

Appendix 5.5 Sea Ice Habitats

Featured Species-associated Ice Habitats: Fast Ice and Pack Ice

Ice in the Arctic environment consists of both “fast ice” and “pack ice.” Shore-fast ice forms in place and is attached “fast” to the coastline or to large floes or pressure ridges that are grounded. Fast ice forms annually and may contain icebergs and floes of older pack ice. It can extend for a few meters from a shore, ice front, shoal, or grounded iceberg, or may extend for several hundred kilometers from such attachment points, depending on water depth. Fast ice is generated in the shallow coastal waters of the northern Bering, Chukchi and Beaufort seas. Its formation depends on a combination of air and water temperatures and wind direction over the continental shelf. Sea ice is dynamic and variable with many cracks or openings.

Pack ice is not anchored to land and moves with the ocean’s currents and winds. It forms annually and can include old sea ice, as well as ice that has formed elsewhere and has floated off with the winds and currents. Under present climatic conditions, pack ice persists in the Arctic Ocean all year. It is extremely heavy and has the effect of dampening sea swells. The rolling motion of the sea can be considerably moderated



Walrus on pack ice

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by a relatively narrow band of pack ice only 100 m or so wide. The result is that where pack ice persists in reasonable quantity, the sea calms down sufficiently for low temperatures to freeze it more easily than moving water. The southern edges of this loose moving ice, called the fringe, are subject to dispersal by wind and currents and are broken by the vertical motion of swells from the open sea. Generally, multiyear pack ice in the Arctic has a 3- to 5-year “life” expectancy.

Due to its movements with ocean currents and wind, pack ice is not continuous; instead pond-like open water refuges called polynyas and long, linear cracks called leads are created. Polynyas are created where winds and currents combine to produce open areas where there is no ice, or comparatively thin ice, during the winter. Some reoccur year after year in the same places, although the exact boundaries vary

annually with prevailing environmental conditions. Extensive polynyas are found in the Bering Sea. Other open areas, such as leads, are created when weak ice is broken by wind stress, initially forming a crack, and then widened by the wind or currents. The maximum southerly extent of the ice pack occurs in April, typically extending no farther south than the Pribilof Islands in the Bering Sea. By September, the ice reaches its maximum northward retreat in the Arctic Ocean (Gibson and Shullinger 1988).

Ice-associated Species

Polar bear, *Ursus maritimus*

Walrus, *Odobenus rosmarus*

Bearded seal, *Erignathus barbatus*

Ribbon seal, *Phoca fasciata*

Ringed seal, *Phoca hispida*

Spotted seal, *Phoca largha*

Bowhead whale, *Balaena mysticetus*

Common Murre, *Uria aalge*

Thick-billed Murre, *Uria lomvia*

Spectacled Eider, *Somateria fischeri*

Arctic cod, *Boreogadus saida*

Ecological Role of Sea Ice Habitats

Nine species of mammals are strongly and positively linked with the occurrence of sea ice in western and northern Alaska. These are the arctic fox; polar bear; beluga and bowhead whales; the walrus; and the bearded, ringed, spotted, and ribbon seals (Burns et al. 1980). Each species of marine mammal requires a certain type of sea ice for resting, molting, socializing, breeding, rearing, migration, and access to prey.

Predator-prey interactions within this marine ecosystem are dictated by spatial and temporal availability of sea ice. Marine mammals such as the polar bear and seals depend almost entirely on sea ice for their habitat. Among the ice-associated seals, ringed seals occur in all habitats offered by sea ice, but are the only seal to inhabit the stable land-fast ice along Alaska's northern shorelines. They make and maintain breathing holes through ice that may be 6 ft thick, and the pups are born in snow caves or lairs excavated in snowdrifts on the ice. Ringed seals do not dive to great depths and make particular use of ice over shallow waters by preying on Arctic cod during their nearshore migration (Burns et al. 1980). Bearded seals typically occur in all but the shore-fast ice, while ribbon seals and spotted seals are generally found only in the ice front from February to late April. Although some spotted seals occur on the ice fringe, as well as deep into the pack ice, they are not typically found in open seas or consolidated ice in the early spring (Trukhin and Kosygin 1988). Spotted seals take advantage of shorefast ice only when the ice front (10- to 20-m rectangular floes with brash ice or open water between) has dispersed in late spring-early summer or in fall before the ice front forms. Polar bears use the sea ice as a platform from which to hunt ringed and bearded seals. They wait for seals to return to air holes, capturing and pulling them through the ice hole as they come up for air. Alternatively, polar bears will slowly stalk and catch seals as they rest on the ice surface. Without sufficient ice, bears may become stranded onshore, unable to access and successfully hunt their usual prey.

Many polar bears den offshore on the pack ice of the Beaufort Sea region during November through March, when they give birth and nurse their young (Amstrup 1988). Walrus calves are usually born on the pack ice in late April–early June. The calf subsists solely on milk for the first 6 months or so, before beginning to eat solid foods. Nursing takes place primarily in the water, but also sometimes on land or ice. Sea ice allows seals and walruses to rest near food resources: It provides spacious habitat, is remote from shore-based predators, is relatively sanitary, and may offer shelter from the wind. The ice edge is also important habitat for birds and marine mammals that are less ice-adapted and cannot feed within the more continuous fast ice zone. These animals are often found feeding and resting in leads and divergence zones near the ice edge.

Quality and quantity of the ice is an important variable in local habitat selection of ice-dependent species. Seasonal environmental change dictates larger scale changes in species abundance and distribution patterns. For example, migrations of sub-Arctic seabirds (e.g., Thick-billed Murres), water birds, fish, and marine mammals follow the retreating ice northward. The reproductive success and spatial distribution of ice-dependent species also vary between warm and cool environmental conditions. For example, seals and walruses haul out on sea ice to sleep and bear young. Walruses mainly occupy a narrow band of the ice edge in the Chukchi Sea in summer and open water and polynyas throughout the range of sea ice in the Bering Sea in winter and spring.

Leads and polynyas provide migration routes from summer feeding grounds to wintering areas. Whales, walruses, and certain seals depend on polynyas for winter survival. During this time their presence in other areas of the Arctic is restricted for lack of places to breathe due to thick ice cover on the sea. The survival of animals overwintering in polynyas depends on the water remaining open, in order to minimize energy used to maintain breathing holes. Migratory sea ducks such as the federally listed Spectacled Eiders move far offshore to waters during the months of October through March, where they sometimes gather in dense flocks in polynyas located amid nearly continuous sea ice.

The presence and condition of sea ice plays a broader and more complex role in the Arctic ecosystem than simply providing a platform and transportation routes. During the winter, tiny marine ice algae populate the lower surface of the sea ice. This ice algae is thickest where openings or thinner ice allow more light penetration. By spring, the algae forms a thin, dense layer. The algae are the food for an under-ice community of diverse biota. Crustaceans and other small sea life feed on these plants, and are in turn, food for fish. Arctic cod are a staple food source for other fish, birds, seals, and beluga whales. Fish species such as herring, capelin, eelpout, sand lance, and pollock, as well as octopus and shrimp, are significant prey species of arctic seals (Quakenbush 1988). As spring approaches, most of the plankton sinks to the sea bottom and supports important benthic communities, including clams, amphipods, worms, snails, sea cucumbers and mollusks, including crab (Gibson and Shullinger

1998). In turn, these bottom-dwelling populations support large resident marine mammals, such as walruses and bearded seals.

Beyond the maximum extent of the pack ice (i.e., in open water), a bloom of phytoplankton occurs later, followed by a bloom of zooplankton that graze on these tiny algae plants. The northern Bering and southern Chukchi Seas provide dense summer concentrations of zooplankton. Whales such as the bowhead, the only baleen whale with a range restricted to the icebound seas, thrive on the zooplankton. Other baleen whales, including gray whales, migrate to this area in the summer and feed on the zooplankton.

Effects of diminished sea ice include potential changes in the timing, migration routes, and numbers of marine mammals. A change in the status, health, or accessibility of marine mammal populations will affect the human coastal and island communities' subsistence activities, economics, and cultural traditions.

Conservation Status

Although diminishing in annual depth and extent, Alaska's sea ice habitat is otherwise generally healthy. Localized development will likely continue to result in habitat alteration. Opportunities should be sought that alleviate negative impacts and maintain connectivity, as well as suitable areas of quality habitat important to the sustainability of species.

Currently, Arctic sea ice habitats are impacted by global warming, offshore oil and gas development activities, and pollution and contaminant transport. Each of these conservation concerns has associated transboundary, regional and international implications that harbor significant threat to Arctic marine and coastal ecosystems in Alaska. Of great concern for Arctic habitats are the ecological implications of reductions in sea ice extent and duration.

In 2000 the Arctic Climate Impact Assessment (ACIA) study was commissioned via a special initiative of the Arctic Council and the International Arctic Science Committee at a ministerial meeting of the Arctic Council in Point Barrow, Alaska. The purpose of the ACIA was to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and associated consequences. Developed by more than 300 international scientists, the ACIA report documents a 4-year study on the rapid warming of the Arctic. In November 2004, the scientists released a 144-page summary of their findings at a press conference in Washington, D.C. This study reports a dramatic reduction in the extent of the summer ice pack in the Arctic Ocean. Specifically, late summer ice coverage has declined by as much as 20 percent in the past 3 decades and is projected to shrink by another 10 to 50 percent by the end of this century (Spotts 2004). These findings point to a real loss of sea ice habitat that Arctic marine mammals depend on. For more information on findings of the ACIA report, see CWCS Section IVA, pages 83–88.

International efforts to protect the Arctic and its biota are occurring under the auspices of the Arctic Council, an intergovernmental forum for addressing common concerns and challenges faced by the Arctic states of Canada, Denmark, Finland, Iceland, Norway and the Russian Federation, Sweden, and the United States. Two Arctic Council programs, in particular, focus on the needs of Arctic marine species; these are the Program for Conservation of Arctic Flora and Fauna (CAFF, described in more detail in Section VIII), which promotes conservation of biodiversity and the sustainable use of living resources, and the Program for the Protection of the Arctic Marine Environment (PAME). PAME addresses policy and nonemergency pollution prevention and control measures related to the protection of the Arctic marine environment from land and sea-based activities, including marine shipping, offshore oil and gas development, land-based activities, and ocean disposal. Established in 1993, the PAME program works closely with CAFF scientists and also with representatives of the other 3 Arctic Council programs: Sustainable Development Working Group (SDWG), which explores the economic, social, and cultural aspects of sustainable development; AMAP, which identifies pollution risks and their impact on Arctic ecosystems and assesses the effectiveness of international agreements on pollution control; and Emergency, Prevention, Preparedness and Response (EPPR), concerned with sharing information and methods for spill prevention and control.

All offshore oil and gas developments require a means of bringing hydrocarbons to the international market. With one exception this requires onshore infrastructure. The exception is offshore oil transfer, which is the single biggest source of oil pollution in the Arctic (Smith 2004).

To date, fast ice has provided a useful platform on which to construct temporary roads and conduct onshore exploratory seismic and drilling operations. Fast ice used for seismic exploration may impact denning polar bears that construct dens where sufficient snow accumulation provides cover. Additionally, seismic exploration has been documented to alter bowhead whale migration routes, as well as to displace ringed seals (Burns et al. 1980).

Alaska's Arctic waters have experienced an increase in use by maritime traffic in recent years, and this trend will likely continue. Based on current activity levels of oil exploration, production, and transportation, Cook Inlet and the Beaufort Sea are the state's areas of highest concern regarding protection from oil spills. Unfortunately, there continues to be no significantly effective method for containing and cleaning up fuel spills that may occur in icy waters (DF Dickins Associates Ltd. 2004). Booms and lenses are ineffective in broken ice and unusable in closed ice conditions. State oil spill contingency plans fall short of the ability to protect Alaska's marine environments. This is particularly troubling because contaminants remain toxic longer and are more difficult to clean up once trapped in ice. They also take longer to break down in the Arctic's colder temperature regime. An additional concern is that fuel spills concentrate in open waters in the sea ice and in breathing holes where animals surface and congregate.

Currently, 30 miles of Arctic Ocean coastline is federally designated as wilderness. This area is known as the Arctic National Wildlife Refuge. It is here, on the coastline of this refuge that more polar bears den than along any other stretch of Alaska's coast. Other important polar bear denning habitat occurs within the Western Arctic Reserve (National Petroleum Reserve-Alaska).

Marine waters within 3 miles of Alaska's coast are under jurisdiction of the DNR's Division of Mining, Land and Water. Waters beyond the 3-mile limit are managed by the NOAA. The COE regulatory jurisdiction under the Clean Water Act and the Rivers and Harbors Act also includes all ocean and coastal waters within a zone 3 miles seaward from the line on the shore reached by the ordinary low tides.

Programs that monitor sea ice in Alaska's waters are important. Such programs should receive support in order to allow for regional assessments and integration with other Arctic and global monitoring programs. Research to develop credible and effective response to spilled oil in moving, broken, pack ice in the ocean, lakes, or rivers is also a high priority. These projects require consistent, long-term funding to be effective and meaningful.

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