The Bali Action Plan is a critical step in moving the UN negotiation process forward toward a comprehensive and effective post-2012 arrangement by 2009. (Please note that measures in the Bali Action Plan, in and of themselves, were not considered as offsetting or otherwise dimishing the risk of sea ice loss in our determination of the appropriate listing classification for the polar bear.) In December 2007, President Bush signed the Energy Independence and Security Act of 2007, which responded to his ''Twenty in Ten'' challenge in his 2006 State of the Union Address to improve vehicle fuel economy and increase alternative fuels. This bill will help improve energy efficiency and cut GHG emissions.

With the world community acting in concert, we are confident the future of the polar bear can be secured.

National Environmental Policy Act

We have determined that we do not need to prepare an environmental assessment or an environmental impact statement as defined under the authority of the National Environmental Policy Act of 1969, in connection with regulations adopted under section 4(a) of the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship with Tribes

In accordance with the President's memorandum of April 29, 1994, ''Government-to-Government Relations with Native American Tribal Governments'' (59 FR 22951), Executive Order 13175, Secretarial Order 3225, and the Department of Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. Since 1997, we have signed cooperative agreements annually with The Alaska Nanuuq Commission (Commission) to fund their activities. The Commission was established in 1994 to represent the interests of subsistence users and Alaska Native polar bear hunters when working with the Federal government on the conservation of polar bears in Alaska. We attended Commission board meetings during the preparation of the proposed rule and subsequent public comment period, regularly briefing the board of commissioners and staff on relevant issues. We also requested the Commission to act as a peer reviewer of the *Polar Bear Status Review* (Schliebe et al. 2006a) and the proposed rule to list the species throughout its range (72 FR 1064). In addition to working closely with the Commission, we sent copies of the proposed rule (72 FR 1064) to, or contacted directly, 46 Alaska Native Tribal Councils and specifically requested their comments on the proposed listing action. As such, we believe that we have and will continue to coordinate with affected Tribal entities in compliance with the applicable Executive and Secretarial Orders.

References Cited

A complete list of all references cited in this rule is available upon request. You may request a list of all references cited in this document from the Supervisor, Marine Mammals Management Office (see **ADDRESSES** section).

Authors

The primary authors of this rule are Scott Schliebe, Marine Mammals Management Office (see **ADDRESSES** section), and Kurt Johnson, PhD, Branch of Listing, Endangered Species Program, Arlington, VA.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Final Regulation Promulgation

■ Accordingly, part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, is amended as set forth below:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

■ 2. Amend § 17.11(h) by adding an entry for ''Bear, polar'' in alphabetical order under MAMMALS, to the List of Endangered and Threatened Wildlife to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic Range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*	*	
Bear, polar	*Ursus maritimus*	U.S.A. (AK), Canada, Russia, Denmark (Greenland), Norway.	Entire	T	....	NA	NA
*	*	*	*	*	*	*	

Dated: May 14, 2008.

Dirk Kempthorne,

Secretary of the Interior.

[FR Doc. E8–11105 Filed 5–14–08; 3:15 pm]

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