The Precarious State of Arctic Marine Mammals in the United States Due to Global Warming

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Executive Summary

The Alaskan North Pacific and Arctic oceans – their seas, bays, fjords and ice pack – are home to a dazzling array of marine mammals. These animals – ice seals, polar bears, walruses, and bowhead whales – are uniquely adapted to exist in one of the most extreme environments on earth: the frozen Arctic. Yet, despite the fact that their habitat is relatively remote, these marine mammals are facing very serious threats from global warming, the sources of which originate far from the Arctic.

SUMMARY

- As ice melts and recedes it leaves vast stretches of open water — polar bears are drowning as they try to navigate these waters
- Reduction of food availability is leading to poor body condition and starvation of polar bears, and documented cannibalism off the north coast of Alaska
- Ringed seals cannot make adequate lairs due to sparse snow cover, reducing their ability to protect newborn pups from the cold and predators
- Ribbon seals, which lack the wariness of seals that live deep in polar bear territory, are likely to be heavily preyed upon if they move north with the receding sea-ice
- Ice seals and walruses, which haul out on ice floes to rest, give birth, and raise their pups, are also forced into deeper waters as the area that freezes each year shrinks, impacting their ability to find food
- Dependent young walruses are abandoned by their mothers in deep, ice-free waters where haul-out locations are non-existent and foraging is impossible
- Bowhead whales' prey-rich waters may change in productivity as open water expands; other species may move into their habitat, competing for space and food

Global warming also creates potential loss and gain among people in areas that have historically been off-limits to most human uses. Decreases in the extent of sea-ice due to global warming greatly reduce the access of subsistence hunters to marine mammals in western and northern Alaska. These communities may go hungry or be forced to find new food sources beyond the Arctic ecosystem. At the same time, the loss of ice opens up access to the Bering, Chukchi and Beaufort Seas and the Arctic Ocean for shipping routes, access to new oil and gas deposits, and fishing grounds, degrading the environment and further jeopardizing the animals that live there.

The purpose of this report is to survey what is currently known about the impacts of global warming on ice-dependent marine mammal species in the U.S., including four species of ice seals (bearded, ribbon, ringed and spotted seals), two stocks of polar bears (Southern Beaufort Sea stock, Chukchi/Bering Seas stock), Pacific walruses, and western Arctic bowhead whales (also known as the Bering/Chukchi/Beaufort Seas stock). The report provides an overview of each of these marine mammal species, its habitat, and the relevant federal statutes, agreements and management entities that govern it. Finally, the report explains the serious threat global warming poses to these animals, and the sobering impacts that they are already experiencing as observed by biologists and Alaska Native subsistence hunters.

The report recommends steps that policy makers can take immediately to help improve the prospects for long term survival of these animals in the Arctic. Government at all levels – federal, tribal, state and local – must aggressively employ all legal authorities, international agreements and management bodies to create systemic protections for ice-dependent marine mammals. For example, the federal government must avail itself of tools it has at its disposal under statutes including the Marine Mammal Protection Act and the Endangered Species Act, to begin to take actions that will conserve these animals and their habitat. Appendix 1 of this report provides a brief description of these legal authorities and management entities.

In recognition of the magnitude of the threat of global warming, the International Fund for Animal Welfare (IFAW) urges policy makers to take into account its effects by adopting the strictest precautionary measures in all policies and decisions affecting the welfare and conservation of marine mammals. IFAW favors mandatory programs to reduce the build up of greenhouse gases and encourages individuals to consider how their daily choices impact global warming, and therefore have a direct impact on the welfare of marine mammals. (For the complete text of IFAW's position statement on global warming and marine mammals, please see Appendix 2).

There is much that we do not yet understand about the profound changes occurring in the Arctic.

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Introduction

In Alaska, ice seals, walruses, polar bears and bowhead whales are reliant upon the sea-ice in the Bering, Chukchi and Beaufort Seas. Much of this water is covered by sea-ice for three quarters of the year, from roughly October until June. Sea-ice, which is seasonal, reaches its maximum extent in March and is minimal in September.

There are three major forms of sea-ice in the Arctic:

1. **Shorefast** or **landfast ice** that is attached to the shore and relatively immobile, extending to variable distances offshore;

2. **Stamukhi ice** that consists of thick ridges that become grounded during the winter and attach to the ocean bottom; and

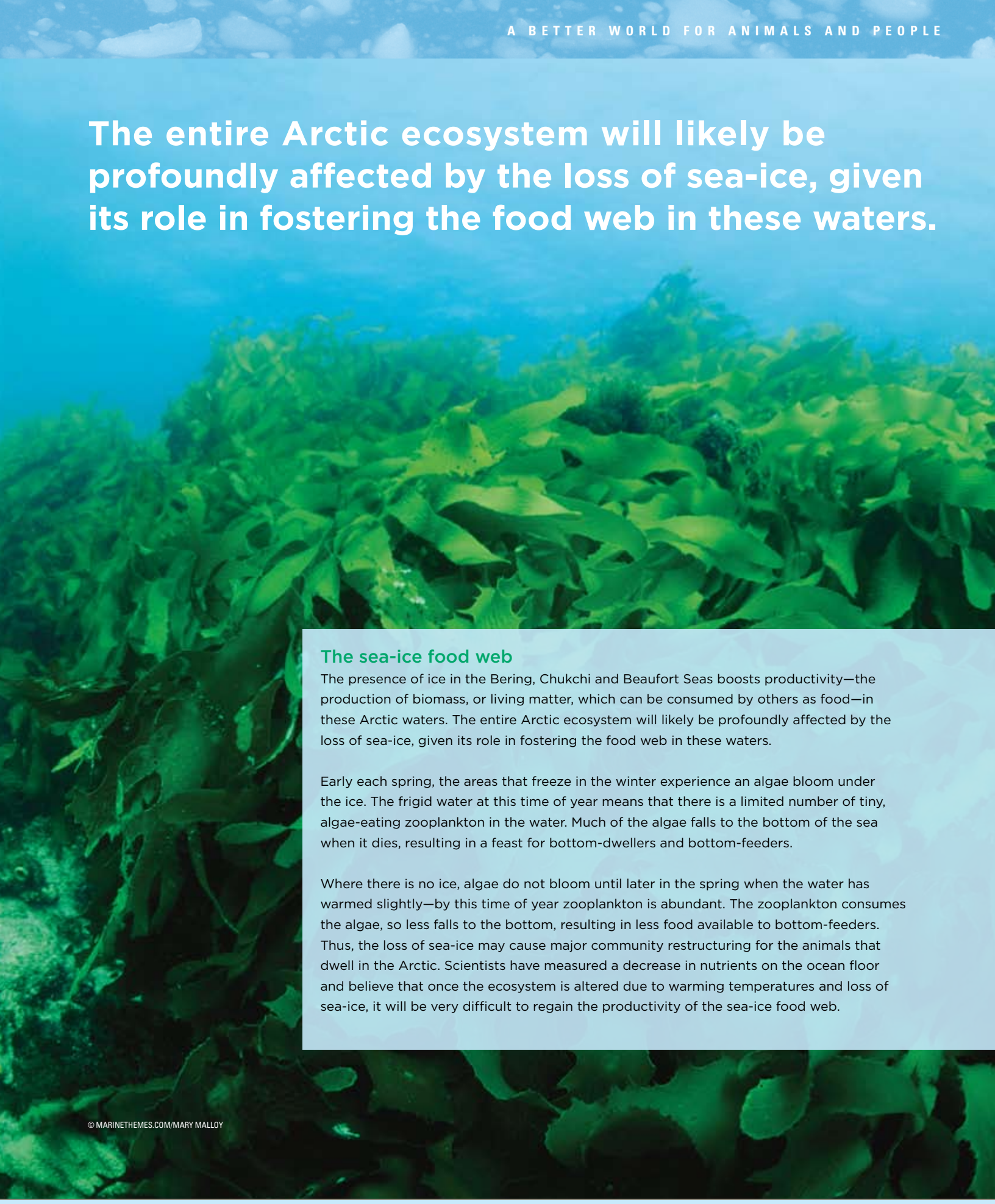
3. **Pack ice** that includes first-year and multiyear ice and moves under the influence of winds and currents. Leads, or channels of water that run through a field of ice, form within the pack ice zone.

Many marine mammals rely on this ice environment as a platform for resting and foraging, breeding, traveling, birthing, nursing and mating. Many species also follow the movement of the ice in their migration patterns. However, each species is precisely adapted to different types of ice.

In addition to the serious implications of global warming, compounded by the lack of adequate background information about different species' populations, there are concerns about emerging human uses that will be made possible by more open water in the northern seas and Arctic Ocean. These could include increased oil and gas activities, the development of new commercial fisheries, new and emerging shipping routes, and increased disturbance of, and pollution in, the ecosystem.

Alaska Natives who are experiencing first-hand the impacts of the changing climate have traditional knowledge about the animals' biology, migrations and ecosystems. It is critical that policy makers work with Alaska Natives to understand their concerns about ice-dependent marine mammals, global warming, subsistence, and the human activities that are increasing in the Arctic. Global warming and loss of sea-ice are so significant that all stakeholders need to work cooperatively to develop creative ways to advocate for greenhouse gas reductions and mitigation measures for any potential new Arctic development.

The entire Arctic ecosystem will likely be profoundly affected by the loss of sea-ice, given its role in fostering the food web in these waters.



The sea-ice food web

The presence of ice in the Bering, Chukchi and Beaufort Seas boosts productivity—the production of biomass, or living matter, which can be consumed by others as food—in these Arctic waters. The entire Arctic ecosystem will likely be profoundly affected by the loss of sea-ice, given its role in fostering the food web in these waters.

Early each spring, the areas that freeze in the winter experience an algae bloom under the ice. The frigid water at this time of year means that there is a limited number of tiny, algae-eating zooplankton in the water. Much of the algae falls to the bottom of the sea when it dies, resulting in a feast for bottom-dwellers and bottom-feeders.

Where there is no ice, algae do not bloom until later in the spring when the water has warmed slightly—by this time of year zooplankton is abundant. The zooplankton consumes the algae, so less falls to the bottom, resulting in less food available to bottom-feeders. Thus, the loss of sea-ice may cause major community restructuring for the animals that dwell in the Arctic. Scientists have measured a decrease in nutrients on the ocean floor and believe that once the ecosystem is altered due to warming temperatures and loss of sea-ice, it will be very difficult to regain the productivity of the sea-ice food web.

The Warming Arctic

The occurrence of global warming as a result of human-generated greenhouse gas emissions – carbon dioxide, methane, and nitrous oxides – is no longer subject to credible scientific dispute. In an assessment of the planet's future, the leading international network of climate scientists concluded that global warming is "unequivocal" and that human activity is the main driver, "very likely" causing most of the rise in temperatures since 1950.

On February 2, 2007, the Intergovernmental Panel on Climate Change (IPCC)[1] released its "Fourth Assessment Report" on the causes and consequences of climate change. For the first time, the IPCC asserted with near certainty – more than 90% confidence – that carbon dioxide and other greenhouse gases from human activities have caused warming in the past fifty years.[2]

While there is continuing debate about the rate and regional effects of global warming, and policy debates about what should be done to address the issue, the best available science clearly demonstrates that global warming exists and will bring profound changes to the world's climate. Most importantly, the IPCC report said warming and its harmful consequences could be substantially blunted by prompt action.

Arctic regions are being disproportionately affected by higher levels of warming. In November 2004, the Arctic Climate Impact Assessment (ACIA),[3] a program in which the U.S. participated, released its report entitled, "Impacts of a Warming Arctic." The report concluded that greenhouse gas-driven climate changes "are being experienced particularly intensely in the Arctic. Arctic average temperature has risen at almost twice the rate as the rest of the world in the past few decades. Widespread melting of glaciers and sea-ice and rising permafrost temperatures present additional evidence of strong Arctic warming." Significantly, ACIA reports that "acceleration of these climatic trends is projected to occur during this century, due to ongoing increases in concentrations of greenhouse gases in the earth's atmosphere."

In Alaska and western Canada, winter temperatures have increased by as much as 3-4° Celsius (°C), (5-7° Fahrenheit (°F)) in the past 50 years.

Over the next 100 years, under a moderate emissions scenario, annual average temperatures are projected to rise 3-5° C (5-9° F) over land and up to 7° C (13° F) over the oceans.

Winter temperatures are projected to rise by 4-7° C (7-13° F) over land and 7-10° C (13-18° F) over the oceans.

Arctic average temperature has risen at **almost twice the rate as the rest of the world** in the past few decades.

Ongoing warming will continue to severely reduce the extent of sea-ice coverage. Over the past 30 years, the average sea-ice extent has decreased by about 8% each year, or nearly one million square kilometers (386,000 square miles), an area larger than all of Norway, Sweden, and Denmark (or Texas and Arizona) combined, and the melting trend is accelerating. Sea-ice extent in summer has declined more dramatically than the annual average, with a loss of 15-20% of late-summer ice coverage.

September 2007 brought record sea-ice melt in the Arctic. According to the National Snow and Ice Data Center, on September 16, 2007, sea-ice extent dropped to 4.13 million square kilometers – 38 percent below average – prompting speculation about the opening of a Northwest Passage from the Pacific to the Atlantic. Increased ship traffic would constitute further disturbance to ice-dependent marine mammals.

The projected temperature increases and ice loss in the polar regions are also expected to alter ocean currents and salinity patterns. This may force the displacement of some marine species into areas of higher salinity, where truly "oceanic" conditions of salinity prevail. Some scientists have warned that global warming in excess of 1° C could trigger a runaway melting of the world's ice sheets. They also warn that air pollution – particularly soot – may hasten the ice melting by decreasing the reflectance, and increasing the absorbance, of heat radiation by water crystals. Even a few parts per billion of soot in snow can have significant effects.

In the Arctic, higher ocean temperatures and lower salinities, contraction of seasonal sea-ice extent, and rising sea levels are certain to have significant impacts on marine species. 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. For marine mammals adapted to sea-ice, a reduction in ice is likely to be reflected initially by shifts in animals' range and abundance. Demographic changes associated with shifts in geographic range will likely be observed as decreased recruitment – fewer new animals added to a population – in areas of reduced sea-ice. The challenge for species to accommodate such change is intensified because of the large area involved, the rapid rate at which the warming is predicted to occur, large inter-annual variations in climate, and the accelerated pace of human development.

Subsistence Hunting

All four species of ice seals are hunted by Alaska Natives in coastal Alaska. Bearded and ringed seals are main subsistence resources and favorite foods of subsistence hunters. Bowhead whales are vitally important to subsistence hunters from the coastal villages in Alaska that are located along the whales' migration route. Alaska Eskimos have hunted bowhead whales for at least 2,000 years. Walruses are an important cultural and subsistence resource along coastal areas of the Bering, Chukchi and Beaufort Seas. In Barrow, walruses comprise the third most important species by weight of harvestable meat.

As global warming continues and the extent and thickness of sea-ice shrinks, the negative impact on subsistence hunting will increase. The many variables that may challenge subsistence hunters include:

- Whether reduced sea-ice will affect the distribution and seasonal movements of marine mammals, and
- Whether the populations will decline due to difficulty in foraging, reduced prey availability, increased predation, and reduced pup and calf survival.

Hunters will likely experience greater difficulty in terms of traveling further distances to find the animals, encountering unstable ice conditions, bigger seas and harsh weather conditions.

Reduction in sea-ice leads to shifts in marine mammal ranges and fewer new individuals added to populations.

1. In 1988, the World Meteorological Organization and the United Nations Environment Programme established the IPCC. Its mission is to assess available scientific and socio-economic information on climate change, its impacts, options for mitigation, and to provide, on request, scientific and technical advice to the Conference of the Parties to the United Nations Framework Convention on Climate Change. Since 1990, the IPCC has produced a series of reports, papers, methodologies, and other products that have become the standard works of reference on climate change.

2. The Report is the product of some 600 authors from 40 countries. Over 620 expert reviewers and a large number of government reviewers also participated. Representatives from 113 governments, including the United States, reviewed and revised the summary line-by-line before adopting it and accepting the underlying report.

3. The ACIA is a comprehensively researched, fully referenced, and independently reviewed evaluation of Arctic climate change and its impacts for the region and for the world. It has involved an international effort by hundreds of scientists over four years, and also includes the special knowledge of indigenous people.

Ice Seals

Bearded, ribbon, ringed and spotted seals are the four species of North Pacific pinnipeds, aquatic carnivorous mammals with four flippers, collectively known as the ice seals. Ice seals rely on ice as a platform from which to feed, birth their pups and rest. The continued loss of sea-ice will greatly impact the long term viability of these seals. Each seal species will be affected by the loss of sea-ice in different ways, based on its specific habitat preferences and unique biological characteristics.

Bearded Seals *(Erignathus barbatus)*

Ribbon Seals *(Histriophoca fasciata)*

These four ice seal species are important components of the ecosystems in the Bering, Chukchi and Beaufort Seas. They are also an important subsistence resource for many coastal villages in Alaska, Canada and Russia, and are a food source for potentially threatened polar bears. The various species differ in their relationship with sea-ice, which likely influences many aspects of their biology and ecology, including population abundance and distribution, breeding behavior, association patterns, movement and dispersal.

Little is known about these and other aspects of the biology and ecology of ice seals. They have received little attention compared to other pinniped species, some of which are known to be in decline, such as Steller sea lions and northern fur seals. Estimates of population abundance and trends, and recent health assessments of ice seals are not available for most species and are confounded by a poor understanding of even the most fundamental information about them, such as population structure, movements and dispersal.

Ice seals are closely identified with the ice pack, spending the majority of their time on the ice, and migrating northward with the ice during the warmer months. This reliance on sea-ice means that they will be severely impacted as the sea-ice diminishes due to global warming. It is believed that they will become more vulnerable to predation by polar bears, experience reduced body condition, have problems pupping and nursing, and possibly have difficulty foraging when they do not have their usual ice habitat from which to seek food and upon which to rest.

For example, ribbon and spotted seals that currently live at the southern edge of the polar bears' range could expand their range northward into polar bear territory. Ribbon seals are surprisingly tolerant of the presence of humans, and mother ribbon seals leave their pups unattended for long periods of time. This suggests that ribbon seals traditionally occupy regions relatively free from predation. If their habitat shifts north as the ice shrinks, ribbon seals may move into polar bear territory, becoming easier targets than other more wary species.

Ringed seals prefer stable, shore-fast ice for construction of birth lairs. Adequate snow drift accumulation is necessary to build lairs with roofs thick enough to protect pups. Use of suitable birth lairs for thermoregulation is considered critical to the survival of nursing pups when air temperatures fall below freezing. For the past six years, ringed seals have abandoned lairs increasingly early as spring temperature and snow melts have advanced. The transition from lair use to basking on the surface was especially early and abrupt in 2002, as by mid-May all the seals had abandoned their lairs. Many pups in their natal coats were resting on the ice in the open instead of in lairs as would be typical in mid-May. The early snow melts that researchers have observed are consistent with a general pattern observed in the Beaufort Sea. Premature lair abandonment by ringed seals, associated with early snow melts, will likely increase juvenile mortality rates due to exposure to freeze-thaw conditions and predation. In situations when lack of snow cover forced birthing to occur in the open, nearly 100% of the pups died from predation.

In addition, increased rain on snow during the late winter damages or destroys snow lairs, placing pups at risk of hypothermia and predation. Researchers believe that if early-season rain becomes regular and widespread in the future, ringed seal pup mortality will increase,

RINGED SEALS *(Phoca hispida)*

SPOTTED SEALS *(Phoca largha)*

Ringed seal pups are the smallest among seals and survive only because they are born into snow caves that their mothers build in snowdrifts above breathing holes in the ice. A reduction in ice or early melt could expose these pups prematurely.

especially in the southern extent of their range. Consequently those local populations may be significantly reduced.

Researchers have reported that early spring breakup of ice also negatively impacts the growth, condition and probably the survival of nursing ringed seal pups. Early breakup likely interrupts lactation in mother seals which negatively affects the condition and growth of pups. Earlier ice breakups are predicted to occur more frequently and result in decreased ringed seal productivity and abundance.

Arctic cod is one of the ringed seals' primary prey species. It is heavily reliant on sea-ice throughout its range and uses the underside of the ice to escape from predators. A decrease in seasonal ice cover could have adverse effects on Arctic cod and consequently its availability to ringed seals as food.

RECOMMENDATIONS

- Federal funding for the study of ice seals must be increased so that further research can be undertaken. It has been decades since there has been any comprehensive study on population numbers and distribution of ice seals. Without this critical information, it is impossible to know how rapidly the seal populations are declining, or to make informed management decisions regarding subsistence hunts.

- Assessment of these stocks should be conducted to determine whether they are depleted and conservation plans should be developed as required under the Marine Mammal Protection Act.

- The federal government should consider whether to propose listing these seal species under the Endangered Species Act. The challenges faced by these seal species are not appreciably different than those faced by polar bears, which the government recently proposed for listing.

SEALS APPENDIX

All four species of ice seals, along with their more southern relative – the harbor seal – are members of the family *Phocidae*, or true seals. Ringed, spotted and ribbon seals are similar in size and general characteristics, although each has a distinct coat pattern.

Bearded Seals *(Erignathus barbatus)*
Bearded seals are the largest true seals found in the seas adjacent to Alaska. As indicated by their name, their most distinguishing feature is their beard of white whiskers, used to find food on the sea floor. Adult bearded seals are gray to brown and do not have spots or other identifying markings. They are usually solitary. Adult males have very audible and musical underwater calls during the breeding period. Bearded seals eat a wide variety of invertebrates and some fish found in and on the rich bottom of the shallow Bering and Chukchi Seas, with their main food sources being crabs, shrimp, clams and snails.

Their primary predators are polar bears, as well as human subsistence hunters who consider bearded seal meat the most desirable of the ice seals. Pups can swim shortly after they are born; this early development of aquatic ability may have evolved as a means of escaping polar bears.

Bearded seals occur throughout the Arctic in the Bering, Chukchi and Beaufort Seas. They usually inhabit shallow waters less than 200 meters deep in areas of broken, moving sea-ice. Spring surveys indicate that bearded seals are typically more abundant within 20 to100 nautical miles (nmi) from shore, on offshore pack ice, than within 20 nmi of shore, with the exception of high concentrations near shore to the south of Kivalina.

Ribbon Seals *(Histriophoca fasciata)*
Ribbon seals are medium-sized in comparison to other ice seals in Alaskan waters. By the age of four, the ribbon seal has four distinct, light-colored ribbons on a dark background—with ribbons encircling the neck or head, the posterior trunk near the level of the navel, and one on each side of the body broadly encircling the front flippers.

Although they eat a variety of different foods, their main prey is fish. In regions where pollock are present, they usually comprise the major single prey item. Areas of ribbon seal abundance usually occur in regions where pollock are also abundant. Ribbon seals probably dive to depths of up to 200 meters in search of food.

Ribbon seals range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas. In Alaskan waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice. They are most abundant in the northern part of the ice front in the central and western parts of the Bering Sea.

Ringed Seals *(Phoca hispida)*
Ringed seals are the most common and widespread seal species in the Arctic. Ringed seals are the only ones that can survive in completely ice-covered waters; other ice seals need natural surface openings to breathe. With strong, specially adapted claws on their front flippers, ringed seals dig out breathing holes in the ice and scratch through up to two meters or more by the end of the winter.

Ringed seals are among the smallest of all the pinnipeds, with adult ringed seals in Alaska rarely exceeding 1.5 meters in length and 68 kg in weight. Their basic coloration pattern is a gray back with black

spots ringed with light marks and a light belly; the seal gets its name from the ringed black spots. Weighing about 4 kg at birth, ringed seal pups survive only because they are born into subnivean lairs (snow caves) that their mothers excavate in snowdrifts above breathing holes in the ice. Throughout the winter and spring, the only access to the lair is through the breathing hole below. The pups are nursed in the lairs where they are safely concealed for most or all of the first two months of life.

During winter, ringed seals are most abundant close to shore on the shorefast ice. As a result, they have been important to the coastal Alaska Native villages as a source of food and usable products. In addition to humans, the chief predators of ringed seals are polar bears. However, Arctic and red foxes, walruses, dogs, wolves, wolverines, and ravens also are known to prey on ringed seals. Ringed seals eat a variety of invertebrates and fish, with the most important being Arctic cod, saffron cod, shrimp, and other crustaceans.

Ringed seals have a circumpolar distribution from 35 degrees N to the North Pole, occurring in all seas of the Arctic Ocean. The Alaska ringed seals, associated with pack ice for much or all of the year, have a range extending from the Beaufort Sea to the Bering and Chukchi Seas. They have been found as far south as the Aleutian Islands. They occupy seasonal and permanent ice, preferring large ice floes greater than 48 meters in diameter and are often found in the interior ice pack where the sea-ice coverage is greater than 90%. Many seals are reported to migrate north-south or inshore-offshore on a seasonal basis in response to ice availability, and there is evidence of long-distance migration and dispersion, particularly for juvenile seals.

Spotted Seals *(Phoca largha)*
Spotted seals are of medium size, similar in size to harbor and ribbon seals, larger than ringed seals, and considerably smaller than bearded seals. The snouts of spotted seals are somewhat elongated, resembling those of most dogs. Spotted seals are named for the numerous dark, irregularly shaped spots that are sometimes encircled by a faint ring on a lighter background, usually of a brownish-yellow color.

During the spring breeding season, spotted seals are found at the southern edges of the pack ice, dependent on openings between ice floes for access to air and the ice surface. Groups of three seals are often seen together on the ice in the early spring, consisting of a female, her mate and her new pup from her mate of last season. It is thought that the male joins the female about 10 days before she gives birth on the ice, and after her pup is born, he mates with her, probably

in the water. Pups are not capable swimmers during their first few weeks of life and have a 45% mortality rate for the first year. In late spring-summer, spotted seals gather to molt among the ice remnants, and sometimes on land when ice is unavailable.

Their principal food source appears to be schooling fish, although the total range of food varies depending on geographical and seasonal differences. Data from satellite tags suggests that spotted seals dive to the bottom to feed. Known predators include polar bears, sharks, killer whales, walruses, Steller sea lions, brown bears, wolves, and foxes.

Spotted seals are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan. They spend the winter and spring offshore along the ice front throughout the Bering Sea. In the summer, they are found along the coast "hauling out" on beaches, barrier islands and remote sandbars on river deltas. Spotted seals form large aggregations on the ice and at favored locations on land. The largest land aggregations in Alaska are at Kasegaluk Lagoon in the Chukchi Sea, near Cape Espenburg in Kotzebue Sound, and on bars and shoals in Kuskokwim Bay. Several thousand seals may be hauled out together in these areas.

Polar Bears *(Ursus maritimus)*

Polar bears have received much media attention in recent years due to their high profile connection to a shrinking sea-ice habitat. In June 2005, 40 members of the World Conservation Union's (IUCN) Polar Bear Specialist Group/Species Survival Commission (the preeminent international scientific body for research and management relating to polar bears) concluded that polar bears should be classified as a "vulnerable" species. This recommendation was based on a likely 30% decline in their worldwide population over the next 35 to 50 years caused principally by climatic warming and its consequent negative effects. In January 2007, the U.S. Fish and Wildlife Service proposed listing the polar bear as threatened under the federal Endangered Species Act (ESA) because of ongoing and projected changes in their sea-ice habitat from climate change.[5] In September of 2007, scientists with the U.S. Geological Survey predicted that polar bears will be gone from Alaska in 50 years due to the profound shrinking of sea-ice.

Changes in sea-ice cover and in the timing of ice freeze-up and break-up have significant effects on polar bears. The Polar Bear Specialist Group of IUCN reports:

- Changes that alter the period of ice coverage could affect polar bear distribution and condition:
  - With ice pack shrinkage, polar bears may spend greater amounts of time on land
  - Polar bears using deteriorating pack ice may experience increased exertion associated with movements and swimming, using up valuable stores of fat
  - More extensive use of terrestrial areas will also result in diminished physical condition due to use of fat stores for energy
  - Such reduced physical condition could negatively affect cub production and survival
- The impact of climate change on prey species will have a negative effect on polar bears:
  - Decreased snow or increased seasonal rain could affect ringed seal pupping as there might not be adequate snow for construction of birth lairs; additionally, increased rainfall could collapse birth lairs and reduce seal productivity
  - Prey reductions could affect polar bear condition and ultimately cub production and survival
- Denning could be impacted by unusual warm spells:
  - Access to high quality denning areas could be limited or restricted
  - Use of less suitable denning habitat could impact reproduction and cub survival
  - Rain or warming could directly cause snow dens to collapse or be subjected to ambient conditions
  - Loss of thermal insulation properties in opened dens could affect cub survival

In Alaska, there is evidence of decreased polar bear body condition, and deaths from drowning, starvation and cannibalism. In recent years, there have been record low ice packs in Alaska's Beaufort Sea region, pushing more and more polar bears onto land for protracted periods. Hungry bears are drawn to village dumps, whale carcass sites from Native subsistence hunts, and other settled areas where they come into conflict with people.

Pack ice is the primary summer habitat for Alaskan polar bears. Shore-fast ice is used for feeding on seal pups, movement, and occasionally for maternity denning. These areas attract seals and other marine mammals, providing polar bears with preferred winter and spring hunting habitat. Snow cover is also part of polar bear habitat because it provides insulation and cover for young polar bears in dens, and because it is where they can find ringed seals in birth lairs.

Polar bears expend more energy in conditions of reduced ice thickness and extent. Arctic sea-ice circulation is clockwise and polar bears tend to walk against this movement to maintain a position near preferred habitat within large geographical home ranges. With diminished ice thickness, there is increased transport of multi-year ice from the polar region, requiring polar bears to work harder to maintain their position near preferred habitat. As sea-ice moves more quickly or becomes more fragmented, polar bears use more energy to maintain contact with consolidated ice.

During summer periods the remaining ice in much of the central Arctic is now positioned away from the more productive continental shelf waters and over much deeper, less productive waters in the Beaufort and Chukchi Seas. As the open water enlarges, polar bears spend more time and energy swimming. In 2004, scientists documented for the first time four polar bear drownings in open water off Alaska and extrapolated that 27 bears may have drowned during that event after trying to swim between shore and distant ice.

Polar bears catch very few seals in open water — sea-ice is essential as a platform from which they hunt.

5. A notice of review for the proposal was issued and public comments were accepted by the Interior Department through April 9, 2007.

Researchers suggest that as habitat patch sizes decrease, available food resources will also decline, resulting in reduced polar bear residency time and increased movement in search of food. Ringed seals, the polar bear's primary prey, are projected to decline due to reduced sea-ice habitat and decreased snowfall that prevents adequate birth lairs necessary to protect ringed seal pups from freezing air. Polar bears cannot offset energy losses from decreased seal consumption by using terrestrial habitat, because food such as berries, snow geese and caribou do not represent significant energy sources. Nutritional stress would result. The consequences of increased energetic costs to polar bears are reduced weight and condition and a corresponding reduction in survival and recruitment rates.

An adult polar bear needs on average approximately 2 kg of seal fat per day to survive.

LOSING WEIGHT

Declines in fat reserves during critical times in the polar bear life cycle are likely to lead to numerous problems. These include: delay in the age of first reproduction; inadequate fat reserves to complete successful denning; decline in litter sizes with more single cub litters and fewer cubs overall; and lower cub body weights and survival rates. When mother bears and their cubs leave the den, their body masses are correlated; heavier females produce heavier cubs and lighter females produce lighter cubs.

Researchers are seeing decreased body condition of southern Beaufort Sea polar bears. Cub survival rates declined significantly when comparing rates from 1967 to 1989 and 1990 to 2006. Cub weights also declined slightly. Scientists believe that poor cub survival may have been related to declining physical condition of females entering dens, reflected in their smaller skull measurements. The lower cub survival rate coincided with warming temperatures and altered atmospheric circulation starting in the winter of 1989-1990 that caused an abrupt change in sea-ice conditions in the Arctic basin.

In addition, broken and fragmented ice conditions may cause cubs to be in the water longer, increasing the chance of hypothermia or death — they cannot survive more than 10 minutes in icy water. Juvenile survival rates have also declined for both males and females. Since 1990, adult male body weights have decreased significantly, and males have also been found to have smaller skulls, reflecting a trend toward smaller size.

In the spring of 2006, three adult polar bears and one yearling were found dead. Two of these females, as well as the yearling, had no fat stores and apparently starved to death. The third female was too heavily scavenged to determine the cause of death but researchers believe starvation was likely as prime age females have had very high survival rates in the past.

RECOMMENDATIONS

- The effort underway by the government to list the polar bear as a threatened species under the Endangered Species Act is an important first step in polar bear protection.

- Congress should close the loophole in the Marine Mammal Protection Act that permits Americans to hunt polar bears in Canada and return home with their bear trophies. While it is illegal to hunt these bears in the U.S., approximately 200 bears are killed by American hunters each year. The Marine Mammal Protection Act should be amended to prohibit these trophies from entering our borders.

POLAR BEARS APPENDIX

- Polar bears, a potentially threatened species, are the largest of all land predators, with males weighing up to 771 kilograms and standing 2-3.5 meters tall. There are 19 recognized populations of polar bears worldwide within the jurisdiction of five countries: the United States (Alaska), Canada, Denmark (Greenland), Norway, and Russia.

- In Alaska, there are two populations:
  - The Southern Beaufort Sea population, which occurs along the North Slope of Alaska and ranges into western Canada
  - The Chukchi/Bering Seas population, which occurs off western Alaska with its range extending to Wrangel Island and eastern Siberia.

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Only the Southern Beaufort Sea population can be reliably estimated. The IUCN's Polar Bear Specialist Group estimates the population at 1,800 bears. The Chukchi Bering Sea population is estimated at 2,000, but that number is unreliable due to widespread poaching in Russia.

Polar bears are superbly adapted for Arctic survival, with physical characteristics that make them especially suited to live in the extremely cold ice environment. Polar bear coats are water-repellant and provide a thermoregulatory benefit, helping to capture sunlight as an external source of heat. Their bodies are entirely fur-covered except for their noses, and they have a thick layer of insulating fat (more than 11 cm thick in places) that keeps their body temperature and metabolic rate stable at -36.66 degrees Celsius. Their claws are suited to grasping prey and for walking on ice, with "suction cups" on the underside of their feet providing increased ice traction. Individuals may travel very long distances to find mates or food. They are agile in the water and can swim as fast as 10 km per hour. They have been seen 160 km from the nearest land or ice.

Polar bears' oar-like feet make them expert swimmers and also serve to spread their weight on the ice. Their acute sense of smell enables them to find seals in snow caves.

At the top of the Arctic food web, polar bears prey primarily on ringed seals but also on bearded seals. Polar bears capture seals by waiting for them at breathing holes and at the edge of leads or cracks in the ice. They also stalk seals resting on top of the ice and catch pups by breaking into snow lairs on top of the ice in the spring. Polar bears often eat only the seal's skin and blubber, leaving the carcass for other animals like Arctic foxes to scavenge. An adult polar bear needs on average approximately 2 kg of seal fat per day to survive. Polar bears also can kill larger prey such as young walruses and beluga whales and occasionally eat small mammals and bird eggs when other food is not available. They also feed on whale, seal and walrus carcasses and have been increasingly congregating around bowhead whale remains from subsistence harvests.

Polar bears may be among the most adept of all mammals in their ability to survive food and water deprivation. While polar bears do not undergo true hibernation, both male and female polar bears can enter a state termed "walking hibernation" at any time of year when food supplies are scarce. The bears' metabolism alters to a hibernation-like state, facilitating significant energy conservation. Polar bears are largely food-deprived while on land in the ice-free period of the year, surviving on stored fat reserves.

Polar bears have a relatively low reproductive rate, with females reaching breeding age when they are from four to six years old, producing small litters and few young in their lifetime. If the cub survives through the weaning stage, the female can breed no more than every three years. Polar bears mate on the sea-ice in the spring, but have delayed implantation so fetal development is arrested until the fall. After mating, a female must accumulate sufficient fat reserves to survive and also support her cubs from the time she enters the maternity den, between late October and mid-November, until the time the family emerges in the spring and begins to feed.

Their acute sense of smell enables them to find seals in snow caves.

Polar bears are most abundant near coastlines and the southern edge of the ice, but they can occur throughout the polar basin. They have an extensive range, related to the seasonal position of the ice edge and distribution of seals. Beaufort Sea polar bears appear to spend about 25% of their time along the Chukchi Sea coast of northwestern Alaska. The Chukchi Sea population winters in the northern Bering Sea and southern Chukchi Sea adjacent to Russia and western Arctic Alaska, and its members seldom enter the Beaufort Sea. During the summer, polar bears are found near the edge of the pack ice in the Chukchi Sea and Arctic Ocean, mostly between 70° and 72° North latitude. In October and November, males head out onto the pack ice where they spend the winter. Female denning occurs along the North Alaska coast, especially within the Arctic National Wildlife Refuge and on the adjacent sea-ice. Pregnant females dig dens in the snow on land or near shore sea-ice where they spend the winter, give birth, and nurse their young.

Pacific Walrus *(Odobenus rosmarus divergens)*

Pacific walruses are exhibiting the effects of global warming associated with the changing distribution and extent of pack ice in the Bering and Chukchi Seas. Pack ice is very important habitat for walruses, allowing them a place to rest and give birth, and providing a platform from which to forage. They can only dive to depths of approximately 90 meters; when the ice recedes north of the continental shelf, they are unable to dive as deep as their bottom-dwelling prey is found.

Alaskan and Russian researchers have conducted comprehensive joint surveys to estimate the size and distribution of the walrus population. Without such data, it is impossible for scientists to advise policy makers on whether the walrus should join the polar bear in being considered for listing under the Endangered Species Act.

In July of 2007, several thousand individuals abandoned the receding ice pack for shoreline between Barrow and Cape Lisburne. Scientists speculated that the animals shifted their distribution to find prey. This year's lowest summer ice cap on record put sea-ice far north of the outer continental shelf, making it impossible for walruses to dive for food.

In addition, walrus calves have been observed swimming in open water alone and are believed to have been abandoned by their mothers who were searching for food in ice-free waters with no place for the dependent calves to rest.

BIOTURBATION

Walruses till the sediment layers on the sea floor to eat. This process, called bioturbation, releases an extraordinary amount of nutrients, including nitrogen, into the water.

Dr. G. Carleton Ray has researched walrus bioturbation and its significance in structuring the benthic environment and releasing nutrients into the marine ecosystem. During a talk entitled, "Pacific Walruses: Benthic Bioturbators of Beringia," given at the Center for Coastal Physical Oceanography at Old Dominion University on November 14, 2005, Dr. Ray said:

Walruses appear to have played a major role for several millennia in structuring the benthic systems of Beringia (the shelf areas across the Bering and Chukchi seas) through their feeding bioturbation. Side-scan sonar and our calculations indicate that the area affected by walrus feeding is in the order of thousands of km^2 per year. The results of walrus bioturbation include large-scale changes in sediment and biological-community structure, and magnified nutrient flux from sediment pore water by two orders of magnitude. The latter has the potential to initiate localized plankton blooms, thereby potentially influencing pelagic [oceanic] systems.

The ecological effects of walrus bioturbation must be placed in the context of regional climate changes and feedback responses. Sea-ice distribution and type strongly influence the extent and duration of walrus feeding and thus bear ecological effects. Current models indicate that Beringia, particularly sea-ice, is undergoing Earth's most rapid regional-environmental change as a consequence of climate change. Should sea-ice continue to change structurally and to move northward, the habitat and ecological role of walruses are likely to be significantly altered and/or diminished.

Researchers believe that walruses return to the same drifting ice floes from which they left to forage in the water. The loss of sea-ice due to global warming will result in diminished extent and configuration of ice platforms from which walruses will feed and bioturbate the benthic environment. According to Dr. Ray, this is significant because "if you take away bioturbation, you take away regeneration of communities."

As noted, walruses are distributed only over continental shelves because they cannot effectively feed at depths much beyond 90-100 meters. After breeding on the winter ice in the Bering Sea, the males retreat to coastal areas while the females and young of up to age three retreat with the ice into the Chukchi Sea. There they feed intensively in between periods of resting and nursing on the ice.

In 1998, the sea-ice in the Chukchi and Beaufort Seas retreated unusually far to the north and by September it covered 25% less of the Arctic Ocean than during the minimum for the previous 35 years. Vessel-based researchers surveying walruses found that substantial portions of the ice edge had receded north of the continental shelf where the water was too deep for walruses to feed. Continued warming and reduction in ice over the continental shelf in summer and fall would likely reduce the amount of forage available to lactating walruses, jeopardizing survival of nursing calves.

Calves have been reportedly abandoned on the ice as well. In April 2006, *Aquatic Mammals* reported that walrus calves had apparently been stranded far offshore by melting sea-ice in the Arctic Ocean.

The sightings of lone calves coincided with evidence of rapidly melting seasonal ice in the shallow continental shelf region where walruses feed on clams and crabs. Researchers measured an unusually warm mass of water moving onto parts of the continental shelf north of Alaska from the Bering Sea that caused seasonal sea-ice to rapidly melt. Sea temperatures there were more than six degrees warmer than those observed at the same time and location two years earlier. In areas where sea-ice remained, the sea floor was too deep, about 2,800 meters, for adult walruses to feed. Calves, which are dependent on mothers' milk for up to two years, cannot forage for themselves. Researchers believe that the mothers had to swim farther and farther from shore to find ice for the calves to rest on and eventually had to

abandon them in waters too deep to reach food. The scientists noted that, "when sea-ice retreats to such deep water, as it did in 2004, there are no platforms in shallow waters for mothers to rest and to leave their calves while they feed, and the pairs become separated."

If these observations portray a larger trend, a warmer Arctic may lead to a decrease in the walrus population. "If walruses and other ice-associated marine mammals cannot adapt to caring for their young in shallow waters without sea-ice available as a resting platform between dives to the sea floor, a significant population decline of this species could occur," the research team wrote in *Aquatic Mammals*.

RECOMMENDATIONS

The same course of action is recommended for walruses as for ice seals:

- "While the current size of the Pacific walrus population is unknown, scientists are analyzing the data collected by American and Russian researchers who finished field work in the spring of 2006 to estimate abundance using new imaging and satellite radio telemetry technologies. Walrus managers should continue to collaborate with Russian scientists to conduct comprehensive surveys and regularly monitor populations."

- In 1994, the U.S. Fish and Wildlife Service issued a walrus conservation plan under the Marine Mammal Protection Act after the public requested stronger protections when a large poaching operation was uncovered. The Walrus Conservation Plan should be updated to reflect the impacts of global warming, including analysis of the shrinking sea-ice, shifting distribution, nutritional stress, abandonment of pups and loss of bioturbation to the ecosystem.

- Important habitat hotspots should be identified and protected for these vulnerable animals and their benthic prey species.

- The government should consider whether to propose listing the Pacific walrus under the Endangered Species Act. The challenges faced by this subspecies are not appreciably different than those faced by polar bears, which the government recently proposed for listing.

WALRUS APPENDIX

Walruses are the largest pinnipeds in the Arctic and sub-Arctic seas, with a geographic range that completely encircles the polar basin. The Pacific walrus, which accounts for 80% of the world's walrus population, is one of two geographically isolated subspecies of walrus. It is found in the North Pacific Ocean's Bering Sea and in Arctic waters from the East Siberian Sea to the western Beaufort Sea, as well as in the Laptev Sea. The other recognized subspecies is the Atlantic walrus.

Walruses require ice thickness of at least 60 centimeters to support their weight and allow ready access to the water for foraging. They prefer first-year ice with natural openings such as leads, and are seldom found in areas of extensive unbroken ice. Ice that rises too high out of the water, such as multi-year floes, prevents walruses from coming out of the water. Thus, in winter their concentrations are in areas of divergent ice flow or along the margins of persistent open water areas, also known as polynyas. In summer those associating with ice are found along the southern margin of the Chukchi pack ice, moving farther into the pack in stormy seas. Floe size and topography appear to be important in the selection of haulout sites. From the ice, walruses feed in benthic areas – at the bottom of the ocean – which are composed of soft, fine sand.

Walruses have flexible hind flippers that can be rotated forward, allowing them to move on land by walking on all four appendages. The genus name *Odobenus* means tooth-walker, referring to their downward projecting tusks, which are elongated upper canine teeth and exist in both sexes. Walruses use their tusks for fighting, climbing onto both land and ice, and as a tool to break up an ice floe to keep breathing holes open or to retrieve calves that are stuck in the ice. Tusks are used a great deal in mutual display; the strongest males with the largest tusks are dominant.

Walruses also have quill-like whiskers on their snouts, giving them a mustache-like appearance. They have small eyes and no external ears. The hide, which is very thick and tough, is dark when young but lightens with age. The head and body are covered with short, tawny hair giving walruses a chestnut to cinnamon coloration. The flippers are bare. When immersed in cold water walruses appear white because of a restriction of blood to the skin, but when hauled out, their skin becomes filled with circulating blood and turns pink to red. Walruses have air sacs under their throats which when full act like floatation bubbles and allow walruses to bob vertically in the water and sleep. Walruses are gregarious, with groups of up to several hundred hauling out on ice floes or along preferred coastal areas.

Commonly found in relatively shallow water areas close to ice or land, walruses spend about half their time in the water and half their time on beaches or ice floes where they gather in large herds. They forage from ice above the continental shelf for bottom-dwelling invertebrates. Their mouths are uniquely adapted for eating buried clams and invertebrates. Walruses squirt high-power jets of water out of their mouths like a water drill to unearth clams mired in

the mud at the bottom. Scientists believe that they then use strong suction to remove the fleshy parts of the prey from the shell and then discard the shell. This intensive tilling of the sea bottom releases nutrients into the water column, provides food for scavengers such as starfish, and increases the patchiness of the bottom, which likely plays an important community structuring function for benthic and pelagic animals.

Pacific walruses range throughout the shallow continental shelf waters of the Bering and Chukchi Seas and occasionally in the eastern Siberian Sea and western Beaufort Sea where their distribution is closely linked with the seasonal distribution of the pack ice. During winter, walruses congregate within the Bering Sea, often downwind of major islands and off river estuaries where motion in the sea-ice forms leads and openings. As spring melting shifts the ice northward, females and their young follow leads into the Chukchi Sea. Most adult males remain south in open water for the summer, hauling out on several islands and spits in Bristol Bay and the Gulf of Anadyr. In fall, this pattern reverses and females move south and males go north to meet up for the January-February breeding season in the Bering Sea pack ice.

Walruses also use terrestrial haulouts on isolated islands, points, spits, and headlands with protection from strong winds and surf. Walruses are not usually found on shores with permanent human occupation. Haulout locations are possibly linked to social factors, learned behavior, and proximity to prey, but little is known about such factors. Major terrestrial haulouts are found in Bristol Bay at Cape Seniavin, Round Island, Cape Pierce, and Cape Newenham. Some individual walruses consistently occupy specific seasonal haulouts, suggesting at least some degree of site fidelity.

Bowhead Whales *(Balaena mysticetus)*

Global warming and the associated changes in the distribution and extent of pack ice in the Bering, Beaufort and Chukchi Seas is a significant concern relative to the wellbeing of bowhead whales. Bowhead whales are sensitive to changes in Arctic weather, sea-surface temperatures, ice extent and the associated effects of prey availability. The International Whaling Commission (IWC) has listed bowhead whales in the Eastern Arctic and Okhotsk Sea as "vulnerable" in part due to climate change.

The bowhead whale's foraging efficiency is intricately linked to the Arctic ecosystem and is affected by changes in ice cover, spring ice break-up, algal blooms, and in the abundance of its prey species. Spending their entire lives in Arctic waters, bowheads may be strongly affected by changes in the distribution or abundance of their prey in these areas. If plankton species are affected by global warming, this could lead to cascading effects through the food web. In addition, global warming and possible shifts in wind patterns could affect the distribution of polynyas. Dark polynyas often contain significant blooms of phytoplankton. Cetacean species such as bowhead whales that rely on ice edges for phytoplankton foraging might be adversely affected by any decline in these habitat areas.

Researchers and subsistence hunters are concerned that bowhead whales may also be impacted by other whale species migrating further northward, beyond their historical range, seeking colder waters. Large pods of gray whales typically travel to the Bering Sea's northern waters each spring from Baja, California, feasting on amphipods, tiny shrimp-like creatures that live in the muck at the bottom of the shallow sea. The gray whales feed voraciously all spring and summer in preparation for a three- to five-month fast during their 12,000-mile journey back to Baja in the fall.

However, now the gray whales are heading north into the Chukchi Sea, above the Arctic Circle, where the colder waters support amphipods. Some gray whales are foregoing their full fall migration, going no further south than Kodiak. It is unknown exactly what effect more gray whales in the northern seas year-round will have on bowhead whales. Both bowhead and gray whale populations are increasing at approximately 3% per year. Gray whales have a broader diet than bowheads, breed faster and generally seem more capable of colonizing new areas than bowhead whales. As the gray whales shift northward, they are moving closer to the territory of the bowhead whale, which feeds offshore on krill. Some Alaskan Native bowhead hunters are concerned that the more aggressive gray whale may interfere with the quieter bowhead, competing for habitat.

During the summers of 2006 and 2007, endangered humpback whales were seen swimming hundreds of miles north of their normal habitat with the whales seen north of the Bering Strait in the Chukchi Sea in 2006 and in the Beaufort Sea east of Barrow in 2007. Also seen in 2007 were endangered fin whales north of the Bering Strait in the Chukchi Sea near Point Lay. Humpback and fin whales are not associated with the ice pack ordinarily found in these waters but with the lowest ice pack on record, this area was ice-free. These whales also appear to be shifting their distribution into bowhead habitat, more than 300 miles north of their normal range in the Bering Sea.

Finally, seasonal changes in ice extent and increased human activity may restrict whale movements such that patterns of gene flow are altered. Bowhead whale migrations and selection of wintering and summering grounds may also shift in a warmer Arctic.

RECOMMENDATIONS

The Alaska Eskimo Whaling Commission should continue to collaborate with scientists to ensure there is adequate data collection and documentation of changes regarding the range and population densities of bowhead, gray, humpback and fin whales in the Arctic, to ensure that we have as much information as possible about the impacts of global warming on the whales.

BOWHEAD WHALE APPENDIX

There are five known stocks of bowhead whales, found in:

- the Bering, Chukchi, and Beaufort Seas,[6] ;
- the Okhotsk Sea,
- the Hudson Bay area,
- the area between Canada and Greenland, and
- North of Europe.

Bowhead whales are the most important subsistence animal for most northwestern and northern Alaska coastal Eskimos. The International Whaling Commission (IWC), which manages the subsistence harvest of whales, has granted the Alaska Eskimo Whaling Commission a harvest quota. For 2008-2012, subsistence hunters received a block quota of 280 bowhead strikes, of which 67 whales (plus up to 15 unharvested in the previous year) could be taken annually. This quota allowed the Chukotka Natives in Russia to take 5 whales.

Prior to the 20th century, commercial whaling severely depleted all bowhead whale stocks. Before commercial whaling, the western Arctic stock was estimated at 10,400-23,000 whales. By 1986, when a moratorium on commercial whaling was established by the IWC, only approximately 1,000 to 3,000 animals remained. Since 1978, Alaska Eskimo whalers worked with NMFS to conduct systematic counts from sites on sea-ice north of Point Barrow during the whales' spring migration, resulting in higher abundance estimates. The National Marine Fisheries Service's 2005 stock assessment includes a 2001 abundance estimate of 10,545 whales, a 3.5% to 4.9% rate of increase.

As a result of heavy exploitation by commercial whalers, the western Arctic bowhead whale stock is still listed as "endangered" under the Endangered Species Act and "depleted" under the Marine Mammal Protection Act. This stock of bowhead whales is the most studied stock in the world due to its importance to Alaska Natives for subsistence and the sub-sea location of oil and gas reserves below bowhead habitat. Research has produced reliable population estimates and trends as well as information about the whale's overall health, migration and stock structure.

6. The National Marine Fisheries Service (NMFS) refers to this stock as the Western Arctic stock and the International Whaling Commission calls it the Bering-Chukchi-Beaufort (BCB) stock.

Bowheads are the only baleen whales that spend their entire lives in waters near sea-ice and do not migrate to temperate or tropical waters to calve. They have the thickest blubber of any marine mammal, up to 0.6 meters thick, which is used for insulation, food storage, and padding. Bowheads can be up to 18.3 meters long, with the females larger than the males. Their immense heads make up nearly one-third of their total body length. A bowhead whale's head is triangular in shape when viewed in profile, possibly an adaptation enabling the whale to break through ice in order to breathe. All seven neck vertebrae are fixed into a single unit to support the bowhead's enormous body weight. Bowhead whales were named for their high, arched upper jaws that somewhat resemble the shape of an archer's bow. Their mouths can be as long as 4.9 meters, as high as 3.7 meters, and as wide as 2.9 meters.

The baleen plates of bowheads are the longest of any baleen whale, exceeding 2.7 meters. Bowhead whales feed seasonally in the summer by filtering plankton, including tiny crustaceans like krill and copepods, from the water. These filter feeders swim slowly with their mouth open, constantly eating. On occasion, they are also bottom feeders.

Bowhead whales mature slowly, taking close to two decades to reach sexual maturity – a slower growth rate than other baleen whales. Females produce a calf once every three to four years, after a 13 to 14-month pregnancy. It is unknown until what age bowheads remain able to reproduce. The bowhead lifespan was once thought to be up to 70 years, but recent discoveries of antique ivory spear points in whales harvested by subsistence hunters have triggered further research, leading to the reliable conclusion that at least some individuals have lived to be 150–200 years old.

Bowhead whales are found only in the seasonally ice-covered waters of the Arctic and in the western Arctic basin, generally occurring north of 60 degrees N. latitude and south of 75 degrees N. latitude. They migrate annually from winter breeding areas in the northern Bering Sea through the Chukchi Sea in the spring and into the Canadian Beaufort Sea in the summer. The spring migration follows fractures in the sea-ice around the coast of Alaska, generally in the shear zone between the shorefast ice and the mobile polar pack ice. They depend on a system of open-water leads to provide a migratory route between wintering and summering grounds, but can also swim below the pack ice. In the fall, the bowheads return south along the same general route.

A Bowhead Whale (Balaena mysticetus) showing it's blowhole mound.

Conclusion

The ice-dependant marine mammals discussed in this report are suffering from the effects of global warming in a number of ways, including:

- Increased mortality of young due to lack of ice and/or shelter
- Reduced food availability
- Increased energy expenditure to locate food sources
- Greater exposure to predators
- Reduced body condition

The potential for increased human activity will further stress the Arctic ecosystem, negatively impacting these populations of animals.

Unless more drastic measures are enacted to reduce greenhouse gas emissions across the globe, we can expect substantial diminishment in populations and ultimately the extinction of some of the species discussed in this report within this century. Such a loss of species and biodiversity will have far reaching effects on the entire vast Arctic ecosystem, the subsistence and cultural use of these animals by Alaska Native peoples, and the natural environment we leave for future generations.

The U.S. Department of Interior (DOI) must meet its statutory deadline that requires a final listing determination to be made within one year of the January 9, 2007, publication of the proposed rule. Likewise, the federal government could propose that ice-dependent seal species and walruses receive the same listing status and habitat protections. Congress should increase government funding for research and stock assessments of ice-dependent marine mammals. Congress should also act swiftly to close the loophole in the Marine Mammal Protection Act that permits the importation of polar bear trophies hunted in Canada. Every governing body, in addition to the federal government, that has management authority over these species must also use its best efforts to find ways to protect them.

There are steps that individuals can take to reduce their own greenhouse gas emissions. These actions, though indirect, will help to improve the long-term survival of Arctic wildlife in the United States.

- Drive less. Walk, bike, take a bus, carpool and combine errands. Do whatever it takes to reduce your time driving.
- Reduce, reuse and recycle. It takes 70%-90% less energy to make recycled paper products than new ones.
- Use a push or electric mower. Gasoline mowers are one of biggest polluters in the neighborhood.
- Conserve hot water. Set your tank at about 120°F, take shorter showers, use water-efficient washing machines and wash clothes in cold water.
- Buy ENERGY STAR. Look for the ENERGY STAR label, an EPA rating system awarded to only the most energy-efficient appliances, computers, light fixtures and many other electrical conveniences.
- Turn down, turn off and unplug. Set thermostats at 68°F when you're home and 55°F or lower at night or when you're away. Turn off lights in empty rooms and use compact fluorescent bulbs in place of standard light bulbs. Unplug electronics such as TVs, DVD players and cell phone chargers that aren't in use.

Note on Research

There is a shortage of background information about almost all ice-dependent marine mammals. This can be attributed to the difficulty of studying animals in a very remote and extreme environment, as well as the expense of both physically accessing the animals and using the appropriate technology to survey them. With the exception of bowhead whales and the Southern Beaufort Sea polar bears, there are no reliable abundance estimates for the animals discussed in this report. Also, there is no information about population trends for these animals and no potential biological removal levels. Therefore, it is virtually impossible to discern the overall status of these marine mammal species, and how much loss of individual animals the populations can sustain.

It is critical that research is undertaken as soon as possible to collect reliable background abundance information, to monitor population trends, to identify sustainable take levels and to evaluate how human-caused and natural events are affecting the populations. In addition, as human activities increase in the Arctic it will become more important to monitor those activities for possible impacts on ice-dependent marine mammals, their prey, and their habitat in order to detect harmful changes as early as possible. Moreover, research is needed to understand the cumulative effects of all issues of concern – global warming, oil and gas activities, contaminants, etc. -- on these animals to inform management actions and implement mitigation where possible.

The current level of financial support for such research limits informed decision-making about the status of Arctic marine mammals. Adequate funding is critical to support efforts by management agencies, their research collaborators and academic institutions to comprehensively survey and study ice-dependent marine mammals.

Appendix 1

Legislation, Agreements and Managing Entities

Legislation

There are two major federal laws that govern our interactions with marine mammals in the United States. The Endangered Species Act (ESA) applies to only those species that the managing agency has listed as either endangered or threatened. Of ice-dependent marine mammals, only the bowhead whale is listed under the ESA as endangered. The U.S. Fish and Wildlife Service (FWS) has proposed listing polar bears as threatened under the ESA, due to loss of ice habitat from climate change.

The Marine Mammal Protection Act (MMPA) applies to all marine mammals, and provides for co-management of marine mammals with Alaska Native organizations. There are several species-specific co-management organizations that have agreements with federal managing agencies regarding subsistence use and research, including for all of the marine mammals discussed here.

Endangered Species Act

The federal Endangered Species Act (ESA) of 1973 provides for the conservation of species that the managing agency, the National Oceanic Atmospheric Administration (NOAA) or FWS, determines to be "endangered" or "threatened" throughout all or a significant portion of their range, as well as the conservation of the ecosystems on which the species depend. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. All federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

The ESA directs the managing agency to develop and implement recovery plans for threatened and endangered species, unless such a plan would not promote conservation of the species. These plans must incorporate, at a minimum:

1. A description of site-specific management actions necessary to achieve recovery of the species

2. Objective, measurable criteria which, when met, would result in a determination that the species be removed from the list

3. Estimates of the time and costs required to achieve the plan's goal

The federal government also must designate critical habitat to protect the listed species, considering economic, national security, and other relevant impacts. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area would result in the extinction of the species concerned.

Marine Mammal Protection Act

In 1972, the U.S. Congress enacted the MMPA in partial response to growing concerns among scientists and the general public that certain marine mammal species and populations were in danger of extinction or depletion as a result of human activities. The MMPA set forth a national policy to prevent marine mammal species and population stocks from diminishing – from human activities – below the level at which they cease to be significant functioning elements of the ecosystem. The MMPA includes a general moratorium on the "taking"[7] and importing of marine mammals. The moratorium is subject to a number of exceptions, including: 1) subsistence hunting, 2) scientific research, 3) public display, 4) incidental take, 5) intentional take, and 6) defense of life.

The MMPA gave NMFS responsibility for managing and conservation of all marine mammals in Alaska, including seals and whales, with the exception of three specific species. Pursuant to the MMPA the Department of Interior (DOI) manages those three species – polar bears, walrus and sea otters. In Alaska, the FWS Region 7 Marine Mammals Management Office is responsible for managing these three species. In addition, the Marine Mammal Commission (MMC) provides oversight of the federal regulatory agencies carrying out marine mammal conservation policies and programs.

Treaties and Cooperative Agreements

International treaties and agreements also pertain to Pacific walrus, polar bears, and bowhead whales. In April 1994, an MMPA amendment provided for the development of cooperative agreements between the federal agencies and Alaska Native subsistence organizations for conservation of marine mammals and co-management of subsistence use by Alaska Natives. Section 119 of the MMPA amendments authorized the appropriation of funds to the Secretary of Interior and the Secretary of Commerce to implement co-management activities in Alaska. To provide the foundation and direction for the use of co-management funds provided under Section 119, the Indigenous People's Council for Marine Mammals (IPCOMM), U.S. Geological Survey Biological Resource Division, NMFS and FWS developed a Memorandum of Agreement.

7. The MMPA defines "take" as to "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

To facilitate co-management activities, there are cooperative agreements between the federal management agencies and the Ice Seal Committee, the Alaska Nanuuq (polar bear) Commission, the Eskimo Walrus Commission, and the Alaska Eskimo Whaling Commission. The cooperative agreements fund a wide variety of management issues, including:

- Commission of co-management operations
- Biological sampling programs
- Harvest monitoring
- Collection of Native traditional and ecological knowledge in management
- International coordination on management issues
- Cooperative enforcement of the MMPA
- Development of local conservation plans

Alaska Inupiat – Canadian Inuit Agreement: Southern Beaufort Sea Polar Bears

In 1988, the North Slope Borough Department of Wildlife Management (representing Alaska Inupiat people) and the Inuvialuit Game Council (representing Canadian Inuit people) signed an agreement to provide for coordinated management of the Beaufort Sea polar bear stock. Since the initiation of this local user agreement in 1988, the combined Alaska/Canada mean harvest from this stock has been 55.1 bears annually. From 1995-2000, the combined harvest of Southern Beaufort Sea polar bears was approximately 52, with the average Alaska harvest 32.2 and the Canadian harvest 19.6, from the same stock. In Alaska, the polar bear harvest is regulated by voluntary actions of local hunters provided that the population is not depleted.

The Alaska Nanuuq Commission

In 1994, the Alaska Nanuuq Commission was formed to represent the Alaska villages and hunters who harvest polar bears. In February 1997, the Nanuuq Commission and FWS signed a Cooperative Agreement for the Conservation of Polar Bears in Alaska pursuant to section 119 of the MMPA for the co-management of polar bears. The current agreement includes feeding ecology studies on the North Slope, public education, predator-prey studies, contaminant assessment, human-bear interactions and cooperation with the Natives of Chukotka in Russia on the conservation of the shared polar bear population. The Nanuuq Commission also has a cooperative agreement with the National Park Service Beringian Heritage Program for polar bear studies in Chukotka and with the National Marine Fisheries Service for studies on ice seals, the primary prey for polar bears.

Harvest levels of the Chukchi/Bering Seas stock by Alaska Natives has been in decline. From more than 100 in the early to mid 1900s, the 1996-2000 mean harvest was 44.8 bears. It is believed that there is substantial poaching going on by Russian Natives, of approximately 200 bears a year. The Alaska Nanuuq Commission is also developing a Native to Native Agreement with the Association of Traditional Marine Mammal Hunters of Chukotka to manage the subsistence harvest of polar bears and to assign quotas.

2000 U.S. Russia Treaty on Polar Bears

In October 2000, the United States and Russia signed a bilateral agreement for population and habitat conservation of the Chukchi/Bering Seas stock. The treaty sets quotas on polar bear hunting by Native populations in the two countries and establishes a bilateral commission to analyze how best to sustain the polar bear habitat. The Alaska Nanuuq Commission was instrumental in developing this agreement that identifies a central role for Native people in future implementation. The treaty is unique in that it allows representatives of Alaska Natives and the Natives of Chukotka to sit with their respective federal government agencies on a joint commission which will set harvest limits on the shared polar bear population in the Bering and Chukchi Seas. Since the U.S. Congress passed legislation in December 2006 to authorize regulation and harvest management of Chukchi bears, both governments are now able to move forward in implementing the treaty.

Ice Seal Committee

Because of the importance of ice seals to Alaska Natives as a source of food and clothing, and to polar bears as prey, the Ice Seal Committee of the Alaska Nanuuq Commission was formed to manage and conserve ice seal populations. The Ice Seal Committee is made up of subsistence seal hunters who represent five different regions that span the coast of Alaska from Bristol Bay to the Canadian border. The Ice Seal Committee helps NMFS manage the four ice seal species through research and education, and the two entities have an agreement to co-manage Alaskan ice seal populations.

Eskimo Walrus Commission

The Eskimo Walrus Commission (EWC) was formed in 1978 as a consortium of Native hunters concerned with the health of walrus and other marine mammal populations; nineteen communities are EWC members.[8] The EWC has taken an active role in the management and research of walrus at the local, state, national and international levels. In 1997, FWS and EWC signed a cooperative agreement to encourage subsistence hunters to participate in conserving and managing walrus stocks in coastal communities. In 1998, a memorandum of understanding between FWS, EWC, and Alaska Department of Fish & Game was signed, allowing joint management of the Pacific Walrus Conservation Fund. The majority of the funds come from the sale of raw ivory by the EWC during state conferences and events.

EWC works cooperatively with FWS on a number of projects:

- Conducting an annual walrus harvest monitoring project to gather information about the size and composition of the annual subsistence walrus harvest in Alaska
- Conducting biannual meetings of commission members who represent the 19 communities
- Monitoring subsistence walrus hunts on Round Island with Bristol Bay Native Association's Qayassiq Walrus Commission in Bristol Bay
- Collecting detailed walrus harvest data and biological samples in five communities
- Recording general walrus harvest data through the federally mandated marking, tagging, and reporting program
- Working through a cooperative agreement between U.S. and Russian governments with all Chukotkan Native coastal communities in the harvest, conservation and management of the Pacific walrus
- Gathering culture-based traditional knowledge
- Working with communities to become more proactive in co-management of the walrus population

While the subsistence walrus harvest in Alaska is fairly well documented, Russian harvest estimates are no longer considered accurate or reliable. Since 1999, the FWS and the EWC have sponsored a walrus harvest monitoring project in Chukot, collaborating with organizations in Chukotka, Russia. The project collects walrus harvest information from the eight primary walrus hunting villages in Chukotka, using local Native harvest monitors. Each spring American and Russian representatives meet in Nome, Alaska, to exchange harvest data and discuss pertinent walrus conservation and management issues.

International Whaling Commission

The International Whaling Commission (IWC) is an inter-governmental commission that is responsible for implementing the 1946 International Convention for the Regulation of Whaling (ICRW). Membership is open to any country which formally adheres to the ICRW. Each country is represented by a commissioner who votes every three years to elect the Chairman and Vice-Chairman. The IWC's explicit objectives are to provide for "the proper conservation of whale stocks and the orderly development of the whaling industry." The IWC's main duty is to review and revise the measures provided in the schedule to the convention which govern the conduct of whaling throughout the world. The IWC can also require catch reporting and other statistical and biological records. In addition, the IWC encourages, coordinates and funds whale research, publishes the results of these and other scientific research and promotes studies into related matters such as the humaneness of the killing operations.

In 1982, the IWC agreed to implement, beginning with the 1985-1986 season, an international moratorium on commercial whaling worldwide.[9] It issues separate quotas for aboriginal subsistence whaling in Denmark (Greenland – fin and minke whales), the Russian Federation (Siberia – gray and bowhead whales), St. Vincent and The Grenadines (humpback whales) and the United States (Alaska – bowhead whales; gray whales by the Makah in the State of Washington).

8. The communities include Barrow, Brevig Mission, Clarks Point, Gambell, Kivalina, King Island, Kotzebue, Kwigilingok, Little Diomede, Mekoryuk, Nome, Point Hope, Point Lay, Savoonga, Shishmaref, Stebbins, Unalakleet, Wainwright, and Wales.

9. Norway lodged a formal objection to the zero catch limits set in 1985/86 and is thereby not bound by them. It has recently resumed commercial whaling, setting its own catch limits on the basis of the IWC Management Procedure.

As part of their response to the decision to stop commercial whaling, some member governments have implemented scientific research programs including the sampling of whales caught under special permits which the Convention allows them to grant. Japan is taking close to 1,000 whales each year in both the Antarctic and the North Pacific under this provision. Norway and Iceland have also issued permits under their scientific programs in the past.

Alaska Eskimo Whaling Commission

The AEWC is made up of the registered whaling captains and their crew members from each of the ten whaling communities in Alaska: Gambell, Savoonga, Wales, Little Diomede, Kivalina, Point Hope, Wainwright, Barrow, Nuiqsut, and Kaktovik. The registered whaling captains are voting members and crew members are non-voting members. The AEWC is directed by a ten-member board (one from each whaling village).

The AEWC was formed after the IWC voted in 1977 to ban the Alaska Eskimo subsistence bowhead whale harvest based on inaccurate population estimates from U.S. government scientists that there was an alarmingly low number of bowheads. The government had not consulted with the Eskimos in determining the population estimate or in communicating with the IWC. Ultimately, the IWC approved a limited quota of 18 strikes for the 1978 bowhead whale harvest across the 10 AEWC member villages. The AEWC communities agreed to abide by the IWC quota until research proved that the Eskimos' estimates of the bowhead population were correct. The North Slope Borough Department of Wildlife Management took the primary responsibility for estimating the population. The AEWC agreed to cooperate fully with federal research efforts. Since 1978, the AEWC has cooperated in bowhead whale surveys.

In March 1981, NOAA substantially delegated authority to the AEWC to manage the subsistence hunt and to enforce regulations imposed on that hunt by entering into a cooperative agreement. AEWC adopted a management plan to improve the efficiency of the subsistence hunt and to educate people about the importance of the bowhead whale to the whaling communities. The AEWC determines the allocation of IWC permitted strikes among the whaling villages. The management plan provides that the meat and edible products of bowhead whales taken in the subsistence hunt are used exclusively for Native consumption and may not be sold.

As a result of AEWC's census work, the long-standing observations of Eskimo whalers have been corroborated and the IWC accepts that bowhead numbers are significantly higher than previously thought. In addition, the IWC accepts AEWC information on each bowhead whale harvested.

Appendix 2

IFAW POSITION STATEMENT: Climate Change and Marine Mammals

Statement of Position:

Climate change, especially global warming, has profound implications for marine mammals.[10] Adverse effects on the welfare of individuals have already been observed, as have significant impacts on marine mammal populations and their habitats.

In recognition of the magnitude of this threat, IFAW urges policy makers to adopt the strictest precautionary measures in all policies and decisions affecting the welfare and conservation of marine mammals. IFAW favors mandatory programs to reduce the build up of greenhouse gases and encourages individuals to understand how their daily choices impact global warming and therefore have a direct impact on the welfare of marine mammals.

Explanatory Notes:

1. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (International Panel on Climate Change (IPCC) 2007).

2. Global climate change, including global warming, has profound implications for all living organisms, including humans (e.g. IPCC 2001). Future impacts are difficult to predict precisely, however, because the interactive effects of climate and ocean processes are complex. Nonetheless, it is clear that rapid human-induced global warming poses profound risks for the welfare and long-term survival of many marine mammals (e.g. Robinson *et al*. 2005).

3. Included among the impacts observed or suggested for marine mammals are: changes in the timing of migration and breeding; changes in, or loss of, haulout sites (e.g. some seals) because of rising sea levels; increased mortality in certain locations or years (e.g. polar bears, harp seals); reduced reproductive success (e.g. southern right whales); changes in the distribution and abundance of important prey species, competitors and predators; and changes in population distribution patterns or ranges (e.g. Leaper *et al*. 2006, Robinson *et al*. 2005, Johnston *et al*. 2005).

4. Ocean processes influence, and are influenced by, climatic changes (including global warming). The oceans have experienced climatic fluctuations in the past within the ranges that are currently occurring. The differences today are that the rapid rate of global warming is unprecedented, and that human activities are a major contributor (e.g. IPCC 2001). Complex interactions between climate and ocean processes create significant environmental change impacting:

   - temperature
   - salinity
   - acidity
   - ocean circulation
   - currents
   - sea levels
   - sea-ice cover and thickness
   - distribution and migration patterns, and
   - abundances of marine mammals and their prey.

Such impacts can in turn affect the nutritional status, reproductive success, and survivorship of marine mammals (e.g. Robinson *et al*. 2005).

5. While it is difficult or sometimes impossible to make precise predications about the impacts of climate change on both marine mammals and their habitats, in recognition of the potential impacts, IFAW will continue to advocate that management authorities incorporate environmental uncertainty into management plans and make management decisions based on the precautionary principle, especially when the species in question are subject to direct killing (e.g. harp and hooded seals, grey seals, walruses, polar bears); incidental killing such as entanglement in fishing gear (e.g. harbour porpoises); disturbances to habitats (e.g. monk seals); exposure to toxic pollutants; exposure to active sonar and other harmful underwater noise pollution; and collisions with ships (right whales).

10. For the purposes of this statement, "marine mammals" include: cetaceans (whales, dolphins and porpoises), pinnipeds (fur seals, sea lions, walrus, and true seals), sirenians (manatees and dugongs), sea otters and polar bears.

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Appendix 3

Source Materials
In order to make this report as readable as possible, we did not include literature citations throughout the text. Readers who want additional information may wish to consult some of the many documents that were used in the preparation of this report. These are listed below, first for the Introduction, and then for each of the Alaska marine mammals covered in the report.

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