Polar Bear

One of the most recognizable species on the planet, polar bears (Ursus maritimus) are among the largest of the eight extant bear species, along with the American brown bear (U. arctos), a closely related cousin. Known colloquially as “the white bear,” this species is so named because of its snow-white fur. The polar bear is an obligate marine predator that spends a vast majority of its time in the Arctic, which it relies on for hunting, foraging, mating, and raising cubs.

**Population Dynamics**

The 19 subpopulations developed by the International Union for Conservation of Nature’s (IUCN) Polar Bear Specialist Group (PBSG) were established based on a combination of genetic information and practical considerations of range state managers, and effectively serve as management units for research, monitoring and reporting on polar bears. According to the PBSG (2017), bear numbers are stable in 6 of the 19 units (32%); increasing in 1 unit (5%); and deemed data deficient in 9 units (47%).

Two of the three subpopulations that use the Chukchi and Beaufort Seas, the Chukchi Sea subpopulation (CS) and the Southern Beaufort subpopulation (SB), are considered to be part of the Polar Basin Divergent ice ecoregion (Amstrup et al. 2008, Reger et al. 2016). They spend the vast majority of their time offshores hunting seals on ice, except when denning or when the lack of available ice necessitates use of coastal fast ice. The Northern Beaufort Sea subpopulation (NBS) is considered a separate Polar Basin Convergent. The smaller, and less well-known Viscount Melville Sound polar bears (VM) are found at the extreme northeastern extent of the project area in the Archipelago Ecoregion, and are not figured here, due to the fact that they do not specifically use the Bering, Chukchi, or Beaufort Seas, and there is very little research regarding this subpopulation (Amstrup et al. 2008, Reger et al. 2016).

While previous efforts that estimated the Chukchi Sea subpopulation at approximately 2,000 bears had been accepted by the PBSG (Belov and Stirling 2003), the Polar Basin Convergent and Archipelago Sea Ice Regions may well be lost strongholds for Polar Basin Divergent bears, as they are forced to seek out more suitable habitat. Since the ice they now rely upon is also lost, they are well-acclimated to utilizing terrestrial habitat for long periods, the Polar Basin Divergent bears are likely the most vulnerable to climate change (Atwood et al. 2015a, b).

**Adaptations**

The polar bear is exceedingly well adapted to utilize the opportunities available in the Arctic. Their dense, white to yellowish fur is distinct and well-suited for the snow-covered ice on which they have evolved. Under their dense fur is black skin (evident in the color of their noses), which serves to absorb the sunlight that penetrates their hollow hair shafts and warms their bodies. Relative to the American brown bear, polar bears exhibit a longer skull and snout, as well as an elongated overall body structure (Stirling et al. 1977, Ramay and Stirling 1988). The ears and tail of the polar bear are especially and predictably small, owing likely to adaptations related to thermoregulation (Allen 1877). Their large feet are covered in papillae, small bumps that improve traction on ice and snow. Their large, strong paws are designed to break through thick sea ice, helping prey and carnassials (modified molars) for shearing meat and holding prey. The polar bear uses its forepaws to draw prey along before using its strong hindlimbs to finish the kill. The short claws makes escape by prey unlikely once captured. Specialized muscle adaptations related to thermoregulation (Allen 1877). Their large feet are covered in papillae, small bumps that improve traction on ice and snow.

**Behavior**

Polar bears are relatively long-lived, reaching sexual maturity at an advanced age. They are characterized by substantial maternal investment in cubs, age. They are characterized by substantial maternal investment in cubs, and hunting habitat for polar bears within this ecoregion. The Southern Beaufort Sea (SBS) polar bear population was estimated at approximately 1,700 bears from 1978-83 (Amstrup et al. 1986), 1500 in the early 2000s (Regier et al. 2006), and 900 by 2010 (Bromagin et al. 2012, Rode et al. 2014). Even the recent declines in polar bear population where due to changes in sea ice availability.

**Sea-Ice Habitat**

During winter and into spring, polar bears seek out the highly dynamic boundary between the sea ice and water to hunt seals that are using ice holes for breathing or are out feeding after having fasted for the productive waters at the sea ice edge. Polar bears very rarely pursue seals on open land or in the water, preferring instead to use leads (spaces of system-induced fissures in sea ice that allow access to open water) (Wegelein 2002), and polynyas (leads or warm-water upwellings, induced ice-free areas) (Stringer and Groves 1991). Leads and polynyas play a crucial role in Arctic ecology, creating a zone of productivity, and access to a vast seascape. These are important feeding areas for seals, which in turn attract polar bears. Once spring arrives, newcubs continue to be critical to polar bear feeding, as do landfast ice zones—that is fastened to the coastline or sea floor (Weeks 2005). Landfast and pack ice are crucial habitat components for ringed seals (Phoca hispida), as they build their birthing lairs here, under the snow. As newborn polar bear cubs emerge between February and mid-April (Stirling et al. 1988), this boreal food source is critical to the survivability of polar bears (Freitas et al. 2012).

When sea ice recedes in summer, sunlight catalyzes algae blooms that form the base of the highly productive waters found at the ice edge throughout the Arctic (see Biological Section chapter). Primary production and zooplankton blooms attract pelagic fish and contribute to seasonal food availability. As sea ice recedes, polar bears decide to either follow the productive but tenuous sea ice north, farther and farther away from the coastline and into the less productive waters over the polar basin, or some alternative, which is too difficult to acquire the calories needed to offset energetic costs associated with terrestrial foraging (Derocher et al. 2010). While sea ice concentration drops below a certain threshold, polar bears have been documented to quickly abandon sea ice for land, where their preferred prey (seal subspecies) are almost entirely absent (Stirling et al. 1999, Cherry et al. 2013).

**Life Cycle**

Polar bears are an ice-adapted and mating habitat. They breed in the spring, generally ending by June (Stebnicki et al. 2006, US Fish and Wildlife Service 2016). Males will follow a female as she makes her way to a denning or Figaro habitat. Every 2 years, the males in pursuit will engage in intense fighting amongst themselves, often resulting in serious injury (Ramsey and Stirling 1988, Stirling at al. 1988).
Specifically adapted to the frigid conditions in the Arctic, polar bears are the most carnivorous of the eight living species of bear, with little to no vegetative food found in most polar bear diets.
POLAR BEARS

MAP DATA SOURCES


Bonépoh Locations: Dutton et al. (2011); Schieble et al. (2008); T. Atwood (pers. comm.)

Polynas: Audubon Alaska (2009a) based on Eicken et al. (2005); Carmack and Macdonald (2002); Stringer and Gows (1991)

Sea Ice Extent: Audubon Alaska (2016b) based on Fettner et al. (2016)

Eaten for eight months, despite exceeding large amounts of energy, birth, and nourishing their offspring (Watts and Hansen 1987).

Due to their tenuous habitat and previously unregulated commercial harvest, logistical production has been nonexistent, and a minimal seasonal harvest cannot ensure the survival of the polar bear. They are a protected species under the Marine Mammal Protection Act (MMPA) of 1972 along with cetaceans (whales, dolphins, porpoises), pinnipeds (seals, sea lions), and the marine mussel (sea otter). MMPA protection does not prohibit tradi- tional subsistence harvest by Alaska Native hunters. Since 2008, polar bears in the US Arctic have been listed as a threatened species under the Endangered Species Act (ESA) of 1973, primarily on the basis of future threat of sea-ice habitat decline. As a result of the observed and projected loss of sea-ice habitat due to global climate change, the polar bear is listed as vulnerable on the IUCN Red List of Threatened Species.

The most pressing concern regarding polar bears is sea-ice decline due to Arctic warming and the resulting habitat loss (US Fish and Wildlife Service 2008, 2015). Without stabilization of annual available sea-ice habitat, the CS and SBS populations will likely need to migrate to other, more suitable ecologies (Polar Bear Conservation, Archipelago), or risk severe reduction in numbers (Durner et al. 2010). Until animal populations achieve a sea-ice extent sufficient to sustain entire subpopulations over the long term (Rode et al. 2015), bonepiles of harvested whale carcasses will continue to provide a complete set of trace elements, vitamins, and minerals for these bears. Hence, the continued availability of this food source is no doubt welcome to many struggling CS and SBS bears (Rogers et al. 2015). While the availability of this food source is no doubt welcome to many struggling CS and SBS bears (Rogers et al. 2015), the threats of disease and injury or death to humans or polar bears. With the discarded bowhead whale carcasses (bonepiles) left by Native hunters, there are accompanying concerns that warrant consideration.

As oil-and-gas activity increases in the Arctic, the likelihood of a spill also increases. A large Arctic oil spill without proper prevention and response measures could heavily impact polar bear populations. Also, an increase in shipping, especially along the Northern Sea Route north of Russia, has been noted. It is unclear what impact this might have on the CS and SBS bears.

**CONSERVATION ISSUES**

Due to their tenuous habitat and previously unregulated commercial harvest, logistical production has been nonexistent, and a minimal seasonal harvest cannot ensure the survival of the polar bear. They are a protected species under the Marine Mammal Protection Act (MMPA) of 1972 along with cetaceans (whales, dolphins, porpoises), pinnipeds (seals, sea lions), and the marine mussel (sea otter). MMPA protection does not prohibit tradi- tional subsistence harvest by Alaska Native hunters. Since 2008, polar bears in the US Arctic have been listed as a threatened species under the Endangered Species Act (ESA) of 1973, primarily on the basis of future threat of sea-ice habitat decline. As a result of the observed and projected loss of sea-ice habitat due to global climate change, the polar bear is listed as vulnerable on the IUCN Red List of Threatened Species.

The most pressing concern regarding polar bears is sea-ice decline due to Arctic warming and the resulting habitat loss (US Fish and Wildlife Service 2008, 2015). Without stabilization of annual available sea-ice habitat, the CS and SBS populations will likely need to migrate to other, more stable ecoregions (Polar Basin Convergent, Archipelago), or risk severe reduction in numbers (Durner et al. 2009, Durner et al. 2011, Durner et al. 2015a), but may occasionally supplement the diets of individual polar bears in the CS and SBS.

The mapped polar bear range was aggregated by Audubon Alaska (2014) based on seasonal models presented in Durner et al. (2009). On the advice of George Durner, our team mapped polar bear sea-ice habitat selection by applying the seasonal resource selection coefficients presented in Durner et al. (2009) to the most recent five years of available ice data. These data were then aggregated to form five sea-ice extent classes to create a data set for each month from October 2008 through September 2013. The models were run for each of the 60 months; then monthly results were grouped by season, averaged into the four seasonal layers representing mean habitat selection value, and clipped to the maximum extent of sea-ice extent (15% ice concentration or greater) for each season over the 5-year period.

**Diet**

Dietary analyses (Wallenius 1999, Rode et al. 2005a), but may occasionally supplement the diets of individual polar bears in the CS and SBS.

**MAPPING METHODS**


Annual subpopulation core areas were analyzed by Amstrup et al. (2005), based on positions of radio-collared females polar bear captured over 18 years in coastal areas of the Chukchi and Beaufort Seas near northern Alaska and northeastern Canada.


Annual subpopulation core areas were analyzed by Amstrup et al. (2005), based on positions of radio-collared females polar bear. Part of this analysis was completed by Audubon Alaska (2016) based on Amstrup et al. (2006), Bromaghin et al. (2015), Durner et al. (2010), Kocihney et al. (2003), National Oceanic and Atmospheric Administration (1988), Rode et al. (2015a, b), US Fish and Wildlife Service (1995)
Polar Bear

**Winter**

In winter, most adult female polar bears are dormant and have likely given birth to their arctic young within their snow-covered den. They will sleep in this state of hibernation until emergence from their den in spring. Male polar bears, however, continue to forage throughout the ice-covered winter, seeking out the maintained breathing holes that betray the snow caves of their favorite prey, the ringed seal. They will also hunt for bearded seals in areas of open water, such as leads and polynyas.

**Spring**

As female bears emerge from their birthing dens with their young, they have likely not eaten for nearly eight months. To support their young, they must venture out onto the pack ice to locate prey. Polar bears that den on pack ice are able to navigate upon emerging, even though the ice has likely traveled hundreds of miles toward the annual sea-ice margin minimum extent in September. Polar bears must decide whether to follow this retreating margin over the less productive Polar Basin or to stay on land and fast, scavenging for energy-poor berries, birds, fish, small mammals, and scavenged uncarved. These foods are a poor substitute for their usual lipid-rich diet of ice seals, and body condition often suffers.

**Summer**

As the temperature warms, the quality of sea ice deteriorates and pulls farther away from shore toward the annual sea-ice margin minimum extent in September. Polar bears must decide whether to follow this retreating margin over the less productive Polar Basin or to stay on land and fast, scavenging for energy-poor berries, birds, fish, small mammals, and scavenged uncarved. These foods are a poor substitute for their usual lipid-rich diet of ice seals, and body condition often suffers.

**Fall**

By fall, food has become scarce, and bennies are often the only high-energy food source. Lack of food and changes in weather signal to the bears that winter is coming and pregnant polar bears will seek out a suitable denning location to prepare for winter. They will wait for the first snowfall and begin constructing their multi-room den, consisting of a narrow entrance tunnel, and often more than one chamber. Polar bears conserve their energy through the late fall and into the winter.
The Pacific walrus (Odobenus rosmarus divergens) is the largest of all pinnipeds. They are social and gregarious animals. They travel together in groups, hauling out to rest on ice or land in dense groups. Walruses are known to pack together in close physical contact with each other, likely for warmth and to protect their young from predators. They are morphologically similar to the Pacific walrus, and generally considered to be the same subspecies. The Atlantic walrus is substantially smaller and has shorter tusks (Fay 1982). Pacific walruses are recognized as the Atlantic (O. r. rosmarus) and Pacific (O. r. divergens) (Fay 1982, Wozencraft 2005). A third subspecies, the Laptev (O. r. laptevi) is sometimes recognized. They are particularly vulnerable to trampling injuries and death.

Historical commercial harvest records indicate that Pacific walruses were hunted along the southern coast of Russia in the Sea of Okhotsk, Ulleung Pass, and the Shumigan Islands of Alaska beginning during the 17th century (Elliott 1882). Harvest continued until a moratorium was imposed on commercial walrus harvests in 1972 in the US. Commercial harvests in Russia ended in 1990. Walruses have long been, and continue to be, a subsistence food for Native communities in the Arctic. Commercial harvest records indicate that Atlantic walrus populations have been, and continue to be, subject to several caveats and are not reliable. The 2006 survey was the only one that allowed for a measure of precision (95% confidence interval) (Taylor and Udvald 2010).

The Pacific walrus population was estimated at over 200,000 animals in both 1985 and 1990 (Gilbert 1989, 1992). However, characteristics of walrus behavior and difficulties associated with conducting surveys, resulted in unreliable estimates (Gilbert 1999). Due to these challenges, the current population size is unknown (US Fish and Wildlife Service 2002, 2014). As recently as 1960, the Pacific walrus population was estimated at less than 100,000 individuals due to commercial harvest (Fay 1982).

**ADAPTATIONS**

**Walrus** tusks are used as offensive and defensive weapons (Kastalein and Gerrits 1990, Kastalein 2009). Adult male walruses use their tusks to display to other males, establishing dominance during mating (Fay et al. 1984). Both male and female walruses use their tusks to establish and defend positions on land or ice haulouts (Fay 1982). Walruses also use their tusks to anchor themselves to ice floes when resting in the water during inclement weather (Fay 2008). They are capable of diving to depths of more than 820 feet (250 m) (Born et al. 2005). Male walruses regularly forage for extended periods, even up to six days, without hauling out to rest by infracting a pouch on their necks with air, allowing them to rest at the surface (Fay 1991, Fay et al. 2010).

Walruses utilize ice floes as platforms for resting and for breeding, with groups of females hauling out together on ice floes as groups of males compete for their attention.

**DISTRIBUTION**

In winter, the entire Pacific walrus population concentrates in the Bering Sea to breed, where sea ice conditions are most favorable for them (US Fish and Wildlife Service 2002). While the exact areas in which walruses congregate in winter to breed vary according to the location and extent of annual sea-ice margins, they are generally found near St. Lawrence Island, Nunivak Island, and in the Gulf of Anadyr (Fay 1982, Myrime et al. 1990, Burn et al. 2009, Speckman et al. 2011).

In spring, sea ice in the Bering Sea begins to retreat northward, and females and juveniles Pacific walruses move with it, through the Bering Strait and into the productive waters over the continental shelf in the Chukchi Sea. In summer, they concentrate mainly in the northwest and northeastern Chukchi Sea, along the edge of the ice (Fay 1982, Jay et al. 2010a). Adult male walruses will stay behind as the females and young move north, opting instead to spend the warmer months feeding near the coastal haulouts in the Gulf of Anadyr and Bristol Bay.

In September, when the annual sea-ice margin is at its minimum extent and ice cover is reduced, walruses may congregate in large numbers at terrestrial haulouts on Wrangel Island, along the northern coast of the Chukotka Peninsula, and increasingly along the Chukchi coast in Alaska, especially near Point Lay (Fay 1982, Belikov et al. 1996, Kochnev 2004, Karyev et al. 2008, Huntington et al. 2012). National Oceanic and Atmospheric Administration (2004). In late September and October, walruses that spent the summer in the Chukchi Sea typically begin moving south in advance of the developing sea ice. Large herds of southern migrants often congregate for short times to rest at coastal haulout sites in the southern Chukchi Sea along the Russian coast (Fay and Kelly 1980).

**Sea-Ice Habitat**

Pacific walruses use ice floes to breed, calve, haul out to rest, and as refuges from predators such as killer whales (Fay 1982, Simpkins et al. 2003). Haulouts are an integral component of walrus energy management, allowing them to rest between foraging bouts. Because sea ice is a critical component of their habitat, females and juveniles follow the ice margins as they advance and retreat throughout the year, staying near the ideal thickness and coverage for feeding and hauling.
Pacific walruses are highly social animals, with intricate heir and subherd social structures and status hierarchies. Out. Walruses prefer ice floes, leads, polynyas, and areas with thinner ice in which they can easily create breathing holes. Conversely, they avoid areas with high concentrations of thick and consolidated pack ice, such as in the Chukchi Sea in winter (Burns et al. 1981). Fay 1982).

Life Cycle

Pacific walruses are identified and managed as a single panmictic (structured, random-mating) population (US Fish and Wildlife Service 2004). They ensure their social standing through a series of confrontations decided by body size, tusks size, and aggressiveness. As individuals that compose a group are constantly changing, they must continually reaffirm their social status with each new group, or group member (Fay 1982).

Lek

Pacific walruses mate primarily in January and February in the Bering Sea. Leks (gatherings of males for the purpose of competing for the attentions of females) are formed in the water alongside groups of females hauld out on sea ice. The competition to mate includes vocalizations and visual displays among the dominant males. Subordinate males keep to the edges of the gathering and do not participate. When appropriate, a single female will join in a male in the water to copulate. During this time, adult males forage very little (Fay 1982, Fay and Stuart 1997). Calves can nurse while in the water after about 14 days.

Diet

Walruses consume a broad diet consisting mostly of benthic invertebrates, such as clams, small crustaceans, snails, and polychaete worms, although fish and other vertebrates are also occasionally reported, including marine birds and seals (Fay 1982, Bowen and Siniff 1999, Dohn et al. 2007, Sheffield and Grembius 2009). Walruses require approximately 60-180 pounds (25-70 kg) of food per day and utilize over 100 taxa as potential sources, although claims typically make up over 90% of stomach contents (Fay 1982).

Walruses root with their muzzles in the bottom sediment of waters 300 feet (90 m) deep or less and use their whiskers to locate prey items (Fay and Burns 1988. Kovacs and Lydersen 2008). They use their fore-flippers, noses, and jets of water to extract prey buried up to 12 inches (30 cm) deep (Fay 1982, Lavrendov et al. 2003, Kastelein 2009). Walruses typically swallow invertebrates without shells in their entirety (Fay 1982). They remove the soft parts of mussels from their shells by suction and discard the shells (Fay 1982). The foraging behavior of walruses can have a major impact on benthic communities in the Bering and Chukchi Seas, as walrus burbot disturbance burts benthic substrates and impacts benthic community, nutrient flux, and benthic species composition (Klaus et al. 1990, Ray et al. 2006).

Conservation Issues

In 2008, the US Fish and Wildlife Service received a petition filed by the Center for Biological Diversity to list the walrus under the Endangered Species Act (ESA), citing global warming as a primary concern. As the climate in the Arctic continues to warm and summer sea-ice margins retract further from the continental shelf, walruses have begun to haulout on land, sometimes prompting longer foraging trips, increasing the likelihood for anthropogenic disturbance, and attracting predators (Tynan and DeMaster 1997, Kelly 2001, Fay and Fischbach 2008). Walruses travel into and out of the Chukchi Sea during the season, and a majority of the animals remain in and out of the Chukchi Sea during the season, and a majority of the animals remain in

Mapping Methods

Walrus data are shown on two seasonal maps: one for winter and spring, the other for summer and fall. The mapping methods are organized to show the distribution of walruses throughout the project area, with distribution data categorized into low, medium, regular-use areas, and high-density (Concentrations of range, species, and high, concentration, and high concentration. Walrus range data were digitized from US Fish and Wildlife Service (2014) for both the winter/spring and summer/fall timeframe. The US Fish and Wildlife Service (2014) summer/fall range data were merged with additional range data provided in Audubon Alaska and Oceana (2016), Fischbach et al. (2018), Jay et al. (2010), and National Oceanic and Atmospheric Administration (1988) by Audubon Alaska (2016).

The summer/fall regular-use areas in the Chukchi Sea represent the 95% monthly occupancy contours analyzed by Jay et al. (2012a), which were merged into a single polygon area by Fay et al. (2017). The winter season was defined by the winter/spring distribution data from Audubon Alaska and Oceana (2016). In the Bering Sea, winter/fall regular-use area is presented in the US Fish and Wildlife Service (2014). This regular-use area was extended to St. Matthew Island based on data from a 2017 winter workshop with Birgland Strait region traditional knowledge experts who reviewed Audubon Alaska’s draft whale maps (Audubon Alaska et al. 2017). The winter/spring regular-use area was based on data from Audubon Alaska et al. (2017), Fay and Fischbach (1984), National Oceanic and Atmospheric Administration (1988), and US Fish and Wildlife Service (2014) by Audubon Alaska (2017).

Summer/fall concentration areas are shown based on data from three primary sources: Audubon Alaska and Oceana (2016), Jay et al. (2012a), and Oceana and Kawerak (2014). The summer/fall concentration areas from Jay et al. (2012a) represent the merged 50% monthly occupancy contours analyzed by the Oceana and Kawerak (2014) and are labeled as medium-density areas. The Audubon Alaska and Oceana (2016) data represent 50% confidence intervals (Jay et al. 2012). The summer/fall concentration areas from Jay et al. (2012a) represent the merged 50% monthly occupancy contours analyzed by the Oceana and Kawerak (2014) and are labeled as medium-density areas.

The winter/spring high-concentration areas near St. Lawrence Island were identified by Oceana and Kawerak (2014) and Audubon Alaska et al. (2017) as a breeding area and is labeled as such. A winter/spring high-concentration area defined by the Oceana and Kawerak (2014) data. The summer/fall high-concentration areas also incorporate 20% monthly feeding contours

Multimodal density was calculated in each grid cell by dividing the observed number of animals over all the years by the measure of total trawl effort × 62 miles (100 km). The observation rate was converted into a density by dividing the data with one point per grid cell (at the centroid), and a kernal density function was run with an anisotropically kernel density function with a 24.8 mile (40 km) north-south search radius and a 46.9 mile (80 km) east-west search radius to smooth the data. The summer/fall concentration areas from Oceana and Kawerak (2014) represent merged concentration polygons specific to the summer and fall seasons. Some of these polygons were based on data from National Oceanic and Atmospheric Administration (1988). These polygons were reviewed and modified by Birgland Strait region traditional knowledge experts who reviewed Audubon Alaska’s draft whale maps (Audubon Alaska et al. 2017). The summer/fall high-concentration areas from Oceana and Kawerak (2014), updated based on Audubon Alaska et al. (2017), represent places where walruses were observed in higher abundance than in other areas, and are labeled as spotty by the dozens, or in a general broad area by the hundreds to thousands. The winter/spring high-concentration areas near St. Lawrence Island were identified by Oceana and Kawerak (2014) and Audubon Alaska et al. (2017) as a breeding area and is labeled as such. A winter/spring high-concentration area defined by the Oceana and Kawerak (2014) data. The summer/fall high-concentration areas also incorporate 20% monthly feeding contours

Walruses can be impacted by the effects of climate change, including changes in sea ice extent, thickness, and location. As the climate in the Arctic continues to warm, the extent and duration of summer sea ice are decreasing, which can affect walruses in several ways. First, decreasing sea ice can affect walruses’ ability to forage for food, as they rely on sea ice to locate and capture their prey. Second, decreasing sea ice can affect walruses’ ability to haul out on land, which is important for breeding and resting. Third, decreasing sea ice can affect walruses’ ability to interact with people, which is important for managing conflicts between walruses and people. Fourth, decreasing sea ice can affect walruses’ ability to transport people, which is important for managing conflicts between walruses and people.
The mapped summer/fall concentration and high-concentration areas from Jay et al. (2012a) and Audubon Alaska and Oceana (2016) were generated from analyses of satellite telemetry data and aerial survey data, respectively. The Jay et al. (2012a) data were generated through a utilization distribution analysis of walrus satellite telemetry data collected from 2008 to 2011 and are specific to female walruses tagged in the Bering Strait, on the north coast of Chukotka, and the northwest coast of Alaska. The Audubon Alaska and Oceana (2016) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016) See Sea Ice Mapping Methods section for details.

Data Quality
Walrus range, regularly occurring areas, and haulout location information is generally consistent across the project area. Data quality of concentration, high concentration, and activity data varies among regions.

Feeding and breeding high-concentration areas are labeled where this information is known. This labeling is not intended to indicate that these are the only portions of the project area where these activities occur; additional feeding and breeding high-concentration areas may be present in regions where such information was not available as of our publication date.

Terri Stinnett Photography

**MAP DATA SOURCES**

**SUMMER/FALL MAP**
- Extent (Summer/Fall): Audubon Alaska (2016k) based on Audubon Alaska and Oceana (2016); Audubon Alaska et al. (2017); Fischbach et al. (2016); Jay et al. (2012a); National Oceanic and Atmospheric Administration (1988); Oceana and Kawerak (2014); and US Fish and Wildlife Service (2014)
- Concentration (Summer/Fall): Audubon Alaska et al. (2017); Audubon Alaska and Oceana (2016); Jay et al. (2012a); National Oceanic and Atmospheric Administration (1988); Oceana and Kawerak (2014)
- High Concentration (Summer/Fall): Audubon Alaska et al. (2017); Audubon Alaska and Oceana (2016); Jay et al. (2012a); Oceana and Kawerak (2014)
- Feeding: Jay et al. (2012a)
- Walrus Islands State Game Sanctuary: Alaska Department of Fish and Game (2016a)

**WINTER/SPRING MAP**
- Extent (Summer/Fall): Audubon Alaska (2016k) based on Audubon Alaska and Oceana (2016); Audubon Alaska et al. (2017); Fischbach et al. (2016); Jay et al. (2012a); National Oceanic and Atmospheric Administration (1988), Oceana and Kawerak (2014), and US Fish and Wildlife Service (2014)

**Haulouts**
- Fischbach et al. (2016); Kawerak (2015)
- Sea Ice: Audubon Alaska (2016b) based on Fetterer et al. (2016)

**HUMAN-CAUSED DISTURBANCE**

Feeding and breeding high-concentration areas are labeled where this information is known. This labeling is not intended to indicate that these are the only portions of the project area where these activities occur; additional feeding and breeding high-concentration areas may be present in regions where such information was not available as of our publication date.

**ACKNOWLEDGMENTS**
- Bering Strait Traditional Knowledge-Holder Map Review Workshop participants
- Jim MacCrae
- Jonathan Snyder

Walrus range, regularly occurring areas, and haulout location information is generally consistent across the project area. Data quality of concentration, high concentration, and activity data varies among regions.

Feeding and breeding high-concentration areas are labeled where this information is known. This labeling is not intended to indicate that these are the only portions of the project area where these activities occur; additional feeding and breeding high-concentration areas may be present in regions where such information was not available as of our publication date.
Pacific Walrus: Summer/Fall

In summer, sea ice is receding and female and juvenile Pacific walruses have moved north to feed in the productive waters of the Chukchi Sea, while males stay south of the Bering Strait in the shallow areas along the coasts of Russia and Alaska. The calves conceived during the previous year’s breeding season are born in late spring and early summer, after female walruses have left the company of larger, aggressive males for more northern summer feeding grounds. Calves will continue the journey north through the Bering Strait soon after birth and will stay with their mothers for up to two years as the females follow the ice margin.

Pacific walruses haul out of the water in groups ranging from less than 100 to more than 10,000. These haulouts have historically been on the pack ice edge, but as the temperature in the Arctic continues to rise, pack ice has become scarce, forcing Pacific walruses to haul out instead on land, increasing the potential for anthropogenic disturbance. To feed, Pacific walruses regularly travel great distances from their haulout on land along “feeding corridors” to areas of high benthic productivity.
Pacific Walrus: Winter/Spring

This map shows the distribution of the Pacific walrus throughout the Bering Sea during the winter and spring seasons. As temperatures begin to cool in fall and early winter and ice margins begin to push southward, female and juvenile walruses also move south, reuniting with male walruses to breed and overwinter in the Bering Sea. During January and February, breeding bull walruses will follow groups of females as they haul out on large ice flows, their preferred breeding habitat.

Pacific walruses haul out of the water in groups ranging from less than 100 to more than 10,000. They tend to congregate around areas of thin ice, and are closely associated with polynyas and leads. In the winter and spring, these haulouts are usually on nearshore pack ice along the coast. Walruses use haulouts to rest after strenuous foraging bouts, to evade predation, and to breed. Throughout the rest of the winter, walruses are pushed farther south as the pack ice margin continues to march toward its maximum extent. Calving happens after 15 or 16 months of pregnancy, in April, May, or June.

Map Authors: Erika Knight, Melanie Smith, and Max Goldman
Cartographer: Daniel P. Huffman

MAP 6.2b

Ice seals are a group of marine mammals adapted to life primarily on ice. Within the Bering, Chukchi, and Beaufort Seas, there are four species of ice seal: bearded (Erignathus barbatus), ribbon (Histriophoca fasciata), ringed (Phoca hispida), and spotted (P. largha). All Arctic ice seals belong to the family Phocaedidae (earless seals) within the seal clade Phociformes (Figure 6.3-2). The bearded seal is the most widespread, while the ringed and spotted seals are more locally distributed, particularly along the sea-ice margins.

ADAPTATIONS

Seal pups have a natal or fetal layer of hair called lanugo. Lanugo is white in all seals except for the bearded seal, where it is brown (Arason et al. 2006). Lanugo is important for thermoregulation, although it is quickly shed as the pup gains a layer of insulating blubber during nursing (Burns 1970, Lydersen and Hammill 1993). Bearded seals often share algae in utero and are born with a thick layer of subcutaneous fat (Kovacs et al. 1996).

Pelage in sub-adults and adults is mainly useful for protection, streamlining while swimming, and traction on ice, rather than for thermoregulation (Ling 1970, 1972). Hair must be annually shed and regrown to maintain its function, a process called molting (Ling 1970).

Pelage in sub-adults and adults is mainly useful for protection, streamlining while swimming, and traction on ice, rather than for thermoregulation (Ling 1970, 1972). Hair must be annually shed and regrown to maintain its function, a process called molting (Ling 1970).

DISTRIBUTION

The bearded seal is distributed widely across the circumarctic Arctic. The ribbon seal and the bearded ice seals in the Bering Sea and the Sea of Okhotsk, seasonally ranging into the Chukchi Sea and occasionally south of the Aleutian Islands. Ringed seals are very broadly distributed throughout the Arctic. Subspecies inhabit smaller areas and even some inland lakes. The spotted seal is distributed, particularly along the sea-ice margins. The ringed seal is distributed, particularly along the sea-ice margins. The spotted seal is distributed, particularly along the sea-ice margins.

Sea-ice Habitat

Ice seals are in a balance of sufficient ice conditions for haulout platforms and sufficient access to open water for foraging and escape from predators. Pack ice is particularly important for whelping, so seals haul out of the water more during molting. Inter-annual variation in ice cover has a significant impact on the distribution and abundance of ice seals, particularly for pups, and hide seals from predators (Smith et al. 2007, Ferguson et al. 2013). At the same time, pack ice can be important for access to preferred deeper waters along the continental shelf edge (Antonelis et al. 1994, Quakenbush et al. 2011).

There are two main subspecies of bearded seals, E. b. barbatus and E. b. naudus. Although they are geographically separated between their ranges, E. b. naudus lives in the Bering, Beaufort, and Chukchi Seas and is migratory (Rice 1998). Bearded seals in this subspecies employ a rolling (rather than territorial) strategy during the breeding season (Van Parijs and Clark 2002, 2004), and rarely haul out on land (Smith 1981).

LIFE CYCLE

Ice seal life histories are dependent upon the seasonal nature of sea-ice extent, balancing suitable marine foraging conditions with the presence of ice haulouts (Lydersen and Kovacs 1999). Most of the key events in sea-ice histories are condensed into the months between spring and summer (generally, March–June). Whelping typically occurs in March and April, followed by nursing, when seal pups rapidly gain mass, up to 7.3 pounds (3.3 kg) per day for bearded seals (Lydersen et al. 1996). Immediately after nursing, seals begin to breed. Implantation of the blastocyst is usually delayed a few months, followed by a seven- to nine-month pregnancy, ensuring that pups are born in the spring, when food is most available (Sandall 1999).

After whelping and breeding have been completed, ice seals undertake an annual molt. Seals haul out of the water more during molting. Generally, ice seals are highly mobile and follow the distribution of sea-ice (MacIntyre et al. 2018), although ribbon seals adapt to a seasonally pelagic life during the open-water season (Bowen et al. 2003).

Diet

Although Arctic ice seal ranges overlap, dietary niches are somewhat partitioned (Dehn et al. 2007). Ringed, ribbon, and spotted seals are pelagic foragers, whereas bearded seals use benthic prey typically crustaceans, cephalopods, and occasionally fish (Dehn et al. 2007, Cooper et al. 2009). Bearded seals eat both benthic and epibenthic benthic species. Although ringed seals shift their dietary intake seasonally, and consume pelagic prey opportunistically (Antonelis et al. 1994, Quakenbush et al. 2010).

Ribbon seals dive deeper than other ice seals (Deguchi et al. 2004) and regularly forage at depths up to 1,600 feet (500 m), but shift to shallower foraging bouts when ice conditions prevent them from diving (Lenfant et al. 1970). Ringed seals regularly forage at depths up to 500 feet (150 m), and very rarely haul out on land (Smith 1981). Although bearded seals have some capacity to create breathing holes in ice, they use them to access deeper waters along the continental shelf edge (Antonelis et al. 1994, Quakenbush et al. 2010).

Ribbon seals dive deeper than other ice seals (Deguchi et al. 2004) and regularly forage at depths up to 1,600 feet (500 m), but shift to shallower foraging bouts when ice conditions prevent them from diving (Lenfant et al. 1970). Ringed seals regularly forage at depths up to 500 feet (150 m), and very rarely haul out on land (Smith 1981). Although bearded seals have some capacity to create breathing holes in ice, they use them to access deeper waters along the continental shelf edge (Antonelis et al. 1994, Quakenbush et al. 2010).
CONSERVATION ISSUES

Due to rising concern about the impacts of reduced sea ice on ice-obligate and ice-associated wildlife, the National Oceanic and Atmospheric Administration (NOAA) recently assessed ice seal conservation status according to the ESA (Boving et al. 2009, Cameron et al. 2010, Kelly et al. 2010b, Boveng et al. 2013). The resulting decisions are the subject of ongoing litigation.

For bearded seals, the original 2012 decision to list Pacific subspecies as threatened was challenged, vacated, and has since been appealed and reinstated in October 2016, with the appellate court denying any future rehearings in May of 2017 (Duffartman 2016, Muto et al. 2016). Currently, both of the DPSs of the bearded seals in the Bering, Chukchi, and Beaufort Seas (a native subspecies) are listed as threatened. The range of the Beringa DPS spans the entire Bering, Chukchi, and Beaufort Seas; the Okhotsk DPS is restricted to the Sea of Okhotsk.

Ribbon seal status was reviewed under the ESA in 2013, and although listing was not warranted, ribbon seals were determined to be a species of concern.

Although Arctic ringed seals were listed as threatened under the ESA in 2010, a subsequent lawsuit vacated the decision in 2016 and ringed seals are no longer listed under the ESA (Muto et al. 2016).

One of three DPSs of spotted seals is listed as threatened. This population breeds in the Yellow Sea and Peter the Great Bay and does not typically reach into the Arctic. The spotted seal (P. largha) is a marine mammal that inhabits the project area—the Bering Sea DPS—are not warranted for listing under the ESA. The spotted seal status was reviewed under the ESA in 2013, and although listing was not warranted, ribbon seals were determined to be a species of concern.

Of the few subspecies of ringed seal, the Arctic ringed seal (pop pictured) is the most numerous and widely distributed. Of the few subspecies of ringed seal, the Arctic ringed seal (pop pictured) is the most numerous and widely distributed.

commercial fishing are not anticipated to be major threats to ice seal populations (Huntington 2009).

Seal populations have been affected by diseases or infections, although it is difficult to predict future trajectories or occurrences. An unusual mortality event (UME) was declared by the NOAA and the US Fish and Wildlife Service (USFWS) for ice seals in 2011. Over 100 ice seals were reported stranded, with hair loss, lesions, and/or weakness (National Oceanic and Atmospheric Administration and US Fish and Wildlife Service 2012). No causes have been identified, and the UME is still an open investigation for ice seals, although few if any new causes have been reported since 2014 (National Oceanic and Atmospheric Administration 2018).

MAPPING METHODS (MAPS 6.3.1–6.3.4)

The ice seal maps show seasonal distribution of each species throughout the project area. Seasonal data are generally grouped into two seasons, winter/spring and summer/fall, with the exception of data that are applicable year-round. Distribution data are also categorized by four intensities: extent of range, regular use, concentration, and high concentration. Areas where winter/spring and summer/fall data of the same intensity level overlap are shown as year-round at that intensity. General methods for mapping each data layer are described below, with specific sources listed by intensity and seasonal grouping in Table 6.3.1–6.3.2. Due to polygon overlap between data sources, some data listed below may be depicted as year-round but listed as winter/spring or summer/fall in “Map Data Sources” for a list of citations by display layer. Also see A Closer Look: Kawerak’s Contribution of Traditional Knowledge.

The mapped ice seal range data were provided in the most recent NOAA status reviews for each species. Seasonal range data were not available for ice seals, with the exception of winter/spring range for spotted seals.

Regular-use data for each ice seal species were composed from a variety of sources.

- Bearded seal regular-use data were composed from several sources. Bearded seals regularly use large portions of the map area throughout the year and typically use other portions of the map area in only the winter/spring season. The year-round data were from National Oceanic and Atmospheric Administration (1988) and three traditional knowledge sources, including data from a February 2017 workshop with Bering Strait regional traditional knowledge experts who reviewed Audubon Alaska’s draft ice seal maps (Audubon Alaska et al. 2017). The winter/spring data came from two sources: an Audubon Alaska GIS file (based on publications by Bengtson et al. 2005, Cameron et al. 2010, and National Oceanic and Atmospheric Administration [1988]) and traditional knowledge from Oceana and Kawerak (2014).

- Spotted seal regular-use data were composed from several sources. Spotted seals regularly use large portions of the map area throughout the year and typically use other portions of the map area in only the winter/spring season. The year-round data were from National Oceanic and Atmospheric Administration (1988) and three traditional knowledge sources, including data from a February 2017 workshop with Bering Strait regional traditional knowledge experts who reviewed Audubon Alaska’s draft ice seal maps (Audubon Alaska et al. 2017). The winter/spring data came from two sources: an Audubon Alaska GIS file (based on publications by Bengtson et al. 2005, Cameron et al. 2010, and National Oceanic and Atmospheric Administration [1988]) and traditional knowledge from Oceana and Kawerak (2014).

- Ringed seal regular-use data were composed from several sources. Ringed seals regularly use large portions of the map area throughout the year and typically use other portions of the map area in only the winter/spring season. The year-round data were from National Oceanic and Atmospheric Administration (1988) and three traditional knowledge sources, including data from a February 2017 workshop with Bering Strait regional traditional knowledge experts who reviewed Audubon Alaska’s draft ice seal maps (Audubon Alaska et al. 2017). The winter/spring data came from two sources: an Audubon Alaska GIS file (based on publications by Bengtson et al. 2005, Cameron et al. 2010, and National Oceanic and Atmospheric Administration [1988]) and traditional knowledge from Oceana and Kawerak (2014).
• Ribbon seal regular-use data were shown based on these data sources, including traditional knowledge and data from NOAA.
• The year-round, regular-use data for ribbon seals were from traditional knowledge (Stephenson and Hartwig 2010; Audubon Alaska 2017) and also incorporate summer/fall data (Audubon Alaska 2016b, Huntington et al. 2015, Stephenson and Hartwig 2010).
• Spotted seal data are shown for winter/spring and summer/fall seasons as well as year-round data, and were acquired from several data sources.

As with regular use, concentration data for the four ice seal species also came from a number of sources.

• Bearded seal winter/fall concentration data (displayed as year-round concentration due to seasonal concentration data overlaps) were available from traditional knowledge, while winter/spring data are shown based on traditional knowledge and several other sources.

• Both summer/spring and fall concentration data for ribbon seals were available only from National Oceanic and Atmospheric Administration (1988).

• The ringed seal winter/spring concentration is represented by the maximum extent of shorefast ice (compiled by Audubon Alaska 2016j); where these activities occur. Little is known about ice seal distributions in Russian waters.

Data Quality
Knowledge of ice seals varies from species to species. While the overall range extent data are comprehensive and consistent for all four species, the quantity of information regarding more detailed habitat use varies across the maps. The available spatial data for ribbon seals, for example, comes from just three data sources while ringed seal data were gathered from over a dozen sources. Much of the habitat use information shown on these maps comes from traditional knowledge and varies in collection methodology from data source to data source. Lack of concentration and high-concentration areas across these maps does not indicate that these regions are unimportant, rather, that the use or non-use of these areas is unknown. Areas where a specific activity occurs, such as breeding or denning, are labeled where this information is known. This labeling is not intended to indicate that these are the only portions of the project area where these activities occur. Little is known about ice seal distributions in Russian waters.

Reviews
• Bering Strait Traditional Knowledge-Holder Map Review Workshop participants
• Michael Cameron

MAP DATA SOURCES
BEARDED SEAL MAP
Extent of Range: Cameron et al. (2000)
Regular Use (Winter/Spring): Audubon Alaska (2017a) based on Cameron et al. (2000), Bengtson et al. (2005), and National Oceanic and Atmospheric Administration (1988); Oceana and Kawerak (2014)
Regular Use (Year-round): Audubon Alaska et al. (2017); Huntington et al. (2015b); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988); Oceana and Kawerak (2014)
Concentration (Winter/Spring): Audubon Alaska (2017a) based on Cameron et al. (2000), Bengtson et al. (2005), and National Oceanic and Atmospheric Administration (1988); Oceana and Kawerak (2014)
Concentration (Year-round): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)

RIBBED SEAL MAP
Extent of Range: Boveng et al. (2013)
Regular Use (Winter/Spring): Audubon Alaska et al. (2017); Boveng et al. (2013)
Regular Use (Summer/Fall): National Oceanic and Atmospheric Administration (1988)
Regular Use (Year-round): Audubon Alaska et al. (2017); Boveng et al. (2013)
Concentration (Summer/Fall): National Oceanic and Atmospheric Administration (1988)
Sea Ice: Audubon Alaska (2016b) based on Fetterer et al. (2016)

RINGED SEAL MAP
Extent of Range: Boveng et al. (2013)
Regular Use (Winter/Spring): Audubon Alaska et al. (2017); Boveng et al. (2013)
Regular Use (Summer/Fall): National Oceanic and Atmospheric Administration (1988)
Regular Use (Year-round): Audubon Alaska et al. (2017); Huntington et al. (2015b); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988)
Concentration (Winter/Spring): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)
Concentration (Summer/Fall): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)
Concentration (Year-round): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)

SPOTTED SEAL MAP
Extent of Range: Boveng et al. (2009)
Regular Use (Winter/Spring): Boveng et al. (2009); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988)
Regular Use (Summer/Fall): Audubon Alaska (2016b) based on Lowry et al. (1998); Huntington et al. (2015b); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988)
Regular Use (Year-round): Audubon Alaska et al. (2017); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988)
Concentration (Winter/Spring): Audubon Alaska et al. (2017); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988)
Concentration (Summer/Fall): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)
Concentration (Year-round): Audubon Alaska et al. (2017); Oceana and Kawerak (2014)

Haulouts: Huntington and Quakenbush (2017); Huntington et al. (2012); Kawerak (2013); Lowry et al. (1998); National Oceanic and Atmospheric Administration (1988); National Oceanic and Atmospheric Administration (2005); Oceana and Kawerak (2014)

Sea Ice: Audubon Alaska (2016b) based on Fetterer et al. (2016)

Ribbon seals are listed as a species of concern under the Endangered Species Act due to their reliance on diminishing sea ice.
Ice Seals

Ribbon Seal  
*(Histriophoca fasciata)*

Ribbon seals are typically found in the Sea of Okhotsk, Bering Sea, and Chukchi Sea, closely following sea-ice fronts to satisfy haulout requirements for breeding, resting, and molting. Although these phases of their life history constrain them to shallower, ice-covered waters less than 200 feet (<100m) deep over the continental shelf, ribbon seals prefer to forage in deeper waters and undertake deeper dives (up to 2,000 feet [600m]) than other ice seal species. Once molting is complete, ribbon seals essentially become pelagic, spending the summer months foraging as well as the drifting, fractured pack ice suitable for haulouts.

Bearded Seal  
*(Erignathus barbatus)*

Bearded seals are the largest of the ice seals and forage mainly on benthic fauna. They are distributed across the circumpolar Arctic, with two subspecies (*E. b. barbatus* and *E. b. nauticus*) that are sympatric at the edge of their ranges in the far western Beaufort and far eastern Chukchi Seas. *E. b. nauticus* is the subspecies that inhabits the shallow Bering-Chukchi intercontinental shelf, exploiting a productive benthic community that, at less than 300 feet (100m) deep, is easily accessible on foraging dives. Within this region, *E. b. nauticus* undertakes generalized, long-distance seasonal movements to follow the sea-ice front, maintaining access to open water for foraging as well as the drifting, fractured pack ice suitable for haulouts.

Spotted Seal  
*(Phoca largha)*

Spotted seals are delimited, based on breeding areas, into three distinct population segments (DPSs): the Bering DPS (breeds in the Karaginsky Gulf, the Gulf of Anadyr, and the Bering Sea), the Okhotsk DPS (breeds in the Sea of Okhotsk), and the Southern DPS (breeds in the Yellow Sea and Sea of Japan).

Like ribbon seals, spotted seals are associated with the sea-ice front in the winter and rely on stable ice for haulout sites for sprouting whelping, nursing, and breeding. However, as the ice recedes, spotted seals move toward the coast, where they make extended foraging trips from shore-based haulouts.

Ringed Seal  
*(Phoca hispida)*

Ringed seals are the most widely distributed ice seal, with five subspecies ranging from the Sea of Okhotsk, to freshwater lakes in Finland and Russia. The Arctic subspecies, *P. h. appaloosa*, ranges from the Bering Sea to the Labrador Sea in the Atlantic Ocean. Because of their ability to create and maintain breathing holes in the ice with their foreflipper claws, these seals are not as closely reliant on following sea-ice fronts, and often remain in landfast sea ice. During the winter, they remain relatively sedentary, heading out in subarctic bays encrusted on snow-covered, stable ice. After the ice breaks up, ringed seals undertake long-distance foraging trips along sea-ice edges or in open water.
The Steller sea lion (Eumetopias jubatus) is the third largest of the pinnipeds, after the walrus (Odobenus rosmarus) and the elephant seal (Mirounga spp.), and is a top predator of the North Pacific. Steller sea lions are amongst the most vocal of marine mammals. Their vocalizations can be “threat calls” that help establish dominance without physical confrontation (Gisiner 1985, Insley et al. 2003). Underwater, Steller sea lions can be heard “mewling, bleating, or yowling.” Females with pups have individually distinct calls, which aid in reuniting mothers and offspring. Steller sea lions are the largest member of the family of eared seals (Phocidae). They have flippers (unlike true seals, which propel themselves with their rear flippers and by undulating their bodies). Steller sea lions are quick and agile swimmers and reach speeds of up to 20 knots by propelling themselves lazily by undulating their bodies. They can travel over 300 miles in a day. Adult females may weigh up to 770 pounds (350 kg) and males up to 2,500 pounds (1,130 kg). Most adult females reach sexual maturity in their third year and begin growing until October. Some females first breed at the age of 12 (Muto et al. 2016). The males reach sexual maturity at 8–9 years of age, but by their sixth year, nearly all are breeding and producing pups. Females give birth to a single pup from mid-May through July, after 11.5 months of gestation (Pitcher and Calkins 1981). They breed shortly after the pup is weaned, usually just prior to the breeding season (Pitcher and Calcites, 1981, Triest et al. 2006). Pups are left for 6–12 hours while their mothers go to sea to feed, depending on how long it takes her to find food (Hood and Oino 1997). A pup’s early growth is key to its survival. Pups can gain nearly 10 pounds per day and can gain 20 percent of their birth weight in the first day or two of life. Females may return to the rookery for birth to 5 times. Pups may grow as young as 3 months old can catch their own fish to supplement their diet (Rawson-Suuny et al. 2022).

Steller sea lions are the largest of the eared seals (Phocidae) and have external ears and rear flippers that can turn forward, allowing them to “walk” with a gait similar to that of land mammals. They swim using their strong fore flippers and steer with their rear flippers (unlike true seals, which propel themselves with their rear flippers and by undulating their bodies). Steller sea lions are quick and agile swimmers and reach speeds of up to 20 knots by propelling themselves lazily by undulating their bodies. They can travel over 300 miles in a day. Adult females may weigh up to 770 pounds (350 kg) and males up to 2,500 pounds (1,130 kg). Most adult females reach sexual maturity in their third year and begin growing until October. Some females first breed at the age of 12 (Muto et al. 2016). The males reach sexual maturity at 8–9 years of age, but by their sixth year, nearly all are breeding and producing pups. Females give birth to a single pup from mid-May through July, after 11.5 months of gestation (Pitcher and Calkins 1981). They breed shortly after the pup is weaned, usually just prior to the breeding season (Pitcher and Calcites, 1981, Triest et al. 2006). Pups are left for 6–12 hours while their mothers go to sea to feed, depending on how long it takes her to find food (Hood and Oino 1997). A pup’s early growth is key to its survival. Pups can gain nearly 10 pounds per day and can gain 20 percent of their birth weight in the first day or two of life. Females may return to the rookery for birth to 5 times. Pups may grow as young as 3 months old can catch their own fish to supplement their diet (Rawson-Suuny et al. 2022).
Steller Sea Lion (Eumetopias jubatus)

The habitat of Steller sea lions extends around the North Pacific Ocean from eastern Japan and Russia through the Aleutian Islands, Bering Sea, Gulf of Alaska, and down the west coast of North America to Central California. Steller sea lions are gregarious, and during the breeding season they concentrate at traditional terrestrial haulouts called rookeries to give birth and mate. There are 10 Steller sea lion rookeries in Russia, 50 in Alaska, 7 in British Columbia, 1 in Washington, 2 in Oregon and 3 in California.

In winter, Steller sea lions may move from their rookeries on the exposed coast to areas more protected from the weather or to the lee sides of islands. They can move over long distances, and adult males, in particular, may disperse widely after the breeding season. During fall and winter, many Steller sea lions disperse from rookeries and increase their use of haulouts, even hauling out on sea ice in the Bering Sea. They also gather at sea in protected bays and channels in a tightly packed group, or “rafts”, near haulouts in winter.

Steller sea lions eat a wide variety of fishes, and invertebrates such as squid and octopus. Feeding occurs from the intertidal zone to the continental shelf, and Steller sea lions are considered top-level predators.
Northern Fur Seal

California species
Jon Warrenchuk and Brianne Mecum

The northern fur seal (Callorhinus ursinus) is a pinniped, and spends most of its life at sea. It comes ashore in the spring and gathers at colonial breeding sites, or rookeries, on only a few islands in the world. The home range during the breeding season is from the Bering Strait to the California Current ecosystem. Despite its expansive range, 50% of the northern fur seal population returns to the Pribilof Island rookeries in the Bering Sea to breed each year, and most northern fur seals were subject to a major commercial harvest for their fur, first starting in California around 1862. That year, the earliest record of a rookery was discovered the Pribilof Island rookeries in 1796, and continued by the US after the purchase of Alaska until 1984.

ADAPTATIONS

Northern fur seals are members of the family Otariidae (the eared seals) and have external ears and rear flippers that can turn forward, allowing them to “walk” with a gait similar to land mammals. They are also aquatic and spend most of their lives in the water, only returning to land tobreed, usually during the winter. The females leave the rookeries and migrate south, traveling through the passes in the Aleutian Islands and into the central North Pacific, Gulf of Alaska, and California Current (Ramey et al. 2005). They remain in the Bering Sea longer and do not migrate as far south as the females (Loughlin et al. 1999). Northern fur seals are a primary migration corridor, used twice per year as the animals leave and return to the Bering Sea (Kagen et al. 1993). In the winter, the females can be found dispersed from southern California to the Sea of Okhotsk and southern Japan off (Kajura and Loughlin 1988, Ramey et al. 2005, Peaden et al. 2004).

LIFE CYCLE

Northern fur seals are terrestrial and most return to the rookeries where they were born to breed (Gentry 1998). Reproductive males begin to compete for females and territories in early fall, as they are free from physical confrontation (Insley et al. 2003). Females and their pups find each other on crowded rookeries through vocalization, and pups can remember their mothers’ unique calls for at least four years (Insley 2000).

DISTRIBUTION

Five stocks of northern fur seals are identified for management purposes: the Eastern Pacific stock which comprises the northern fur seal populations from St. Paul Island to the Commander Islands, to the Commander Islands, Kurland Islands, and Robben Island stocks in Russia; and the California stock which comprises the northern fur seal populations from the California Current. This same migration route has been documented by Sterling et al. (2014), who assessed the contrasting wintertime distributions of northern fur seals from Benoit-Bird Summer Feeding Areas, St. Paul Island Fur Seals: (2015c).

MAP ON PAGE 238

Summer Feeding Areas, St. Paul Island Fur Seals: Sterling et al. (2015c)

The most recent population estimate for the Eastern Pacific stock of northern fur seals is an estimated 1.8–2.1 million animals (National Marine Fisheries Service 2007). The Northern fur seals disperse widely through the Pacific when they leave their summer breeding rookeries, and may spend as much as two years at sea. Female migration patterns can be interpreted as threat calls by other individuals and may help establish dominance without physical confrontation (Yorks and Hartley 1981). This at-sea harvest of northern fur sea population at 3.7 million (Coues 1877, Elliott 2007).

CONSERVATION ISSUES

Northern fur seals are subject to periods of intense commercial exploitation for their fur, first by Russia and then by the US Government after Alaska was purchased (National Marine Fisheries Service 2007). The populations were also taken on sea, and this practice of commercial pelagic sealing killed the lactating females that were on foraging trips, and they were away from their pups on the rookeries (Roppel and Davey 1965, York and Hartley 1981). This at-sea harvest of the mothers also resulted in the deaths of the dependent pups back at the rookeries. Northern fur seals have also begun to be threatened by pollution, and the effects of pollution have been found to be more severe for females than males. In response to a request by Japan to reduce the fur seal population (York and Hartley 1981), Japan was concerned the fur seals were eating too much fish (York and Hartley 1981). The fur seal population subsequently plummeted.

Northern fur seals seem to be particularly vulnerable to entanglement in marine debris and fishing gear. Death through entanglement in debris and illegal gear has been thought to have population-level impacts in the past (Titus and Larkin 1989, Fowler et al. 1992). These seals disperse widely through the Pacific, and are at risk of entanglement with debris and derelict gear each year by drift gillnets fishing for squid in the high seas until the fishing practice was banned (National Marine Fisheries Service 2007). Commercial fisheries have a potentially significant adverse effect on fur seals in the North Pacific. Despite the fur seal season being off limits (<5% harvest rate) (Sinclair et al. 1994, Robson et al. 2004, Robson et al. 2005, Gudmundson et al. 2006, Kuhn et al. 2014). The Bogof! stock southern fur seal populations on Pribilof Islands, the Commander Islands, Kuril Islands, and Robben Island stocks in Russia; and the California stock which comprises the northern fur seal populations from the California Current. This same migration route has been documented by other studies. In contrast, male fur seals displayed a wide variety of migratory behaviors, so it was not possible to delineate a distinct migration route.

Data Quality

Anecdotal information for northern fur seals were limited to the Eastern Pacific stock only. Because of their behavior and locations on only three islands in the Bering Sea, northern fur seal foraging areas in the summer, and winter migration behavior, this group is fairly well documented. Males, however, exhibit less predictable behavior so data for northern fur seals are lacking.
**Northern Fur Seal**

This map shows summer foraging areas and spring rookeries of three subpopulations of northern fur seals in Alaska. The northern fur seal is a pinniped, and spends most of its life at sea. It comes ashore in the spring and gathers at colonial breeding sites, or rookeries, on only a few islands in the world. The home range of the northern fur seal covers a vast area, from the Bering Strait to the California Current. Despite its expansive range, 50% of the northern fur seal population returns to the Pribilof Island rookeries in the Bering Sea to breed and give birth to their young. When foraging offshore, they concentrate at major oceanographic frontal features formed by offshore seamounts, canyons, and the continental shelf break. After the pups are weaned, females leave the rookeries and migrate south, traveling through the passes in the Aleutian Islands and into the offshore Pacific, Gulf of Alaska, and California Current. Older males remain in the Bering Sea longer and do not migrate as far south as the females. Unimak Pass serves as the primary migration corridor twice per year as the animals leave and return to the Bering Sea.

Northern fur seals were subject to a major commercial harvest for their fur, first starting when Russian explorers discovered the Pribilof Island rookeries in 1796, and continued by the US after purchase of Alaska until 1984.
Beluga whales (Delphinapterus leucas) are unmistakable Arctic special-
ist broadly distributed throughout the circumpolar northern latitudes. With at least 19 global stocks, or distinct population segments (DPSs), of which 5 use the Bering, Chukchi, or Beaufort Seas, beluga whales are among the very few entirely Arctic marine mammals on the planet (Bramham et al. 1994, Soloviev et al. 2015). A sixth stock, the critically endangered Cook Inlet DPS, never travels outside of the sheltered waters of Cook Inlet in Alaska.

Beluga whales are extremely social animals, feeding and traveling in and out of the shelf waters, although belugas also use the much deeper water of the Bering Sea, and Beaufort Sea populations. Each stock winters in a different area, including the Bristol Bay, Eastern Bering Sea, Anadyr, Eastern Chukchi Sea, and Beaufort Sea stocks. The Bristol Bay stock, the Eastern Bering Sea stock, the Anadyr stock, the Eastern Chukchi stock, and the Beaufort Sea stock (Map 6.6.1). For beluga whales, the shelf waters, although relatively shallow, are the preferred habitat due to seafloor bathymetry and hydrography, and seas to be unaffected by salinity changes. They concentrate in shallow water and rub against coarse gravel, removing the top layer of small rocks to reveal the upper layer of sand, silt, or mud (Daitch 1990a, b). During certain times of the year, belugas are also known to travel far up stream to feed in freshwater rivers, and are adapted to live in fresh water (Watts and Draper 1988, Hobbs et al. 2005, Harwood et al. 2014). Belugas swim in the marginal ice zone of Arctic and subarctic waters, where water temperatures may be lower than 32°F (0°C), to forage and travel. Belugas are probably the most social of all marine mammals and are extremely vocal, making sounds that are completely different from those of other toothed whales, the brains of belugas show no evidence of the fused cervical vertebrae that keep them from moving their heads this way. Like all other Arctic marine mammals, the beluga’s thick layer of blubber insulates them from the frigid and often ice-covered waters of their Arctic range.

Vocalizations

Beluga whales are highly vocal and are often referred to as the “canaries of the sea,” in reference to the vast array of sounds they produce, including whistles, squeals, moans, grunts, and clicks (Schevill and Smith 1966a, b). The need for such a repertoire may stem from their highly social tendencies and their often dark, ice-covered habitat with poor visibility, which necessitates vocal communication. Belugas also have highly developed senses of hearing and vision, and possess a unique organ called a melon, which is a malleable, cranial mass used for echolocation (Mooney et al. 2008). Their closest relative, the narwhal, is of similar size, lives in the same habitat, and also has the melon organ. Like those other toothed whales, the brains of belugas show no evidence of olfactory bulbs or nerves, which suggests they do not have a sense of smell. Instead, they appear to use a combination of vision, hearing, echolocation, and even taste when they “smell” the water (O’Corry-Crow 2002). Vocalizations can be used to communicate with others and to locate food sources. The beluga whale’s vocal repertoire is extensive and includes a variety of sounds, from high-pitched whistles to low-frequency growls.

ADAPTATIONS

Known in many regions as the “white whale” due to the white skin color of the adults, beluga whales are small relative to other whales, with an average adult weight and length of 3,150 pounds (1,400 kg) and 13 feet (4 m) (Bramham 1998). Beluga whales are measurably smaller than their male counterparts, usually by 300 hundred pounds (140 kg) and 2–3 feet (less than 1 m). Beluga calves are born weighing more than 150 pounds (68 kg) and measuring around 5 feet long (less than 2 m). As a toothed whale, the beluga’s dentition lends insight into their longevity, with the rings of their teeth suggesting typical lifespans of 35–50 years, extending to 70 years in some cases (Luske et al. 2007, Suydam 2009). Unlike most other pinnipeds, beluga whales lack true dorsal fins and do not produce a typical mist when surfacing to breathe. Belugas are also unique in that they can move their heads up, down, left and right—a possible benefit while hunting (Brodie 1989). The melon of beluga whales has a unique shape, which is a malleable, cranial mass used for echolocation (Mooney et al. 2008). The unique, white skin of the beluga makes them one of the most familiar and easily recognized cetaceans.

Distribution

Beluga whales live throughout the Arctic, from Greenland to North America to Russia, including in the Sea of Okhotsk, the Bering Sea, Cook Inlet, Gulf of Alaska, Beaufort Sea, Baffin Bay, Hudson Bay, and the Gulf of St. Lawrence (Hauser et al. 2014, Marcoux et al. 2012). They prefer coastal or continental shelf waters, although belugas also use the much deeper water of the Bering Sea, and Beaufort Sea populations. Each population winters in a different area, including the Bristol Bay, Eastern Bering Sea, Anadyr, Eastern Chukchi Sea, and Beaufort Sea stocks. Five separate stocks of belugas winter in the Bering Sea, including the Bristol Bay stock, the Eastern Chukchi Sea stock, and Beaufort Sea populations. Each stock winters in a different portion of the Bering Sea, and exhibits site fidelity from year to year, suggesting that belugas from different populations have population-specific winter ranges (Citta et al. 2018).

In summer, the Eastern Chukchi Sea and Beaufort Sea beluga stock ranges overlap in the Arctic, while the Bristol Bay, Eastern Bering Sea, and Anadyr stocks are restricted to their respective ranges (Suydam et al. 2001, Hauser et al. 2014, Hauser et al. 2017a, b). During certain times of the year, belugas are also known to travel far upstream to feed in freshwater rivers, and are adapted to live in fresh water (Watts and Draper 1988, Hobbs et al. 2005, Harwood et al. 2014). Belugas swim in the marginal ice zone of Arctic and subarctic waters, where water temperatures may be lower than 32°F (0°C), to forage and travel. Belugas are probably the most social of all marine mammals, and also have the melon organ. Like those other toothed whales, the brains of belugas show no evidence of olfactory bulbs or nerves, which suggests they do not have a sense of smell. Instead, they appear to use a combination of vision, hearing, echolocation, and even taste when they “smell” the water (O’Corry-Crow 2002). Vocalizations can be used to communicate with others and to locate food sources. The beluga whale’s vocal repertoire is extensive and includes a variety of sounds, from high-pitched whistles to low-frequency growls.

Diet

Opportunist feeders, the belugas of the Bering, Chukchi, and Beaufort Seas move between seasonally disparate habitats and consume equally diverse prey. They concentrate their hunting efforts on calanoid-biased primary prey, such as cephalepods, bristles, gastropods, arthropods, and algae, and a variety of fishes, including salmon, eulachon, cod, and flounder (Loseto et al. 2009, Marcus et al. 2012, Quakenbush et al. 2015). The universal movements of water through Barrow Canyon in the far eastern Chukchi Sea result in high concentrations of Arctic cod (Arctogadus glacialis) during the summer months, a resource the belugas of the Chukchi and Beaufort Seas exploit each year (Hauser et al. 2015, Stafford et al. in press).

Conservation Issues

The critically endangered Cook Inlet DPS is the only population of belugas listed under the Endangered Species Act (ESA). Genetically isolated for millions, the population has been reduced in the last 40 years from 1,300 individuals in the late 1970s to approximately 280 whales in 2010 (Allen and Angilier 2014, Muto et al. 2016). In 2011, 3,106 square miles (7,930 square km) of marine habitat were designated as Critical Habitat for the Cook Inlet beluga whale DPS (76 FR 2080; 50 CFR part 226.240). As of 2012, the International Union for the Conservation of Nature (IUCN) lists the entire species as near-threatened (IUCN 2012). They are protected under the Marine Mammal Protection Act (MMPA), and were listed as depleted in the late 1990s.

The Arctic climate continues to change significantly, requiring adap-
tion by the species that rely upon this unique ecosystem. Changes in sea ice extent, quality, and timing directly and indirectly impact the life history of beluga whales (Johannessen et al. 2004, Hauser et al. 2017a, O’Corry-Crow et al. 2018). Ice-associated and ice-obligated species will be forced to adapt to shifts and changes in water tempera-
tures, habitat availability, prey species quantities and composition, and weather patterns, although there is evidence that the beluga whale may be less susceptible to the potentially drastic changes they face owing to their broad distribution and exhibited adaptability (Laidre et al. 2008, Moore and Huntington 2018, Heide-Jørgensen et al. 2019).

Sea-Ice Habitat

During the winter, beluga whales are found in offshore waters near the pack ice margin, and closely associated with polynyas and leads. Beluga whales in the marginal ice zone of Arctic and subarctic waters, where water temperatures may be lower than 32°F (0°C), to forage and travel. Belugas are probably the most social of all marine mammals, and also have the melon organ. Like those other toothed whales, the brains of belugas show no evidence of olfactory bulbs or nerves, which suggests they do not have a sense of smell. Instead, they appear to use a combination of vision, hearing, echolocation, and even taste when they “smell” the water (O’Corry-Crow 2002). Vocalizations can be used to communicate with others and to locate food sources. The beluga whale’s vocal repertoire is extensive and includes a variety of sounds, from high-pitched whistles to low-frequency growls.

Life Cycle

In the Bering, Chukchi, and Beaufort Seas, belugas mate in the spring, usually in March or April. Gestation lasts about 14–15 months, and in the northernmost portions of their respective ranges, most calves are born between May and July, when the water is warmest, as newborn calves lack a thick blubber layer. The calves are born toothless and nurse exclusively for 12–18 months. When their teeth emerge, they begin to supplement their diets with shrimp and small fishes, although they will often continue to nurse. Females are old enough to reproduce at around four years of age, and females have been recorded to live to three years. Males reach sexual maturity between ages seven and nine (Dodge 1990a, b).

Molt

Belugas shed their outer layer of skin, or molt, each summer around July. They concentrate in shallow water and rub against coarse gravel, removing the old layer of skin to reveal the new skin (St. Aubin et al. 1990).
Beluga Whale Stocks

**Map Authors:** Erika Knight and Max Goldman

**Cartographer:** Daniel P. Huffman

**MAP 6.6.1**

---

**Beluga Whale Stocks**

**Extent of Range:**
- **Summer:** Beluga Alaska (2016c) based on Angliss and Outlaw (2008), Citta et al. (2016), Clarke et al. (2015), Hauser et al. (2014)
- **Winter:** Hauser (2017a); Muto et al. (2016)

**Regular Use (Winter):**
- Beluga Alaska (2016a); Citta et al. (2016); Hauser et al. (2014)

**Concentration (Winter):**
- Beluga Alaska and Oceana (2016); Citta et al. (2016); Clarke et al. (2015); Ferguson et al. (2015); Hauser et al. (2014); Muto et al. (2016); Suydam and Alaska Department of Fish and Game (2004)

**High Concentration (Non-winter):**
- Beluga Alaska (2017a) based on Beluga Alaska and Oceana (2016), Beluga Alaska et al. (2015), Daniel et al. (2015), Stafford et al. (in press); Harwood et al. (2004); Huntington and the Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik (2001); Paulic et al. (2012); Stephenson and Hartwig (2010); Suydam and Alaska Department of Fish and Game (2004)

**Reproduction:**
- Beluga Alaska et al. (2017); Clarke et al. (2015); Huntington and the Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik (1999)

**Migration:**
- Beluga Alaska (2016a) based on Beluga Alaska and Oceana (2016), Beluga Alaska et al. (2015), Daniel et al. (2015), Stafford et al. (in press); Harwood et al. (2004); Huntington and the Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik (2001); Paulic et al. (2012); Stephenson and Hartwig (2010); Suydam and Alaska Department of Fish and Game (2004)

**Sea Ice:**
- Beluga Alaska (2016c) based on Fetterer et al. et al. (2016)

**BELUGA STOCKS MAP**
- **Anadyr Stock:** Summer and winter—Citta et al. (2016)
- **Bristol Bay Stock:** Summer and winter—Citta et al. (2016)
- **Cook Inlet Stock:** Year-round—Muto et al. (2016)
- **Beaufort Sea Stock:** Summer—Hauser (2017a); Winter—Citta et al. (2016)
- **Eastern Chukchi Sea Stock:** Summer—Hauser (2017a); Winter—Citta et al. (2016)
- **Sea Ice:** Beluga Alaska (2016c) based on Fetterer et al. et al. (2016)
Beluga Whale

**Beluga Whale** (*Delphinapterus leucas*)

Often referred to as white whales, or the canaries of the sea, beluga whales are Arctic specialists that spend their entire lives in the icy waters of the far north. In the Bering, Chukchi, and Beaufort Seas, there are five distinct population segments, or stocks, that utilize these waters alone throughout the year. In the fall, when ice coverage in the Beaufort and Chukchi Seas begins to limit prey availability, the Eastern Chukchi and Beaufort Sea stocks of beluga whales move south through the Bering Strait and, along with whales from the Eastern Bering Sea, Bristol Bay, and Anadyr stocks, spend the winter in the Bering Sea.

Highly social animals, they travel in groups that can number in the hundreds, feeding on a wide variety of sea life, such as squid, bivalves, snails, and fish. The wintering area for each of the five stocks is likely distinct, exclusive, and consistent among years.

Beluga whales are ice associated, generally feeding near the productive sea-ice margin and commonly utilizing the productive waters found in leads and polynyas throughout the Bering Sea. As the weather begins to warm, beluga whales follow leads in the ice north to their spring breeding grounds to mate, before completing the journey back to their summer habitat. Belugas calve after a 15-month gestation period in the portion of their respective ranges where the water is warmest, as their young do not yet have the necessary blubber to keep them warm in the coldest waters of the Arctic. Beluga whales utilize the gravel-bottomed shallows of their summer range to molt their now yellowed and dingy skin, an uncommon behavior among cetaceans.

---

**Map Authors:** Erika Knight, Max Goldman, and Melanie Smith

**Cartographer:** Daniel P. Huffman

**Map 6.6.2**

© Uko Gorter
Bowhead whales (Balaena mysticetus) are endemic to northern latitudes, living out their entire lives in Arctic or subarctic waters (Niebuhr and Schall 1993). Closely related and similar in appearance to right whales of the genus Eubalaena, the bowhead whale is the sole extant species in the genus Balaena. While bowhead whales came under enormous hunting pressure in the late 19th and 20th centuries, environmental protection and moratoria on commercial whaling have secured a future for this unique animal, and population numbers have rebounded significantly. Scientists classify the bowhead whale into five subpopulations or stocks: The Hudson Bay-Foxe Basin stock, the Baffin Bay-Davis Strait stock, the Western Arctic or Bering Chukchi Beaufort stock (International Whaling Commission 2010). For management purposes, four bowhead whale stocks are currently recognized by the International Whaling Commission, with the Hudson Bay-Foxe Basin and Baffin Bay-Davis Strait stocks being divided into the eastern Arctic-West Greenland stock (International Whaling Commission 2010).

ADAPTATIONS

Bowhead whales are mystics, meaning they have baleen plates instead of teeth for filtering food out of the ocean. They have the largest mouths of any animal on the planet, containing numerous baleen plates up to 14 feet (4.3 m) long (Quakenbush et al. 2008). Distinctively, bowheads have a dark body, a white chin, and a lack a dorsal fin. Their 17-19 inch (45-50 cm) thick blubber layer is thicker than that of any other living animal, allowing them to thrive in the frigid waters of the high Arctic (Quakenbush et al. 2008; Quakenbush et al. 2013a, b). Their paired blowholes are positioned at the elevated peak of their massive heads, presumably allowing them to breathe through small openings in the frozen surface of the Arctic Ocean (Burns et al. 1993, Quakenbush et al. 2010a). The huge, 16-foot (5-m) long skull of the bowhead whale makes up nearly a third of their overall body length and is used to break through ice and to otherwise unattainable food sources. At about 45-50 feet (14-18 m) long and weighing 150,000–200,000 pounds (68,000–90,000 kg), bowheads are among the largest animals on the planet (Burns et al. 1993).

Vocalizations

Bowhead whales spend their entire lives in the often icy waters of the far north. For a substantial portion of the year, this habitat is shrouded in darkness and crusted with ice, making communication between individuals and groups using visual stimuli difficult or impossible. Bowhead calfs add to the varied arctic soundscape that includes sounds produced by animals, wind, ice, and people (Blackwell et al. 2007, Hildred et al. 2009). Bowhead whales have evolved to communicate by producing both simple calls and elaborate songs based in part on external stimuli in the aural environment (Clarke et al. 2015).

DISTRIBUTION

Bowhead whales are distributed in seasonally ice-covered waters of the Arctic and subarctic (Moore and Reeves 1993). Bowhead stocks can be found in the Sea of Okhotsk (Russian waters), Baffin Bay-Davis Strait and Hudson Bay-Foxe Basin (western Greenland and eastern Canadian waters, sometimes split into two separate stocks), in the eastern North Atlantic (the Svalbard stock near Svalbard), and in the Bering-Chukchi-Beaufort Seas (the Western Arctic stock), which is the largest subpopulation and only stock found within US waters (Rugh et al. 2003).

The Western Arctic stock occurs from Chaunskaya Bay (Russia) in the western Chukchi Arctic Archipelago, and the northern Bering Sea south from near Cape Navarin (Russian Federation) along the Bering slopes and St. Matthew Island (Rice 1999, Quakenbush et al. 2013). Despite the geographical proximity of wintering bowhead whales from the Western Arctic stock in the northern Bering Sea to those from the Sea of Okhotsk stock, there is no evidence of any geographical or temporal overlap of these stocks (Vashchenko and Clapham 2010).

Sea-Ice Habitat

Bowhead whales are found only in Arctic and subarctic regions. Western Arctic bowheads spend much of their time in, near, and even under the pack ice, migrating north to the Beaufort shelf and northern Chukotkan coast in summer and retreating south through the Bering Strait with the advancing ice edge in winter (Moore and Reeves 1993). During winter, bowhead whales frequent areas near the sea-ice margin, utilizing leads (large cracks in ice) and polynyas (areas of open water in ice caused by wind or warm-water upwelling), and in areas of ice productive for calving. Calves are born near open water not as closely tied to these areas as previously understood (Nerini et al. 1984). During the spring those whales use leads to penetrate areas that were inaccessible during the winter due to heavy ice coverage. If no open water is available, they will locate a thin portion of the ice cover and use their massive heads to push up or break the ice sheet so they can breathe. Bowheads can break ice up to 2 feet (0.6 meters) thick.

Migration

Bowhead whales of the Western Arctic stock migrate each spring from the Bering Sea through the Chukchi Sea to the eastern Beaufort Sea where they spend most of the summer (Moore and Reeves 1993). By early September bowheads begin their fall migration, leaving the eastern Beaufort Sea during September and October. The bowheads move past Barrow before heading west across the Chukchi Sea toward Russian waters (Moore and Reeves 1993, Clarke and Ferguson 2010, Clarke et al. 2016), where many feed in late fall off the northern coast of Chukotka before returning to the Bering Sea.

During the spring migration, bowhead whales typically begin arriving in the Utkusigaq area (formerly Barrow) area in early April and continue migrating past Utkusigaq until well into June. Most of this migration appears to be a fairly steady flow of whales traveling from the Chukchi Sea to the Beaufort Sea, but in late spring some whales have been seen making frequent turns in a small area, and are presumably feeding (Carroll et al. 1987). Although bowheads are more commonly seen off the coast of Utkusigaq during the spring and fall migrations, there have also been reports of whales feeding near Utkusigaq from late September to early September (Moore 1992, George et al. 2004, Moore et al. 2010). A smaller portion of the landscape follows an atypical migration path, instead migrating west along the northern Chukotkan coast in spring and summer and back to the Chukchi Sea during summer and fall, before returning to the Bering Sea in winter.

LIFE CYCLE

Bowhead whales reach sexual maturity at approximately 20 years of age. During northerly spring movement in April, displays of breathing and fluke slapping ensue prior to mating. It is not clear if this activity is competitive in nature or a part of a cooperative mating strategy (Foote 1964, Everett and Krogman 1979, Würsig et al. 1995, Audubon Alaska et al. 2017).

After a gestation period of 13-14 months, females give birth to a calf about 13 feet (4 m) long and weighing about 2,000 pounds (900 kg) (Nerini et al. 1984). Calves are born to swim during the spring migration between April and June (Burns et al. 1993, Quakenbush et al. 2008). They form close bonds with their mothers, staying together for 9-12 months. Females give birth every three to four years (Nerini et al. 1984).
Commercial whaling in the north Pacific began in the mid-19th century, escalating and continuing into the 20th century before a near-global moratorium was agreed upon in 1982 (International Whaling Commission 2007). Minimum annual quotas on bowhead stocks are estimated to have been 3,000 for the Okhotsk Sea stock; 12,000 for the Hudson Bay-Foce Basin and Bath Basin; and 100,000 for the Spitzbergen stock (Woodby and Bolton 1993). The Western Arctic stock was estimated to be 12,000–20,000 animals (Brandl and Wada 2006).

The current range-wide abundance of all five stocks of bowhead whales is not known. Although the best available data suggest a population of nearly 17,000 (George et al. 2004, Govers et al. 2013). Estimates of proportions of the ranges of the Western Arctic, Chukchi, and Baffin Bay bowhead stocks support population estimates of 3,500 and 3,700 respectively (Civers and Blouw 2013, Koski et al. 2006b).

There are many areas of concern regarding the health of bowhead populations. While the biggest threat of the past was overharvest from commercial whaling activities, bowhead harvest for subsistence is currently well-managed (National Oceanic and Atmospheric Administration 2013). However, broad-scale habitat degradation from human activities could affect bowhead behaviors and abundance, which should be carefully considered for stock management in the future (Richardson 1995, Croll et al. 2001). Climate change and loss of sea ice affects production and availability of food resources—a yet unknown effect on the future of bowhead whale populations (George et al. 2016). Bowhead noise disturbance from ships and are vulnerable to ship strikes, which will likely increase along with an increase in vessel traffic (Reeves et al. 2002). Hydrocarbon exploration may also affect bowheads, especially from seismic activities (Ljungblad et al. 1988, Richardson 1995). Offshore energy development may also pose threats. A large oil spill could be catastrophic due to sea ice conditions that make a spill hard to clean up, especially in response infrastructure or capability. Commercial fishing gear entanglement is another issue of concern (Reeves et al. 2012, Reeves et al. 2014). Although commercial fisheries are not currently a significant impact on bowheads, Native subsistence hunter have reported entanglements of bowheads (National Oceanic and Atmospheric Administration 2013).

MAPPING METHODS (MAPS 6.7a-6.7h)

Bowhead whale data are mapped on four season-specific maps (spring, summer, fall, and winter). Each map shows the overall (year-round) range extent of bowhead whales, as well as the season-specific range extent. Bowhead whale distribution for each season was further categorized into areas where there are known concentrations of bowhead whales and areas where there are lower concentrations of bowheads. Migration arrows and reproduction areas are shown where this information is available.

Bowhead whale year-round range was compiled from seasonal range data, which was primarily based on figures published in Quakenbush et al. (2013). The spring seasonal range extent from Quakenbush et al. (2013) was expanded based on Bogoslovskaya et al. (2014). Spring Biologically Important Areas (BIAs) for bowhead whales published in Clarke et al. (2015). and data from a February 2017 workshop with Bering Strait region traditional knowledge experts who reviewed Audubon Alaska’s draft bowhead maps (Audubon Alaska et al. 2017). The summer and winter ranges were based on Quakenbush et al. (2013) and expanded based on Bogoslovskaya et al. (2016) and Audubon Alaska et al. (2017). No modifications were made to the fall range from Quakenbush et al. (2013).

The summer and winter ranges were based on Quakenbush et al. (2013) and expanded based on Bogoslovskaya et al. (2016) and Audubon Alaska et al. (2017). No modifications were made to the fall range from Quakenbush et al. (2013).

Seasonal concentration areas were merged by Audubon Alaska (2016d) based on BIAs (Clarke et al. 2015), density information from satellite telemetry from Città et al. (2015), and seasonal information from Quakenbush et al. (2013). Data regarding summer feeding aggregations (Paulic et al. 2012) were included in this summer concentration area. Summer and fall concentration areas also incorporate the 95% isopleth from the Audubon Alaska and Oceana analysis (Audubon Alaska and Oceana 2016) of data from 2000 through 2014 from the Aerial Survey of Arctic Marine Mammals (ASAMM) (National Oceanic and Atmospheric Administration 2015a). The ASAMM data (formerly Bowhead Whale Aerial Survey Project [BWASP]) were analyzed in consultation with Megan Ferguson and James Clarke. Aerial survey methods, data, and metadata for the ASAMM database are available at http://arcgis.nos.noaa.gov/DMML/Software/bwalk-comida.php. The Audubon Alaska and Oceana analysis used only on-transect data where there were 0–60 sea miles (100 km) of survey effort in a 1.2 by 1.2-mile (24 km by 24 km) grid cell. An observation rate (i.e. relative density) was calculated in each grid cell by dividing the observed number of animals over all years by the total transect length over each year. This observation rate was converted into presence data with one point per grid cell (i.e. relative density). A kernel density function was run with an anisotropic kernel density function with a 24.8 by 40 (km) north-south search radius and a 49.6 mile (80 km) east-west search radius to smooth the data.

Seasonal high-concentration areas were also compiled by Audubon Alaska (2016e), largely based on density information from satellite telemetry (Città et al. 2015) and seasonal information from Quakenbush et al. (2013), as described for summer season. The summer and fall high-concentration areas incorporate the 50% isopleth from the Audubon Alaska and Oceana analysis (Audubon Alaska and Oceana 2016) of 2000 through 2014 ASAMM data described above. Each seasonal high-concentration area also includes traditional knowledge information from Huntington and Quakenbush (2009) (spring and summer), and fall and/or of Noongwook et al. (2007) (winter and spring).

Reproduction information is labeled where such information is known based on traditional knowledge (Huntington and Quakenbush 2009) (summer and fall) and/or of Noongwook et al. (2007) (winter and spring). Migration information was derived from a combination of sources, including National Oceanic and Atmospheric Administration (1988), Alaska Department of Fish and Game (2009), Audubon Alaska et al. (2017), and the North Slope Borough Department of Planning and Community Services: Geographic Information Systems Division (2013). Bowhead whaling communities shown in a NOAA environmental impact statement are also mapped (National Oceanic and Atmospheric Administration 2013). Shaktoolik was removed from this dataset based on consultation with Bering Strait region traditional knowledge experts (Audubon Alaska et al. 2017).

Sea-ice data shown on these maps approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska and Oceana analysis (Audubon Alaska and Oceana 2016) of data from 2000 through 2014 ASAMM data described above. Each seasonal high-concentration area also includes traditional knowledge information from Huntington and Quakenbush (2009) (spring and summer), and fall and/or of Noongwook et al. (2007) (winter and spring).
Bowhead Whale

**Winter**

Bowhead whales are large baleen whales endemic to Arctic and subpolar waters. With the thickest blubber of any living animal, and a massive head well-suited for lifting and breaking sea ice, bowheads are adapted to winter life in the frigid waters of the far north. They spend this time bottom-feeding in the Bering Sea. In this dark, ice-covered world, vocalization is critical, and bowhead whales use song extensively, with seasonal, variable songs that are improved and passed down from generation to generation. Bowheads likely breed in winter.

**Spring**

In spring, as the ice margins retreat northward, bowhead whales have already begun to migrate to their summer feeding grounds. Along the way, calves are born. Spring migration routes vary little, with the majority of bowheads traveling through the Bering Strait past the North Slope of Alaska, and dispersing along the ice-covered Beaufort shelf as far east as Amundsen Gulf, although a smaller portion of the population heads to the waters off the northern coast of Chukotka. The spring passage of bowheads is an opportunity for Native subsistence hunters along the Chukchi coast, who often take whales during this time.

**Summer**

After migrating northward from the Bering Sea through the Strait and the Chukchi and western Beaufort Seas in spring, most bowhead whales spend the summer feeding on zooplankton in the eastern Beaufort Sea and northeastern Chukotska coast. The bowhead calves born in spring spend this time developing in protected coastal waters with their mothers, whom they will accompany for the next year. Later in summer, bowheads loop back west along the nearshore waters of the US Beaufort shelf toward Barrow Canyon, bringing them to their fall feeding grounds.

**Fall**

Fall marks the start of the journey to return to the southern portion of their range. As colder temperatures move in, ice begins to form in the Beaufort Sea and food becomes scarce, necessitating the bowhead whale fall migration. Bowheads gather in the nearshore waters along the US Beaufort shelf to feed in the fall, before crossing the Chukchi Sea to congregate at fall feeding areas along the northern Chukotska coast. Later in the fall, the newly forming ice margins slowly push the whales further south from their feeding, breeding, and calving grounds until they reach the leads and polynyas they will rely on for the coming winter months. Newborn calves follow their mothers away from their birthplace for the first time, but will return again when the winter ends and the ex-melts away.
Gray whales (Eschrichtius robustus) are large mysticetes, or baleen whales, that forage from the southern tip of Baja, Mexico in the winter to the Chukchi and Beaufort Seas in northern Alaska in the summer. These whales are the family Eschrichtiidae, gray whales are not closely related to any living cetacean (Amos et al. 1993, Sasaki et al. 2005). There are two isolated geographic distributions of gray whales in the North Pacific Ocean during summer breeding: the Eastern North Pacific (ENP) stock, found along the west coast of the United States and Alaska, and the critically endangered Western North Pacific (WNP) stock, found along the coast of eastern Asia. In winter, these whales congregate off the coasts of Baja California, Mexico, and is limited genetic data seems to suggest overlap in genetics. Gray whales are generally observed alone or traveling in small, loosely affiliated groups, although large aggregations have been observed on feeding and breeding grounds (Zimshuko and Lenskaya 1970, Berzin 1984).

ADAPTATIONS

Gray whales have a mottled, slate-gray body with small eyes located just above the corners of the mouth. The back of the gray whale is distinctly short and cream colored, and the whale has a few of the ventral furrows that denote the closely related rorqual baleen whales. The tail flukes are more than 15 feet (3 m) wide and can be used by scientists to identify individual whales, based on the tail shape and the distinct white scarring left by parasites that fall off when gray whales enter the cold, Arctic waters of their summer habitat. Gray whales can grow to lengths of approximately 80,000 pounds (35,000 kg), females are often slightly larger than males (Jones and Swartz 1984).

DISTRIBUTION

Gray whales are distributed throughout the North Pacific Ocean, generally staying within coastal waters. Most of the ENP stock spends the summer feeding in the northern Bering and Chukchi Seas (Ciampi et al. 1999), with small groups or individuals feeding farther south along the Pacific coast of the US. In the fall, many gray whales migrate south along the coast of North America to winter off the coast of Baja California, Mexico, in their breeding and calving areas. However, studies indicate that gray whales move widely within their range on the Pacific coast, and are not always found in the same areas each year (Camphuysen et al. 1999, Duan 2000, Camphuysen et al. 2002). There is some evidence that gray whales off of the northern coast of Alaska during winter (Steffen et al. 2007).

Migration

Gray whales make the longest known annual migration of any mammal they travel about 8,000 miles (13,000 km) round trip, with the longest recorded migration of over 15,670 miles (25,100 km) by a female gray whale (Jones and Swartz 2002). Male gray whales may travel over 2,000 miles (3,200 km) every year. The ENP stock of gray whales migrates north along the coast, often accompanied by their newborn calves (Ferguson et al. 2015).

LIFE CYCLE

Gray whales become sexually active around eight years of age (Rice 1984). Courting and mating rituals are complex, consisting of arching out of the water, rolling in the water, side-swimming, flipper displays, and often involve three or more whales of mixed sexes. Breeding synchronize with their annual migration patterns that ensure newborns are born in the warm waters off the coast of Mexico (Swartz et al. 2006). After 13 months of gestation, females give birth to a single, 15-foot-long (4.5 m), 2,000-pound (900 kg) calf (Rice et al. 1984).

Due to their annual migration along the highly populated coastline of the western US as well as their concentration in limited winter and summer areas (Ferguson et al. 2015), the ENP stock may be particularly vulnerable to impacts from commercial and industrial development (National Oceanic and Atmospheric Administration 2010). The sea-ice conditions and local catastrophic events. While the immediate threat of over-harvesting and other human activities being taken by this stock has been removed from the ESA, other issues remain.

As the Bering Sea is one of the world's most productive fisheries, bycatch is a perpetual concern for gray whale conservation, and entanglement is another. Untangled, gray whales are responsible for a number of gray whale deaths each year (Zerbini and Kotas 1998, Kiszka et al. 2009). This is exacerbated by the fact that gray whales are more likely to become entangled due to their feeding processes, and sell any whales caught as bycatch, potentially incentivizing “accidental” entanglements of marine mammals (Jenkins and Romanzo 2015).

Aggregations of whales are often accompanied by guided tourist vessels (O'Connor et al. 2009). Harassment of backyard whale watchers is an increasing issue, especially when there is stress in targeted whales and has resulted in inadvertent ship strikes (Carton 2001, Wiley 2008, Gabrielson et al. 2011). While ecosystem changes may be a concern, a maritime recreational vessel’s practices such as harvest, care needs to be exercised and guidelines developed to protect the whales and ensure the safety of the whales (Weirich and Cornish 2007).

Gray whales feed on benthic and epibenthic invertebrates such as amphipods and isopods, as well as any other sea creatures that get stuck behind their short, stiff flukes when they turn on their side and scoop up a mouthful of water and seafloor sediment. When feeding gray whales are often streaked with mud and are commonly observed leaving a trail of sediment behind them (Camphuysen et al. 2002, Jones and Swartz 1984, in press).

CONSERVATION ISSUES

In the mid-1930s, the League of Nations adopted a ban on commercial gray whale and right whale (Eubalaena spp.) hunting, entering into the first international conservation agreement. The ban on commercial gray whale catches continues under the International Whaling Commission (IWC), established in 1946 when the League of Nations faded during the Second World War. Although gray whales are still hunted by the native people of Chukotka in Russia and Washington State in the US, they are subject to sustainable catch limits under the IWC.

The ENP stock of gray whales was removed from Endangered Species Act (ESA) protection after research estimated their population had recovered to pre-whaling numbers, with an expectation of sustained growth (50 CFR). The status of the ENP stock of gray whales recommended the continuation of this stock’s classification, based on sustained growth of the population without evidence of imminent threats to the stock.

The WNP stock of gray whales has not recovered, and is either severely depleted or is functionally extinct and is now made up of colonizing gray whales of the ENP stock (Mate et al. 2015). It is also possible that the 150 or so whales found in Asian waters are a combination of eastern gray whales inhabiting a larger-than-known range along with a smaller-than-estimated “true” Western gray whale population (Weller et al. 2002, Scheinin et al. 2011, Mate et al. 2015). This stock is listed as endangered under the ESA and depleted under the Marine Mammal Protection Act (MMPA).

MAP DATA SOURCES


Feeding: Audubon Alaska and Oceana (2016b) based on Moore et al. (2016). Clarke and Ackerman (2016); Clarke et al. (2015); Ferguson et al. (2015); Heide-Jørgensen et al. (2012); Yablokov and Bogoslovskaya (1994).

Gray Whale

*Eschrichtius robustus*

Gray whales are large baleen whales that use Arctic and subarctic waters to feed on benthic invertebrates in the summer and fall, after migrating over 10,000 miles (16,000 km) from their subtropical breeding grounds. They are split into two stocks, the critically endangered Western North Pacific (WNP) and the Eastern North Pacific (ENP) stocks. Some WNP whales migrate across the Bering Sea from the Okhotsk. ENP whales head north to feed in coastal areas of the Sea of Okhotsk. ENP whales head north to feed in coastal areas of the Bering and Chukchi Seas.

MAP 6.8

Gray Whale

Humpback whales migrate in the longest of any mammal, with adults regularly traveling a staggering 10,000 miles (16,000 km) each year. Global humpback whale distinct population segment (DPS) breeding/wintering grounds, and their respective summer feeding areas (National Oceanic and Atmospheric Administration 2017). The gray whale migration is the longest of any mammal, with adults regularly traveling a staggering 10,000 miles (16,000 km) each year.

ADAPTATIONS

Humpback whales are among the largest animals on the planet, regularly reaching lengths of 55 feet (16-17 m) and weighing in excess of 90,000 lbs (41,000 kg), with females often measuring up to 6 feet (2 m) longer than their male counterparts (Ornus 1966). They feed using their large, keratin baleen. They have long pectoral fins and distinct color pattern variation on the ventral side of their fluke, allowing for individual identification. Their dorsal surface is generally dark gray, although ventral coloration varies substantially from white to black to a marbled intermediate (Perrin et al. 2009). Humpback whales exhibit highly varied acoustic calls or songs, and a diverse repertoire of surface behaviors.

Vocalizations

Humpback whale songs have been studied for many years, yet their specific function remains unknown. The most likely utility for complex humpback singing is interaction with female humpbacks or dominance over other males (Darling et al. 2006). What is known is that all males in a population sing the same song, yet that song changes and evolves over time, with individuals offering intermittent variation, and the group either adopting or rejecting the variations (Sousa Lima 2005).

DISTRIBUTION

Humpback whales are a globally occurring species with breeding areas located in a latitudinal band from the 30°N to 30°S parallels (Matilsky et al. 2000, Gabriela et al. 2017, Figure 6.9-1). When not breeding or calving, many populations travel to areas of high latitude in both temperate, Arctic, sub-Antarctic and Antarctic waters to feed, often traveling 3,000 miles (5,000 km) or more (Gabriela et al. 1996, Rasmussen et al. 2007, Robbins et al. 2011). The humpback whales that utilize the Bering Sea in the summer are of the Western North Pacific DPS with breeding areas near southern Japan and the Philippines, (Fig. 6.9-1, #3), as well as the Hawaii-breeding DPS (Fig. 6.9-1, #4), and the Mexico-breeding DPS (Fig. 6.9-1, #5).

LIFE CYCLE

Humpback whales spend the colder months in low-latitude breeding grounds. Their mating system is thought to be male-dominated, described by Clapham (Chapman 1996) as a “floating lek.” Males compete with each other for the affection of a female humpback whale by engaging in a complex series of aggressive behaviors, such as chasing and tail thrashing, with competing whales often colliding or surfacing on top of each other (Tyack 1981, Baker and Herman 1984, Clapham 1996). These behavioral displays are often accompanied by complex songs that may last nearly a half-hour and can be heard 20 miles (32 km) away (Clapham and Mattila 1990, Cato 1991).

Clapham et al. (2007) described by Clapham (Clapham 1996) as a “floating lek.” Males compete with each other for the affection of a female humpback whale by engaging in a complex series of aggressive behaviors, such as chasing and tail thrashing, with competing whales often colliding or surfacing on top of each other (Tyack 1981, Baker and Herman 1984, Clapham 1996). These behavioral displays are often accompanied by complex songs that may last nearly a half-hour and can be heard 20 miles (32 km) away (Clapham and Mattila 1990, Cato 1991).
11 months, and weaning begins at about age 6 months and culminates with calves reaching swimming depth near the end of their first year (Clapham and Mayo 1990).

**Diet**

After migrating to summer and fall feeding areas in high latitudes, humpback whales spend their time storing energy in the form of blubber deposits for the long trip back to their breeding and calving range, where they will likely feed very little or not at all (Zebrini et al. 2006). In the Bering Sea, they concentrate their feeding efforts over the productive waters of the continental shelf, avoiding the relatively barren areas of the basin (Moore et al. 2002, Zebrini et al. 2006).

Humpback whales utilize many food sources and strategies. They are known to feed both in cooperative groups and as solitary animals (Clapham 1993). Most of the time they feed alone, advancing on prey with wide-open mouths, then closing their mouths and filtering the water out through their baleen plates. Groups of whales will work together to trap schooling fish using bubble curtains and kick-feeding, unique methods likely taught and learned between individuals and populations (Weinrich et al. 1992, Friedlaender et al. 2009).

Their main prey species are euphausiids and small schooling fish, such as herring (Clupea pallasii), mackerel (Scomber scombrus), sand lance (Ammodramus hexapterus), and capelin (Mallotus villosus) (Baker et al. 1985, Calambokidis et al. 2001).

**CONSERVATION ISSUES**

Humpback whales were first listed as endangered in 1970 under the precursor to the Endangered Species Act (ESA), the Endangered Species Conservation Act of 1966. When the ESA was formally enacted in 1973, humpback whales were again listed as endangered. They are protected from any hunting under the Marine Mammal Protection Act of 1972. The International Whaling Commission (IWC) has protected all cetaceans since the 1970s.

In September of 2016, the ESA listing for humpback whales was updated to specify “3 DPSs; with 1 considered Great Eastern (Mexico DPS) and 4 listed as endangered (Cape Verde Islands/Northwest Africa, Arabian Sea, Western North Pacific, and Central America DPSs) (National Oceanic and Atmospheric Administration 2015b). Humpback whales from the Western North Pacific DPS venture into the Bering Sea in the summer (see Fig. 6.9-1).

While humpback whales have made a substantial recovery through much of their range, there are many areas of concern, especially regarding the endangered Western North Pacific DPS, which spends the summer in the Bering Sea. As the Bering Sea is one of the world’s most productive fisheries, bycatch is a perpetual concern for humpback whale conservation, and entanglement in fishing gear, such as nets, long lines, and crab pots, is responsible for a number of humpback whale deaths worldwide each year (Zerbini and Kotsis 1998, Kicza et al. 2009). This issue is exacerbated by the fact that Korean and Japanese fishermen are legally allowed to keep and sell any whales caught as by-catch, potentially incentivizing “accidental” entanglements of marine mammals (Likenschuster et al. 2009). They are also susceptible to other anthropogenic disturbances such as ship strikes. Humpback whales are particularly vulnerable to inadvertent ship strikes in the Bering Sea near Unimak Pass (Williams and O’Hara 2010).

While commercial hunting of humpback whales ended in 1966, humpbacks have been a proposed target for lethal sampling research conducted by Japan through the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA, JARPA II), although no humpbacks were actually ever killed under those programs (Nishiwaki et al. 2009). In 2014, IWC pressure resulted in Japan abandoning the JARPA II program and its harvest goal of 50 humpback whales per year for the New Scientific Whale Research Program in the Antarctic Ocean (NNEWRP-A), which does include humpbacks as a species for lethal sampling, although many more than 300 minke whales are included in the lethal sampling goals (International Whaling Commission 2015). Subsistence harvest of humpbacks is not widespread, although western Greenland (Denmark) and St. Vincent and the Grenadines (in the Lesser Antilles Islands) each participate in subsistence hunting of humpback whales, with Greenland adhering to the ten humpback whales per year quota recommended by the IWC and St. Vincent and the Grenadines taking two or fewer each year (Reeves 2002).

Aggregations of whales in areas such as the Gulf of Maine, Hawaii, and Southwest Alaska are often accompanied by guided tour vessels (O’Connor et al. 2009; Gabrielle et al. 2011). Harassment and noise by irresponsible whale watchers is a concern, and is likely responsible for increased stress in targeted whales and has resulted in inadvertent ship strikes (Carlson 2001, Wiley et al. 2008). While ecotourism is commonly thought of as a monitory replacement for more impactful practices such as whaling, care needs to be exercised to ensure the safety of the whales (Weinrich and Corbelli 2009).

In far northern latitudes, such as the Bering Sea, large fluctuations in lower trophic recruitment have been observed as a result of a changing climate (Bakun et al. 2015). Humpback whales, along with all other life in the Arctic, will be impacted by those changes, and substantial decreases in available food could prove detrimental to the already endangered Western North Pacific DPS as they rely on feeding in the Bering Sea to store up the energy needed to make the long migration south to their perennial breeding grounds (McBride et al. 2014).

**MAPPING METHODS** (MAP 6.9)

The humpback whale map shows summer and fall use of the project area; because humpbacks only inhabit our map area during the summer and fall, the data are not differentiated seasonally. The summer/fall range, in general, is larger than the fall range. Cetacean use data are summarized by Ferguson et al. (2015) into the feeding BIAs shown as summer use. The use of BIAs is fairly general. Fine scale distribution data exist for US and Canadian waters (e.g. Friday et al. (2013), Zerbini et al. (2006), and Zerbini et al. 2016) among others), and this detailed spatial information has been digitized from the Marine Mammal Stock Assessment. Feeding concentration areas in Ferguson et al. (2015) were downloaded from the National Oceanic and Atmospheric Administration (NOAA) website. The sea-ice data show this area is approximated as the extent of sea-ice concentration areas in Ferguson et al. (2015) were downloaded from the National Oceanic and Atmospheric Administration (NOAA) website.

The humpback whale map shows summer and fall use of the project area; because humpbacks only inhabit our map area during the summer and fall, the data are not differentiated seasonally. The summer/fall range, in general, is larger than the fall range. Cetacean use data are summarized by Ferguson et al. (2015) into the feeding BIAs shown as summer use. The use of BIAs is fairly general. Fine scale distribution data exist for US and Canadian waters (e.g. Friday et al. (2013), Zerbini et al. (2006), and Zerbini et al. 2016) among others), and this detailed spatial information has been digitized from the Marine Mammal Stock Assessment. Feeding concentration areas in Ferguson et al. (2015) were downloaded from the National Oceanic and Atmospheric Administration (NOAA) website. The sea-ice data show this area is approximated as the extent of sea-ice concentration areas in Ferguson et al. (2015) were downloaded from the National Oceanic and Atmospheric Administration (NOAA) website.

The extent of range (MAP 6.9) was updated to specify “3 DPSs; with 1 considered Great Eastern (Mexico DPS) and 4 listed as endangered (Cape Verde Islands/Northwest Africa, Arabian Sea, Western North Pacific, and Central America DPSs) (National Oceanic and Atmospheric Administration 2015b). Humpback whales from the Western North Pacific DPS venture into the Bering Sea in the summer (see Fig. 6.9-1).

**Data Quality**

The information regarding humpback whale distribution shown on this map area is fairly general. Fine scale distribution data exist for US and Canadian waters (e.g. Friday et al. (2013), Zerbini et al. (2006), and Zerbini et al. 2016) among others), and this detailed spatial information has been summarized by Ferguson et al. (2015) into the feeding BIAs shown as summer feeding concentration areas on our map. We were unable to find information regarding concentration and high-concentration areas for the Russian portion of the project area.

**References**

- Alex Zebrini
- Bering Strait Traditional Knowledge-Holder Map Review Workshop participants

**MAP DATA SOURCES**

**Extent of Range:** Muto et al. (2016)

**Regular Use:** Muto et al. (2016)

**Feeding Concentration:** Ferguson et al. (2015)

**Sea Ice:** Audubon Alaska (2016) based on Fetterer et al. (2016)

**Summer Feeding Concentration Area**

**Summer Regular Use Area**

**Cooperative feeding by humpback whales drives prey species to the surface, where seabirds also partake in the bounty.**

**Humpback Whale (Megaptera novaeangliae)**

**Summer / Fall**

Humpback whales are large balaenopterids that use Arctic and subarctic waters to feed primarily on euphausiids in summer and fall. Off of the 14 distinct population segments (DPSs) of humpback whales, 3 forage on the productivity of the Bering Sea: the Central North Pacific (Hawaii) DPS, the threatened Mexico DPS, and the endangered Western North Pacific DPS. These whales feed seasonally in the Gulf of Alaska, the eastern Aleutian Islands, and Bristol Bay in the eastern Bering Sea, and can be found as far north as the western Beaufort Sea.**