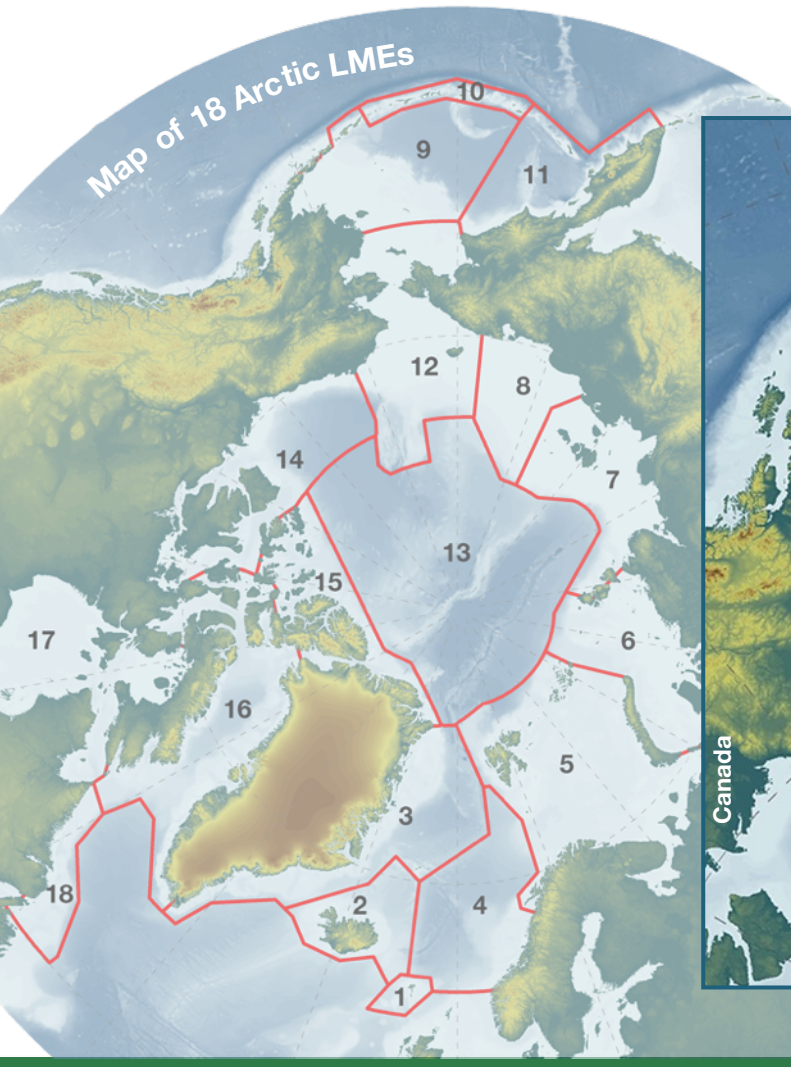
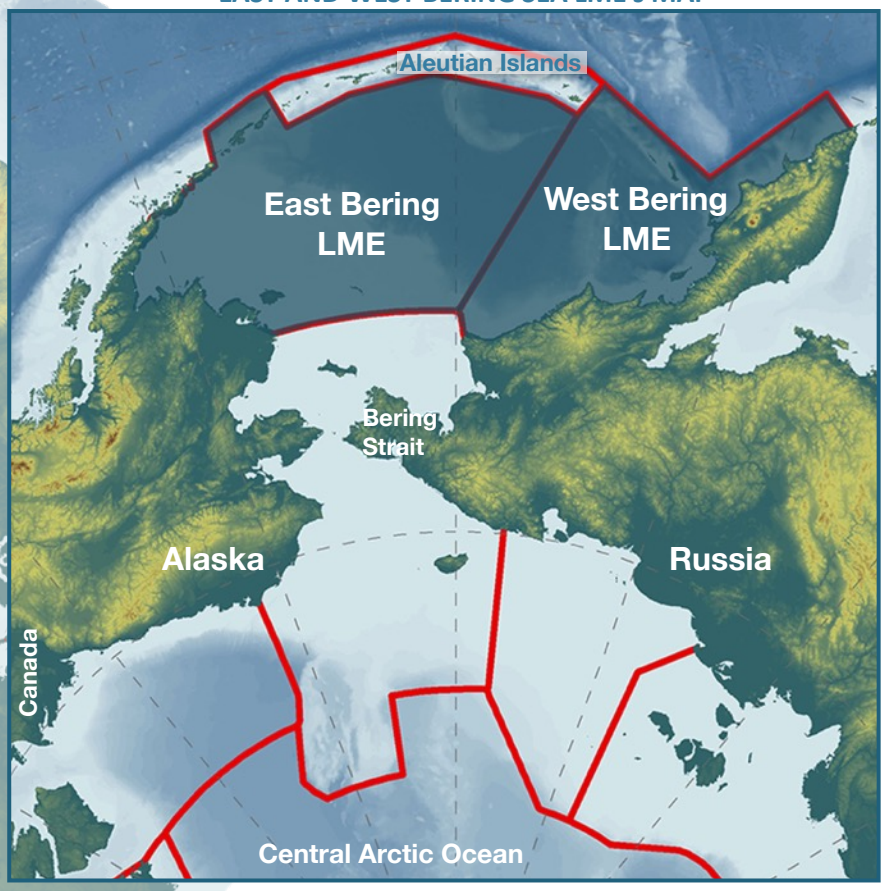
BERING SEA LME
EAST AND WEST



EAST AND WEST BERING SEA LME's MAP



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PAME

Protection of the Arctic Marine Environment

ARCTIC LMEs

Large Marine Ecosystems (LMEs) are defined as regions of ocean space of 200,000 km² or greater, that encompass coastal areas from river basins and estuaries to the outer margins of a continental shelf or the seaward extent of a predominant coastal current. LMEs are defined by ecological criteria, including bathymetry, hydrography, productivity, and tropically linked populations. PAME developed a map delineating 17 Arctic Large Marine Ecosystems (Arctic LME's) in the marine waters of the Arctic and adjacent seas in 2006. In a consultative process including agencies of Arctic Council member states and other Arctic Council working groups, the Arctic LME map was revised in 2012 to include 18 Arctic LMEs. This is the current map of Arctic LMEs used in the work of the Arctic Council in developing and promoting the Ecosystem Approach to management of the Arctic marine environment.

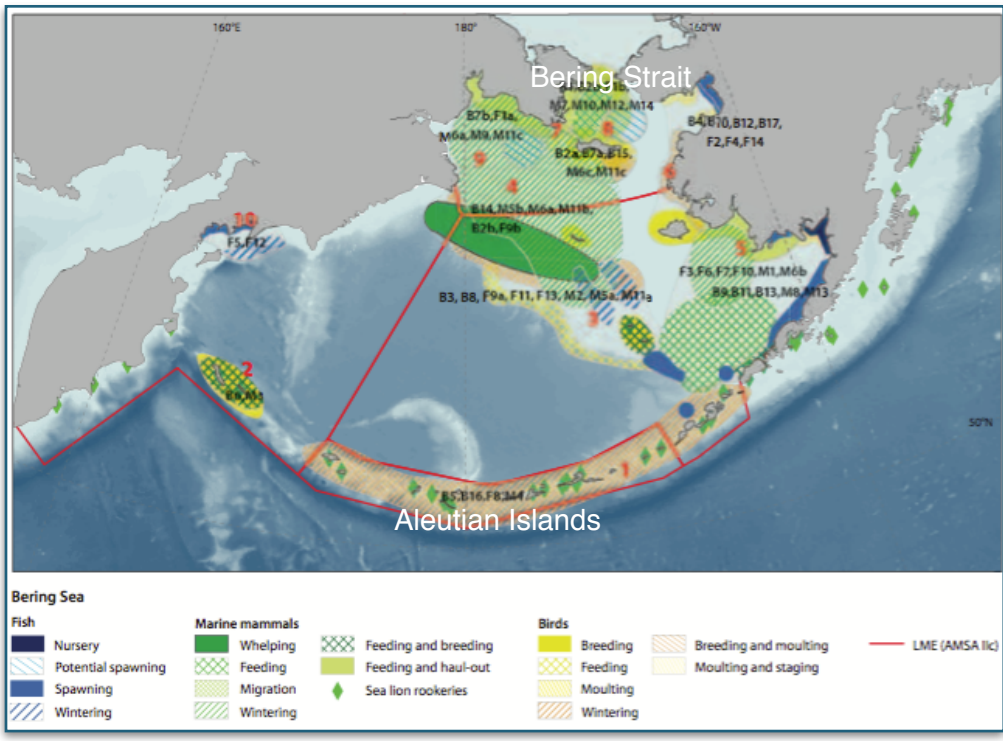
Joint EA Expert group

PAME established an Ecosystem Approach to Management expert group in 2011 with the participation of other Arctic Council working groups (AMAP, CAFF and SDWG). This joint Ecosystem Approach Expert Group (EA-EG) has developed a framework for EA implementation where the first step is identification of the ecosystem to be managed. Identifying the Arctic LMEs represents this first step.

This factsheet is one of 18 in a series of the Arctic LMEs.

OVERVIEW: BERING SEA LME - EAST AND WEST

The Bering Sea is separated into the Western Bering Sea LME and the Eastern Bering Sea LME. The Bering Sea is large with a total area of about 2.6 million km², divided almost equally between the eastern and western parts, 1.36 and 1.26 million km², respectively. The southern boundary is made up of the Aleutian Islands, which is a curved volcanic archipelago extending from the Alaska Peninsula to the Komandorskiye Islands off Kamchatka. The northern boundary is the shallow Bering Strait that connects it to the Arctic Ocean.



Map: The Bering Sea LME - East and West. *Source: AMSAIIC*

The shelf region of the Bering Sea is usually covered by ice in winter, whereas the deep basin region in the southwest is not. In cold years, seasonal ice forms over the whole shelf in both east and west and also out over slope waters. In warm years, however, ice may be limited to the northern parts of the shelf, while Bristol Bay in the southeast is ice-free. All of the Bering Sea clears of ice in summer with the minimum sea-ice extent in September, when the ice edge lies in the Chukchi Sea north of the Bering Strait. Freeze-up usually starts in late October or November and the ice progressively develops and extends southwards during winter. The ice is carried south by the predominant northerly winds and contributes to the heavy pack ice of the northern Bering Sea. The rate of ice drift may be 20 to 30 km/day with rates as high as 50 km/day in the Bering Strait. Unreformed ice thickness is 0.5 to 1 m.

The polynyas south of St. Lawrence Island and along the southern coast of the Chukotka Peninsula are particularly important wintering habitats for marine mammals (walrus, bowhead, beluga) and birds such as eiders.

The bottom-dwelling animals (benthos) of the eastern and northern Bering shelf are rich in species and occur in high abundance and biomass. In a large survey that extended into the southeastern Chukchi Sea, a total of 472 different species were identified. In terms of biomass and as an average for the whole area, bivalves and sea urchins were the most important groups, making up 38% and 19% of the total biomass. The rich benthos of the Bering shelf supports large populations of demersal fish and marine mammals.

MARINE MAMMALS

The species of marine mammals that are regular inhabitants of or visitors to the Bering Sea comprise 16 species of cetaceans (whales, dolphins and porpoises), eight species of pinnipeds (seals, walrus, sea lions), the sea otter, and the polar bear. Many of the species are summer visitors that come to feed in the Bering Sea, including fin, humpback, grey, blue, sei, and sperm whales. Eight species of marine mammals are associated with ice: ringed, bearded, spotted and ribbon seals, walrus, bowhead, beluga, and polar bear; they spend the winter and spring in the Bering Sea where many of them breed before they retreat with the ice to spend the summer in the Arctic north of the Bering Sea. However, some parts of the walrus, spotted seal and beluga populations may remain in the coastal areas of the northern and eastern Bering Sea during summer. Resident species that occur mainly in ice-free parts of the Bering Sea include harbor seal, Steller sea lion, minke and killer whales, and Dall's and harbor porpoises.

Most species of marine mammals occur in the coastal areas or shelf regions where they feed variously on small fish, crustaceans, and other prey. This includes many of the seal species, walrus, harbor porpoise, beluga, bowhead, and sea otter. The large baleen whales (other than bowhead) occur variously in shelf, slope, and basin waters where they feed on zooplankton and small schooling fish. Sperm and beaked whales feed largely on cephalopods and to a lesser degree on fish over deep basin or slope waters. Pacific walrus and grey whale are particularly adapted to feed on benthos and benefit from the rich production and high abundance of benthic fauna in the shallow parts of the northern Bering Sea region.

Grey whales have a feeding migration from breeding and calving areas off Baja California into the northern waters where they feed in summer by sucking up patches of the fine sediments of the seafloor rich in amphipods, which the whales retain by filtering the suspended sediments through their baleens. The size of the eastern grey whale population is currently estimated to be a minimum of about 19,000 individuals.

Belugas are abundant and widely distributed in coastal waters in the Bering Sea and also offshore, mainly in the pack ice during winter. Four beluga stocks occur in the Bering Sea during either the winter season or the whole year. The two populations resident in the Bering Sea, the Eastern Bering Sea and Bristol Bay stocks, total about 20,000 individuals. The Bering Sea is the main wintering area of belugas from two migratory populations in the Beaufort and Chukchi Seas. The Beaufort Sea stock is the largest with a minimum estimate of about 32,500 individuals, while the East Chukchi Sea stock has a minimum estimate of about 3,700 individuals. Belugas feed to a large extent on a variety of fish species, including polar cod, saffron cod, herring, and various species of coregonid whitefish, flatfish, and sculpins, but they also take shrimps and crabs where they are available.

In addition to beluga, there are eight more species of toothed whales that occur in or visit the Bering Sea. These are the sperm whale, three species of beaked whales, two porpoises, the killer whale, and a smaller dolphin. Sperm whales, the three beaked whales (Baird's, Cuvier's, and Stejneger's), and Dall's porpoises feed to a large extent on squid. These species are distributed over deep basin waters and to some extent in slope waters. They are also the most numerous of the whales or dolphins (Springer et al., 1999). Harbor porpoise is mainly a coastal and shelf species, whereas killer whales range from oceanic to coastal environments.

The northern Bering Sea is the main wintering area for the bowhead whale of the Bering-Chukchi-Beaufort stock, also called the Bering stock or the western Arctic stock. This stock is estimated to number about 10,500 individuals. It is still considered endangered under the U.S. Endangered Species Act. The entire population is thought to winter in the seasonal pack ice of the north-central and northwest Bering shelves. The northward spring migration of bowheads starts early in the season, coinciding with the onset of variable ice drift and opening of the pack. Most mating probably occurs in the Bering Sea in March to April before or at the start of the seasonal migration. Following the seasonal feeding in the Beaufort and Chukchi Seas, the whales return to the northern Bering Sea in late autumn or early winter. Bowheads are specialized to feed on zooplankton and are equipped with very long, fine-meshed baleen. Their main food items are copepods, krill, and amphipods.

The **North Pacific right whale** occurs with two populations in the eastern and western North Pacific. The species was severely depleted by previous whaling and is estimated to exist with only about 500 animals and assessed to be endangered. About 400 of these whales (the estimate is possibly on the low side) belong to the western population that are regularly sighted in the Okhotsk Sea, which is a main summer feeding area. The eastern North Pacific population probably totals only tens of animals and is considered to be critically endangered. The National Marine Fisheries Service has designated critical habitat for the North Pacific right whale in the southeastern Bering Sea and northwestern Gulf of Alaska, where right whales have been consistently spotted in the past ten years.

Fin whale is a large, rapid-swimming baleen whale that can be up to 27 m long, second in size only to blue whale. Most fin whales are believed to migrate seasonally from lower latitude winter habitats, where breeding and calving take place, to relatively high latitude summer feeding habitats. Copepods form an important part of the diet of fin whales early in the season; krill are important later in the summer. Commercial whaling from the 1950s to the 1970s caused a severe decline of the fin whale population in the North Pacific. Currently, around 4,000 fin whales are estimated to come to the central and southeastern shelf of the Bering Sea for summer feeding.

Humpback whale is a smaller species (up to 17 m) that was also severely depleted by whaling. About a few hundred humpback whales come to feed in the Bering Sea in summer. Humpbacks in the Bering Sea have been found to feed on Atka mackerel, pollock and euphausids.

Minke whale is the smallest of the baleen whales (up to 9 m) and is also believed to migrate between wintering and breeding areas at low latitudes and northern summer feeding areas; 3,000 individuals were estimated to occur in the Bering Sea. Minke whales are often found in coastal areas and in the southern edge of the pack ice. They feed mainly on euphausids and small fish, including herring, Pacific cod, pollock, Atka mackerel, Pacific sand lance, capelin, polar cod, and saffron cod.

The blue whale and **Sei whale** may occur as summer visitors in the Bering Sea. Blue whales from the western population are thought to migrate north while a few sei whales have been seen on the central and southeastern Bering shelf in summer sighting surveys.

Sperm whales segregate according to sex, with mature males migrating to northern feeding grounds, while females and younger individuals remain at lower latitudes. Males of the northwestern stock have the Bering Sea as the main feeding area, where they may be widely distributed over the deep basins. Deep-water cephalopods are the main prey of sperm whales, especially squids. Sperm whales are abundant but there are no good estimates of their populations.

Harbor porpoises are distributed near the coast in the inner shelf domain of the Bering Sea. They generally feed on various fish and squid, with fish likely the predominant prey for much of the population.

Killer whales occur in the Bering Sea with a fairly low population, estimated to be about 400 animals on the southeastern shelf. They are found in both deep basins and shallow coastal waters. Killer whales migrate north in the Bering Sea in summer where they feed on fish including herring, capelin, polar cod, Pacific cod, skates, sharks, halibut, and salmon species. They attack and eat a wide range of mammals including beluga, minke, humpback and grey whales, seals, Steller sea lion, northern fur seal, sea otter, and walrus.

Pinnipeds

Eight species of pinnipeds occur in the Bering Sea: five species of seals (ringed, ribbon, spotted, bearded, and harbor seals), two species of eared seals (northern fur seal and Steller sea lion), and the Pacific walrus. Harbor seal is a coastal species that is resident in ice-free parts of the Bering Sea. Steller sea lion is also a year-round resident with rookeries along the Aleutians and at the coast of Kamchatka. Northern fur seals breed in the Bering Sea with the largest colonies on the Pribilof Islands, but most animals leave in winter to live pelagically in the North Pacific.

Bearded seal is an ice-associated seal that occurs in the Bering Sea primarily in winter and spring when the sea is ice-covered. Bearded seals are benthic feeders and are found over the shelf typically at depths <150 m, shallow enough for bottom feeding. Bearded seals in the Bering Sea feed on a variety of invertebrates including crabs, shrimps, clams, snails, and octopus. Fish are generally of little importance but bearded seals take some polar cod, saffron cod, flounders, and sculpins.

The three other ice-associated seals in the Bering Sea, **ringed, spotted,** and **ribbon seals**, differ from walrus and bearded seal by eating mainly fish and other mobile prey. They differ among themselves in that ringed seals occur mainly in fast ice and heavy pack ice, whereas spotted and ribbon seals occur mainly in the marginal ice zone during winter and spring. Whereas the ringed seal has a circumpolar distribution, spotted and ribbon seals are North Pacific species found in the Bering Sea and adjacent waters. Ribbon and ringed seals retreat with the ice to occur mainly north of the Bering Strait during summer, whereas many spotted seals move to coastal habitats of the Bering Sea as the ice disappears.

The Pacific walruses in the Bering and Chukchi Seas, considered to constitute one migratory population, have been estimated number between 200,000 and 250,000 animals in different surveys between 1975 and 1990, but there is a large uncertainty owing to the difficulty of surveying the walrus population. They generally are found in areas of broken ice over relatively shallow continental shelf waters to allow them to rest between feeding bouts. Walruses are extremely social and gregarious animals, and spend approximately one-third of their time hauled out onto land or ice. Walruses rely on sea ice as a substrate for resting and giving birth. In winter, Pacific walruses inhabit the pack ice of the Bering Sea, mainly concentrated in two major areas where open leads, polynyas, or thin ice occur overlying shallow water. They breed between December and March when they are concentrated in the pack. By late April, the walruses are distributed north to the Bering Strait, and as the pack ice continues to recede northwards, most of the population, except for the adult males, migrates into the Chukchi Sea where they feed during summer. Most adult males remain in the Bering Sea during spring and summer, using coastal haulouts in Bristol Bay and the Gulf of Anadyr. Walruses specialize in feeding on benthic macroinvertebrates and prefer to forage in areas <80 m deep. Feeding areas are typically sediments with soft fine sands that are habitats of burrowing clams, the main and preferred prey of walrus. Walruses may take larger prey and have been reported to eat small seals such as ringed and ribbon seals.

Sea otters occur in nearshore coastal waters in the Aleutian Islands. Sea otters play an important role in maintaining the coastal ecosystems they inhabit. Sea otters are considered a keystone species in nearshore kelp beds because their presence maintains kelp forests that provide habitat for a wide diversity of species. Sea otters prey extensively on sea urchins, a dominant herbivore in the Aleutian archipelago, which in turn feed on kelp. Without sea otters, urchins overpopulate and overgraze kelp, causing kelp forests to disappear. This results in exposure of the remaining fish, crustaceans, and bivalves, and ultimately in declines of many fish and other animals. Sea otters depend on their fur for keeping warm, and as for the northern fur seal, life in cold water is energetically demanding (Estes and Bodkin, 2002). The pelage has a very dense underfur that traps small air bubbles that contribute to the insulating properties of the fur. Sea otters have a high energy demand and eat an amount of food equivalent to about 25% to 30% of their own body weight per day. Owing to their reliance on fur to keep warm and their high metabolism, sea otters are very sensitive and vulnerable to oiling heat loss and food requirements in cold water. This was demonstrated by the Exxon Valdez oil spill in Prince William Sound that killed a minimum of 750 sea otters.

Polar bears from the Bering-Chukchi subpopulation occur in the northern Bering Sea when sea ice is present. In cold winters they may be abundant, occurring south at least to St. Lawrence Island. In most years, relatively few bears move into the northern Bering Sea, where they spend a limited time in winter. Ringed seal is the main prey for polar bears in the northern Bering Sea as it is in other areas.

SEABIRDS

The Bering Sea contains very large seabird populations, totaling 36 million individuals or more. The diversity of marine birds is large, with approximately 132 species of marine or marine-oriented birds occurring in the eastern Bering Sea. This includes shorebirds or waders and waterfowl such as ducks and geese that spend time in the coastal marine environment. The seabirds are represented by a variety of types of birds, including the northern fulmar, storm petrels, cormorants, jaegers (or skuas), gulls, kittiwakes, terns, and different types of auks (murres, guillemots, murrelets, auklets and puffins). In addition, eiders and other marine ducks are also important parts of the marine bird fauna.

The seabirds of the Bering Sea can be broadly divided into two main categories: visitors and residents. There are three main types of visitors: 1) Arctic species that come from north to spend the winter in the marginal ice zone and ice-free areas of the Bering Sea, including king eider, spectacled eider, Ivory gull, and others; 2) species that breed in the southern hemisphere and spend the austral winter in the North Pacific, such as short-tailed and sooty shearwaters and 3) species that arrive to breed and feed in the Bering Sea during summer but leave the area to spend the winter at lower latitudes. Arctic tern is an example of this type, where the individuals migrate to Antarctic waters to spend the winter.

The majority of seabirds in the Bering Sea are residents. They usually move seasonally within the Bering Sea to breed at colonies in the central and northern parts in the summer and to feed in the marginal ice zone or ice-free areas of the southern parts in winter. This is the case for common murre, thick-billed murre, least auklet, glaucous gull, and others. Many of the resident species extend their breeding range north into the Chukchi Sea or wintering range south into the Gulf of Alaska and further south.

The abundance and distribution of seabirds in the Bering Sea broadly reflect the abundance and distribution of prey species, as well as the availability of suitable breeding habitats. Of the 34 species of seabirds, ten have total populations in the range of 0.8 to 9 million individuals. Together, these ten species make up about 95% of the total number of seabirds in the Bering Sea. They comprise six species of auks, two storm-petrels, the northern fulmar, and the black-legged kittiwake. They have in common that they feed to varying degrees on zooplankton (predominantly copepods and krill) and small schooling pelagic fish such as capelin, sand lance, and Pollock.

WATERFOWL

Waterfowl is a term for birds that use freshwater or marine habitats during some part of their life cycles. This group includes ducks, geese, and swans. The Bering Sea is a very important area for waterfowl, with a total of more than 10 million individuals of about 30 species (and subspecies) dependent on habitats in this area, as estimated in the 1970s. Waterfowl use Bering Sea habitats variously for breeding, feeding, staging, and wintering. The eastern Bering Sea in particular offers large areas of intertidal and shallow subtidal habitats. This is related to the combination of the very wide and shallow shelf gradually sloping off from land, and a fairly high tidal range (about 3 m) in the southeastern Bering Sea.

SHOREBIRDS

The shorebird fauna is rich with about 47 species breeding in the Bering Sea region. They comprise seven species of plovers, three snipes and dowitchers, seven godwits and curlews, ten shanks, two turnstones, 16 sandpipers, and two species of phalaropes. This includes a fairly large group of Arctic species that breed mainly in the northern part of the Bering Sea, comprising several species of plovers. The large number of species reflects the occurrence of 17 Eurasian species that extend their breeding range to the western Bering Sea, and 13 North American species that are found adjacent to the eastern Bering Sea.

In total, about 33 species are found breeding in the western Bering Sea, while about 31 species breed in the eastern Bering Sea. About five species of shorebirds commonly breed on the Aleutian Islands. These are semipalmated plover, least sandpiper, rock sandpiper (subspecies couesi), common snipe (with two subspecies in the western and eastern part), and red-necked phalarope. More species may occur here during migration, e.g., ruddy turnstone, bar-tailed godwit, bristle-thighed curlew, grey-tailed tattler, sharp-tailed sandpiper and others.

The vast majority of shorebird species in the Bering Sea region are migratory and leave the area to winter along coasts or inland at lower latitudes and in the southern hemisphere. However, a few species or subspecies remain to winter in the Bering Sea area, primarily on the Aleutian Islands. Rock sandpiper is resident year-round on the Aleutians with subspecies couesi, and on the Komandorskiye Islands with subspecies quarta. Sanderling also winters on the Aleutians, although the bulk of the population moves much further south.

FISH

The Bering Sea is a very rich fisheries area with a wide range of fish and shellfish stocks targeted. The total catch from the eastern Bering Sea has been 1.1 to 1.9 million tonnes since the mid-1970s. Walleye pollock is by far the most dominant fish species and a key component of the Bering Sea ecosystem. It is a generalist species that is widely distributed in both deep and shelf waters of the Bering Sea. The larvae and juveniles of walleye pollock feed mainly on zooplankton and, as they grow, krill, while adults of walleye pollock feed largely on copepods, krill, lanternfish and other mesopelagic fish, and squid. The pollock stocks of the Bering Sea are large and support one of the world's largest fisheries.

Other important commercial species are Pacific cod, yellowfin sole, Greenland halibut or turbot, Pacific halibut, several other flatfish species, Pacific ocean perch, sablefish, and Pacific salmon species. There is also a sizable fishery for crabs, notably red and blue king crabs and snow and Tanner crabs.

The fish fauna of the Bering Sea comprises about 300 species from 45 families. Most of these species live at or close to the bottom, with the largest number of species in the families Cottidae (sculpins) and Liparididae (sea snails), making up 22% and 15% of the total number of fish species, respectively. Among the dominant families of fish that contain commercial species are the Pleuronectidae (flounders, 8%), Scorpaenidae (rock fish, 5%) and Salmonidae (4%). The majority of species are boreal forms distributed in the warmer parts of the Bering Sea, with only about 15 species of Arctic origin living in the cold waters of the northern shelf (the 'Anadyr cold region').

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Acknowledgements

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Nordic Council of Ministers

OAK FOUNDATION

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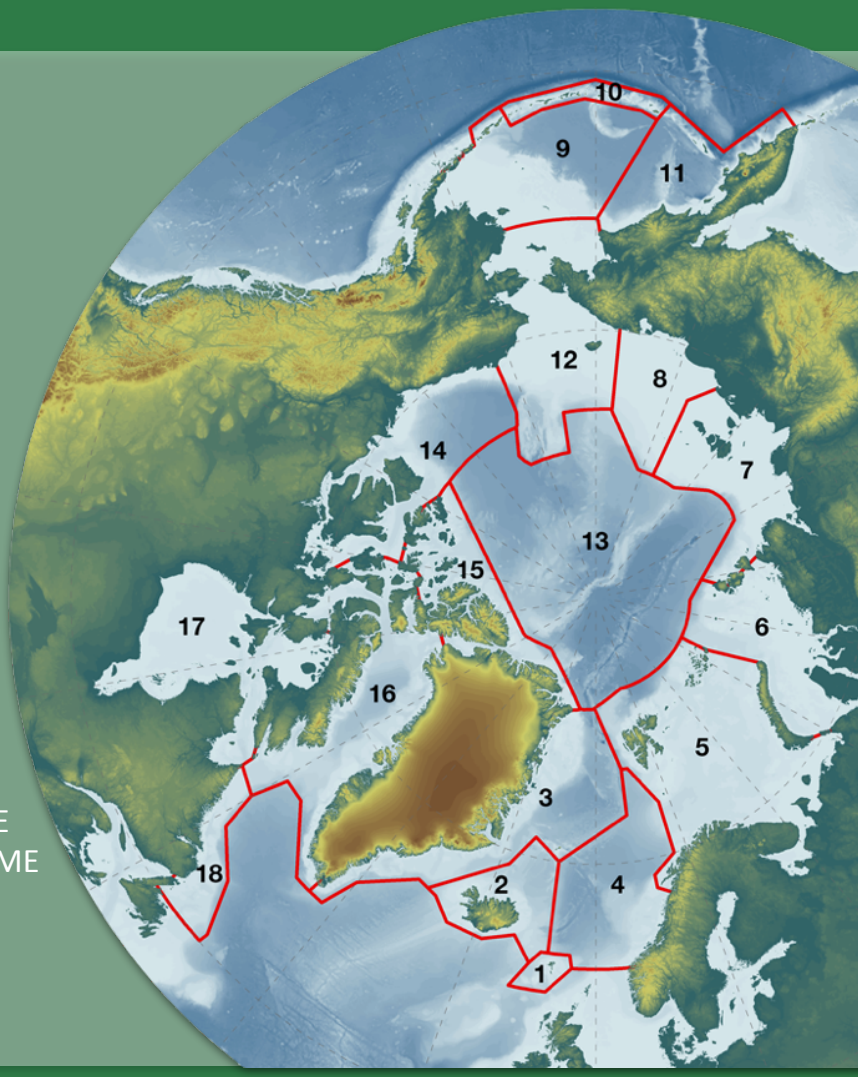
Protection of the Arctic Marine Environment

ARCTIC LMEs

1. Faroe Plateu LME
2. Iceland Shelf and Sea LME
3. Greenland Sea-East Greenland LME
4. Norwegian Sea LME
5. Barents Sea LME
6. Kara Sea LME
7. Laptev Sea LME
8. East Siberian Sea LME
9. East Bering Sea LME
10. Aleutian Islands LME
11. West Bering Sea LME
12. Northern Bering-Chukchi Sea LME
13. Central Arctic Ocean LME
14. Beaufort Sea LME
15. Canadian High Arctic - North Greenland LME
16. Canadian Eastern Arctic - West Greenland LME
17. Hudson Bay Complex LME
18. Labrador-Newfoundland LME



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