Chapter Four: Habitat, Fish, and Wildlife

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Chapter Four: Habitat, Fish, and Wildlife

AS 38.05.035(g) directs that best interest findings consider and discuss the fish and wildlife species and their habitats in the lease sale area. The Beaufort Sea lease sale area includes important habitats and many fish and wildlife species that support subsistence activities for residents. Most habitats and populations of fish and wildlife in the area are healthy because of careful management, conservative laws governing importation and introduction of exotic animals, regulatory mechanisms in place for development, and relatively slow population growth (ADF&G 2008a). Only four species found in the lease sale area are listed as threatened or endangered under the federal Endangered Species Act: polar bear (threatened), spectacled eider (threatened), Steller's eider (threatened), and bowhead whale (endangered).

A. Habitats

The Beaufort Sea lease sale area includes terrestrial, freshwater, estuarine, and marine habitats. A large onshore area immediately adjacent to the lease sale area, the Arctic National Wildlife Refuge, has been set aside for habitat protection.

1. Terrestrial Habitats

Terrestrial habitats of the lease sale area lie within the polar Arctic tundra, Beaufort Sea coastal plain ecoregion (ADF&G 2006). The terrestrial portion of the lease sale area is part of the Arctic coastal plain, of which over 90 percent of the habitat is considered to be intact (WWF 2001). The area is dominated by tundra and is mostly treeless.

Several types of tundra are found in the Beaufort Sea area. These include wet sedge tundra, found in drained lake basins, swales, and floodplains; and tussock tundra and sedge-dryas tundra found on

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Winter sea ice terrain of the Beaufort Sea.

ridges. Low willow thickets, dwarf birch, various heath species, and herbs and lichens also grow in the area (Table 4.1; CEC 1997; ADF&G 2006).

Plant species of the tundra are few, their growth is minimal, and most of their biomass is concentrated in the root system. They often reproduce by division because of the short growing season (ADF&G 2006). Trees are generally absent because of the impermeable permafrost layer and thin soils. The short period of thawing during the summer and persistence of permafrost near the surface limit diversity of plant and animal species. Despite the low precipitation, much of the area remains marshy throughout the summer (Truett 2000).

2. Freshwater Habitats

Freshwater habitats of the Beaufort Sea area include several large rivers; an abundance of lakes, streams, and wetlands; and numerous seasonal ponds and creeks. The thousands of shallow, thaw lakes cover up to 50 percent of the Arctic coastal plain, and over 82 percent of the ecoregion is considered wetland (ADF&G 2006).

a. Lakes and Rivers

The freshwater lakes and rivers in and near the Beaufort Sea lease sale area provide important habitat for fish, wildlife, and birds of the area. Although these water bodies are abundant, many freeze to the bottom during the winter, making them unavailable as overwintering habitat for fishes (Moulton and George 2000). Available freshwater habitats are decreased by 97 percent by late winter because they may freeze to the bottom (Gallaway and Fechhelm 2000, citing to Craig 1989).

Table 4.1. Some terrestrial plants found in the Beaufort Sea area.

Common Name	Scientific Name
Sedges and Grasses	
water sedge	*Carex aquatilus*
tussock cottongrass	*Eriophorum vaginatum*
tall cottongrass	*Eriophorum angustifolium*
bigelow sedge	*Carex bigelowii*
tundra grass	*Dupontia fischeri*
alpine foxtail	*Alopecurus alpinus*
pendent grass	*Arctophila fulva*
Mosses	
	Scorpidium spp.
	Drepallodadus spp.
	Tomenthypnum nitens
	Distichium capillaceum
	Drepanocladus spp.
	Campylium stellatum
feather mosses	*Hylocomium splendens, Sphagnum spp*
lichens	*Cetraria cucullata, C. islandica*
	Cladonia spp.
reindeer lichen	*Cladina rangiferina*
reindeer mosses	*Cladonia rangeiferina, C. stellaris*
distichium moss	*Distichium capillaceum, Hypnum bambergeri*
ditrichum moss	*Ditrichum flexicaule*

-continued-

Table 4.1. Page 2 of 2.

Common Name	Scientific Name
Shrubs	
dwarf arctic birch	*Betula nana*
crowberry	*Empetrum nigrum*
narrow-leaf Labrador tea	*Ledum decumbens*
mountain-cranberry	*Vaccinium vitis-idaea*
entire-leaf mountain-avens	*Dryas integrifolia*
white mountain-avens	*Dryas octopetala*
mountain cranberry	*Vaccinium vitis-idaea*
four-angled cassiope	*Cassiope tetragona*
alpine bearberry	*Arctostaphylos alpine*
red-fruit bearberry	*Arctostaphylos rubra*
blueberry	*Vaccininium spp.*
four-angled cassiope	*Cassiope tetragona*
American green alder	*Alllus crispa*
Richardson willow	*Salix lanata*
diamond leaf willow	*Salix planifoli*
gray leaf willow	*Salix glauca*
netleaf willow	*Salix reticulata*
skeleton leaf willow	*Salix phlebophylla*
least willow	*Salix rotundifolia*
arctic willow	*Salix arctica*
polar willow	*Salix polaris*

Source: ADF&G 2006.

Lakes and ponds of the area are sustained by the thick layer of permafrost that prevents downward percolation of water (Howard et al. 2000). During the winter, ponds and lakes freeze to a depth of about 1.7 m, during June and July they thaw, and they begin freezing again in September. Ponds and lakes provide important habitat for invertebrates, which are the principal prey for many of the fish and birds of the area. As it decomposes, peat underlying the tundra contributes to the detritus of tundra ponds and provides phosphorous and other nutrients to invertebrate food webs (Howard et al. 2000).

Teshekpuk Lake, the largest lake on the Arctic Coastal Plain, is located adjacent to the Beaufort Sea lease sale area. The lake covers over 320 mi^2, and adjoining interconnected channels, lakes, and nearshore regions cover an additional 12,600 mi^2. Studies of habitat use by fishes indicate that the lake provides over 200 mi^2 of important habitat deeper than 7 ft for fishes, and an additional 21.5 mi^2 is available as potential overwintering habitat at the lake outlet (Moulton et al. 2007). The numerous small tundra streams and lakes of the area are used extensively by both anadromous and resident fish species for summer rearing (Morris and Winters 2008).

Principal rivers flowing through or into the lease sale area include the Kogru, Kalikpik, Tingmeachsiovik, Colville, Kachemach, Miluveach, Unguravik, Sakonowyak, Kuparuk, Putuligayuk, Sagavanirktok, Kadleroshilik, Shaviovik, Staines, and Canning rivers. Warm shallow areas of these rivers are important habitat for fishes in the summer, and deep areas are important for overwintering areas (Moulton and George 2000). Riparian zones along rivers and streams provide important habitat for brown bears. Habitats that support the preferred forage plants and prey species of brown bears are limited on the arctic coastal plain, and riparian zones are some of the few areas that do (Shideler and Hechtel 2000).

The freshwater rivers of the Beaufort Sea area are also important for estuarine and marine habitats. The Colville River, and the Mackenzie River (located outside the lease sale area in Canada), and numerous other rivers and streams along the Beaufort Sea coast, discharge massive amounts of freshwater and sediment into the Beaufort Sea. The Colville and Mackenzie rivers discharge about 350 km^3 of runoff and 130 x 10^6 tons of sediment into the Beaufort Sea shelf region (Dunton et al. 2006, citing to Macdonald et al. 2004). At the Kuparuk River, about 60% of the annual water flow is carried to the Beaufort Sea during just 2 to 3 weeks of spring floods; at the Sagavanirktok River, about one third is carried to Beaufort Sea during that period (Trefry et al. 2009). Interannual variability can be significant for onset date for river flow, volume at peak flow, and duration of flow (Trefry et al. 2009). These freshwater discharges create a definite estuarine environment along the coast (Dunton et al. 2006). High concentrations of suspended sediment from upland regions are swept into the nearshore waters of the Beaufort Sea by coastal erosion and river discharge. As a result, terrestrial organic matter is assimilated into marine food webs. Carbon from terrestrial sources may contribute as much as 30-50 percent of the total dietary requirements of some fishes inhabiting lagoons of the Beaufort Sea, and Arctic cod may derive as much as 70 percent of their carbon from terrestrial sources (Dunton et al. 2006).

b. Wetlands

Wetlands are transitional zones between aquatic and terrestrial habitats that are characterized by poor soil drainage, and are primarily of four types in Alaska: bogs, grass wetlands, sedge wetlands, and marshes (ADF&G 2006). The water contained in bogs comes primarily from rainfall rather than from runoff, streams, or groundwater. Bogs are characterized by nearly complete plant cover, including up to 100 percent moss. Over 50 percent of the plant species in grass wetlands are water-tolerant grasses. This habitat is important for recharging ground water, and for maintaining baseflows for aquatic resources downstream by storing storm and floodwaters. Sedge wetlands are found in very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, and sloughs, and in depressions of upland areas. Salt marshes are intertidal wetlands composed of salt-tolerant plants, usually located at river mouths; behind barrier islands, coves, and spits; and on tide flats (ADF&G 2006).

The U.S. Army Corps of Engineers has developed criteria for defining wetlands. Those criteria do not constitute a classification system but only provide a basis for determining whether a given area is a wetland for purposes of Section 404, without attempting to classify it by wetland type. The U.S. Army Corps of Engineers defines wetlands as (Environmental Laboratory 1987):

> a. **Definition**. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
>
> b. **Diagnostic environmental characteristics**. Wetlands have the following general diagnostic environmental characteristics:
>
> > (1) ***Vegetation***. The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in “a” above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions[1]. Indicators

[1] Species (e.g., *Acer rubrum*) having broad ecological tolerances occur in both wetlands and non-wetlands.

of vegetation associated with wetlands are listed [elsewhere in Environmental Laboratory 1987].

(2) ***Soil***. Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are listed [elsewhere in Environmental Laboratory 1987].

(3) ***Hydrology***. The area is inundated either permanently or periodically at mean water depths ≤6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation[2]. Indicators of hydrologic conditions that occur in wetlands are listed [elsewhere in Environmental Laboratory 1987].

c. **Technical approach for the identification and delineation of wetlands**. Except in certain situations defined in [Environmental Laboratory 1987], evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.

Delineation of wetlands is further refined for Alaska in USACOE (2007), addressing regional wetland characteristics and differences such as climate, geology, soils, hydrology, plant and animal communities, and other factors important to the identification and functioning of wetlands.

Bergman et al. (1977) developed a system of eight water body classifications, all of which occur within the uplands adjacent to the lease sale area.

Class I Flooded tundra is composed of shallow waters formed during spring thaw when melt water overflows stream basins or is trapped in vegetated tundra depressions. Such pools formed in low centers of polygonal ground often produce a mosaic pattern of ridges and flooded sedge.

Class II Shallow-*Carex* water bodies are shallow ponds with a gently sloping shore zone surrounded by and usually containing emergent *Carex aquatilis* with a central open water zone.

Class III Shallow-*Arctophilia* ponds are shallow ponds or pools containing pendent grass (*Arctophilia*) in the center and shoreward stands of pendent grass or sedge (*Carex*). Shallow water and extensive stands of pendent grass provide feeding and nesting habitat and cover for birds. Most species use these wetlands, but key species include red-throated loons, king eider, tundra swans, and pintails.

Class IV Deep-*Arctophilia* ponds or lakes are second generation basins resulting from melting of ice-rich zones in drained basins. Identified by shoreward stands of pendent grass (*Arctophilia*) and a lack of emergent vegetation in their center, these ponds or lakes have distinct shores and flat or gently rolling bottoms. These lakes are principal aquatic habitats for all waterfowl, especially tundra swan, king and spectacled eider, long-tailed duck, brant, and Pacific and red-throated loons.

Class V Deep open lakes are large, deep lakes that have abrupt shores, sublittoral shelves, and a deep central zone.

Class VI Basin-complex water bodies are large, partially drained basins; they may contain water continuously in the spring, but as summer progresses, water levels recede. Since water levels vary, vegetation is diverse and prolific. Non-breeding pintails feed in these basins,

[2] The period of inundation or soil saturation varies according to the hydrologic/soil moisture regime and occurs in both tidal and nontidal situations.

and emergent vegetation stands provide cover during their wing molt in July. King eiders and loons use lakes within basin-complexes for feeding and staging, principally during the early summer before deeper wetlands have thawed.

Class VII Beaded streams are small, often intermittent streams consisting of a series of channels formed in ice-wedges and linked to pools that develop at ice-wedge intersections. Beaded streams are common throughout the coastal plain, and they are often the only class of wetlands in large areas of well drained regions of the interior coastal plain.

Class VIII Coastal wetlands are aquatic habitats bordering the Beaufort Sea within a zone directly influenced by seawater. Periodic saltwater flooding, the presence of brackish water, and unique vegetation of sedge and grass distinguish coastal wetlands from other types. Nesting and feeding black brant use coastal wetlands. Coastal wetlands are primarily used by snow geese for brood-rearing and staging. These wetlands may be found in most river deltas and adjacent to coastal lagoons.

Four water body types are generally used by birds more than others: shallow-*Arctophilia*, deep-*Arctophilia*, basin-complexes, and coastal wetlands (ADF&G 1997). In a study at Storkersen Point near the mouth of the Kuparuk River, Bergman et al. (1977) reported that these four types represented 35 percent of the area's wetlands, but received more than 68 percent of the study area's use by loons and other waterfowl. These wetlands support significant numbers of waterbirds, such as geese, ducks, and loons, and are used more intensively than other types of water bodies. Although limited in aerial extent, these wetlands are used more extensively by waterbirds than other wetland types.[3]

Meehan and Jennings (1988) studied the distribution and behavior of birds on the Colville Delta, and derived nine habitat classes for large waterbirds (tundra swan, greater white-fronted goose, Pacific loon, yellow-billed loon, and brant):

- **Discrete Lake** habitat includes lakes and estuarine water bodies, similar to Bergman's Class V.
- **Tapped Lake** habitat includes lakes that are hydrologically connected to a river system. In spring, flooded channels breach these lakes, allowing sediments and salt water to infiltrate. This class is also similar to Bergman's Class V.
- **Wet-Moist Flooded Tundra** includes wet sedge polygonal ground (Bergman's Class I) and moist sedge willow (Bergman's Class II).
- **Wet Graminoid** habitat is found along lake shores and polygonal ponds. Similar to Bergman Classes III and IV, the largest stands on the Colville Delta are located in its south central portion (located within the lease sale area). This habitat includes dominant species, *Arctophila fulva* and *Carex aquatalis*.
- **Wet-Moist Polygons** include moist to wet low tundra meadows; near lake ponds and margins, flooded basins, and polygonal ground. Similar to Bergman Classes I and II, this habitat is the most abundant vegetation cover on the Colville Delta. This vegetation type was used by Pacific and Yellow-billed loon nesting and Tundra swan and white fronted geese.
- **Brackish Flats**, similar to Bergman's Class VIII, is found along the fringe of the delta, river channels, and tapped lakes. This habitat type has been associated with high brant use.

[3] Lessees are advised that the state may adopt, or approve the use of, an alternate wetlands classification system in the future. However, the protective nature of the wetlands mitigation measures developed for this and other oil and gas lease sales will remain consistent regardless of the wetlands classification system ultimately selected.

- **Shrub Dominant Areas** consist of low willow communities on river banks, terraces and dunes. Most bird use was low, and there was no equivalent Bergman class.
- **Barrens** include partially vegetated dunes, grass-forb lake shore, and partially vegetated and unvegetated floodplain. Similar to Bergman's Class VIII, this habitat is of low use by most birds and covers about 30 percent of the Colville Delta's total area.
- **Sedge-Tussock Tundra**, found in the western part of the delta, has no comparable Bergman class.

Meehan and Jennings (1988) ranked the importance of habitat classes relative to usage by key bird species. Discrete lakes were used the most, followed by wet-moist polygons, brackish flats, wet graminoid, and wet-moist flooded tundra. Tapped lakes and shrub dominant areas received an equal amount of use after the top six, followed by sedge-tussock tundra and barrens which were used the least. The authors cautioned that although the classes may apply to habitats across the North Slope, the ranking should only be applied to the Colville River Delta.

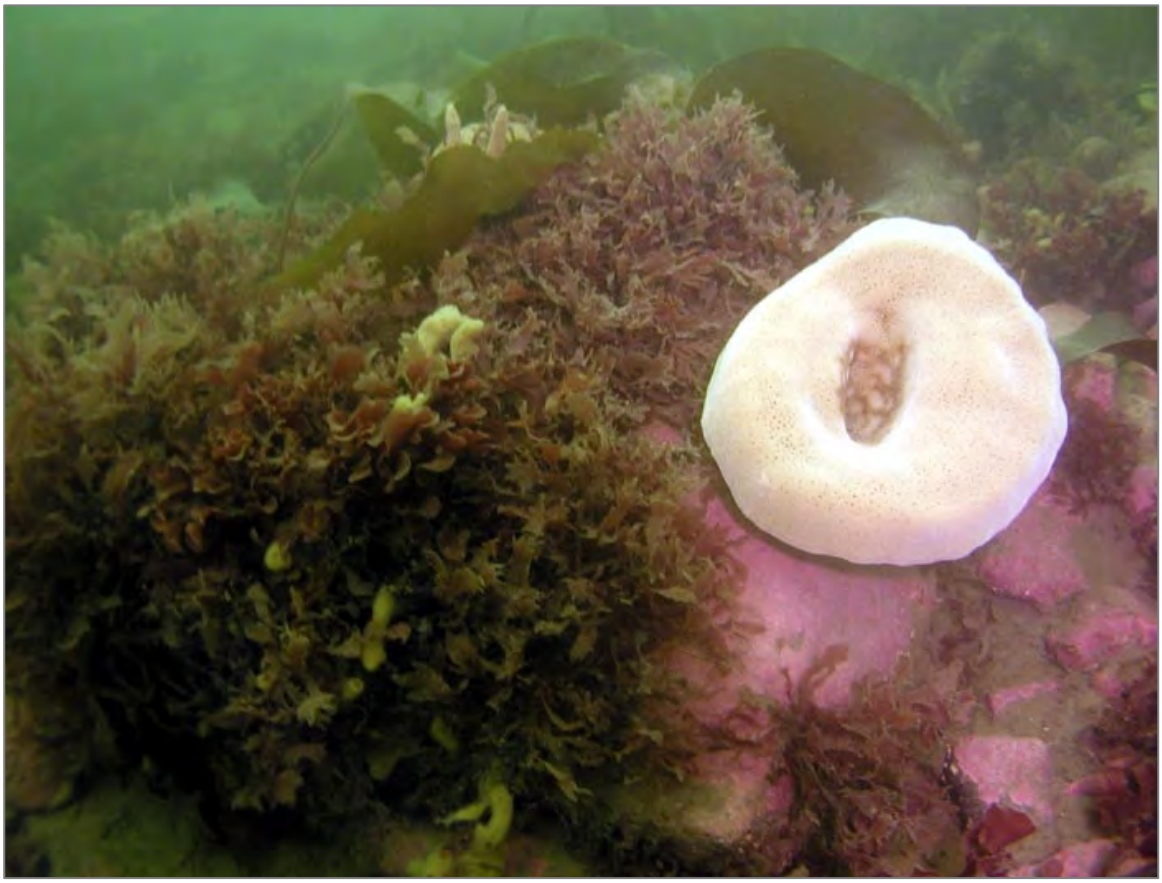
3. Nearshore Estuarine and Marine Habitats

The Beaufort Sea provides important habitat for fishes, marine mammals, and birds, and especially provides habitat for the marine invertebrates that make up the base of the food webs for the area. However, relative to the Bering and Chukchi seas, the Beaufort Sea has relatively low productivity and biomass of benthic fauna (Dunton et al. 2006, citing to Dunton et al. 2005). The Beaufort Sea shelf region, which includes three distinct shelf environments, varies in width from 80 km in Alaska to 150 km in Canada (Dunton et al. 2006, citing to Macdonald et al. 2004). Nearshore waters of the Beaufort Sea are characterized by physical and biological extremes (Dunton et al. 2006). Surface waters of the Beaufort Sea are frozen from October-May, and ice cover reaches a thickness of 2 m by late winter (Gallaway and Fechhelm 2000). By mid-July, nearshore waters are usually ice-free from shore to the edge of the pack ice. By late summer, the pack ice is from 10 to 100 km offshore.

Nearshore waters of the Beaufort Sea have estuarine characteristics because of the high input of freshwater from the Colville and Mackenzie rivers (Dunton et al. 2006). Melting coastal ice also contributes to the brackish conditions of nearshore areas (Gallaway and Fechhelm 2000). The relatively warm river discharges combined with increased solar radiation to elevate nearshore water temperatures provide the physical environment to support the intense biological activity that sustains the area's fish, birds, and marine mammals (Gallaway and Fechhelm 2000). Brackish waters form a relatively narrow band that becomes discontinuous by late summer (Thorsteinson et al. 1991).

This is the prime feeding area for diadromous fishes of the North Slope. Marine invertebrates are prolific, thriving in the warm, detritus-laden shallows. Marine mysids and amphipods are most abundant, but freshwater chironomids washed downstream are also important. Studies have estimated that "of all the marine and freshwater habitat available to diadromous fishes during summer, coastal waters hold 90% of the exploitable prey biomass" (Gallaway and Fechhelm 2000 [pg. 351], citing to Craig 1989).

Phytoplankton in the Beaufort Sea includes diatoms, dinoflagellates, and flagellates with the diatom *Chaetoceros spp*. being the most abundant. Studies conducted in Harrison and Prudhoe bays found that flagellates were most numerous at the surface with diatoms most numerous in the water column. Primary productivity was highest in the water column where diatoms were the most abundant organism, rather than at the surface. The horizontal distribution of diatoms in waters close to shore and river mouths suggests that light levels, rather than salinity or temperature, determine diatom distribution (Horner 1984). Phytoplankton production gradually increases after ice break-up, when light becomes increasingly available. Production declines after September when light availability limits photosynthesis. During the bloom period from spring through summer, the phytoplankton



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Organisms of the Boulder Patch, Stefansson Sound.

community on which zooplankton graze changes (Horner 1984). Productivity in Harrison Bay and Simpson Lagoon was measured at 10 to 23 g, and less than 10 g per m^2 in Prudhoe Bay. Primary productivity values can fluctuate as much as three-fold from year to year (Horner 1984), which may affect population dynamics for other species in the food web.

Zooplankton abundance and species diversity appear to increase with increasing distance from shore. One species group prefers deeper, more saline oceanic water offshore and includes *Mysis litoralis, Parathemisto abyssorum, Hyperia galba, Calanus hyperboreus, C. glacialis, and C. hydromedusae*. A second species group prefers lower salinity barrier island lagoons and includes *Mysis relicta, Monoculodes crassirostris, Onisimus glacialis, Acanthostepheia incarinata,* and *Pontoporeia affinis*. A third species group is transitional, preferring shallow offshore waters, and this community includes species of the other two groups (NSBCMP 1984).

Larger invertebrate communities in the nearshore lagoons include animals living in the bottom (infauna), animals usually living on or near the bottom (epibenthic), and those living in the water column (pelagic). In Simpson Lagoon, infauna are restricted to depths greater than 2 m because shallower portions freeze solid during winter. These include polychaete worms (*Ampharete vega and Terebellides stroemi*) and bivalves (*Cyrotidaria kurriana*). Epibenthic organisms include amphipods, mysids, and isopods. Pelagic species include copepods and chaetognaths; important food sources for anadromous fishes. During winter, epibenthic and pelagic species disappear, and then emerge again in spring, whereas infauna and some amphipods may be present year-round (Craig et al. 1984). These organisms are an important source of food for birds and marine mammals.

The Boulder Patch, an area of Stefansson Sound located about 20 km northeast of Prudhoe Bay, supports abundant algae, including kelp, and invertebrates that are important to nearshore food webs (Dunton and Schonberg 2000; Dunton et al. 2005). The sea bed, which is usually composed of silty sands and mud, is made up of cobbles and boulders in this area. Water depths are generally shallow, ranging from 3-9 ft. The boulders and rocks of the area provide refuge to organisms and allow accumulation of detrital material (Dunton and Schonberg 2000).

Arctic kelp coexist with a large invertebrate community in Stefansson Sound, with *Laminaria solidungula* the most dominant species present. In contrast, shallow water and a lack of rocky substrate prevent Arctic kelp from surviving in Simpson Lagoon (Craig et al. 1984). This marine plant endures nine months of darkness, but grows fastest in late winter and early spring due to higher concentrations of inorganic nitrogen in the water column. Sediments trapped in the ice above the kelp block light and restrict growth, however the presence of leads and cracks has the opposite effect. Kelp make up between 50 and 55 percent of the available carbon in the Stefansson Sound kelp community, while phytoplankton make up between 23 and 42 percent. This ratio has been linked to the level of sediments on the surface in a given year. The consumers of this carbon include filter feeding invertebrates like the chiton, *Amicula vestita* (Dunton 1984).

The National Marine Fisheries Service has defined areas of Essential Fish Habitat (EFH) for federally managed fish species in Alaska as required by 1996 revisions to the Magnuson-Stevens Act. EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Many fish species exist in Alaska waters. However, EFH is identified for only those species managed under a federal Fishery Management Plan. Federal agencies must consult with NMFS regarding any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH. Text descriptions and maps are available that identify EFHs for each life stage of fish under federal management (NMFS 2008d; NMFS 2008e).

B. Fish and Wildlife

1. Fish

At least 17 species of marine fishes, 14 species of freshwater fishes, and 12 anadromous species may be found in the waters of the Beaufort Sea area (Wiswar 1992; Wiswar et al. 1995; Wiswar and Fruge 2006; Scanlon 2008; USFWS 2008a; Table 4.2; Map 4.1). Anadromous fish-bearing streams flowing through or into the lease sale area include the Aichilik, Hulahula, Okpilak, Kogotpak, Egaksrak, Kongakut, Aichiklik, Canning , Staines, Shaviovik, Sagavanirktok, Kuparuk, Colville, Fish Creek, Kogru, Ikpikpuk, Alaktak, Chipp, Topagoruk, and Meade rivers. Diversity of fish species is greater in lakes connected to rivers than in isolated lakes. Ninespine stickleback are the only species inhabiting many isolated lakes, and isolated lakes may be barren (Wiswar 1994).

Several of the more important fish species in the Beaufort Sea area are Dolly Varden and Arctic char, Coregonids (whitefishes and ciscoes), and Arctic cod.

a. Dolly Varden and Arctic Char

Dolly Varden are found in many rivers and streams throughout Beaufort Sea drainages, and during the summer adults are distributed widely in the nearshore waters of the Beaufort Sea (Viavant 2005). They are so closely related to Arctic char that distinguishing between the two species requires counting gill rakers and pyloric caeca (Morrow 1980). In Alaska, most Arctic char are lake resident (Armstrong 1996), but information about their distribution in the Beaufort Sea area is lacking (ADF&G 2008d). However, they are one of the dominant species found in Simpson Lagoon and adjacent coastal waters of the Beaufort Sea during summer (Craig et al. 1985). Dolly Varden are important to North Slope ecosystems because they provide marine-derived nutrients to low

productivity aquatic food webs, and they are a source of food for bird and mammal predators (Viavant 2005).

Although Dolly Varden generally spawn in the fall, their life history is notoriously variable. For example, Dolly Varden populations can be sea-run (spending time in freshwater and nearshore marine waters) or resident (spending their entire life in freshwater), and within the same population some individuals may be sea-run while others are resident. Among freshwater residents, there are lake, stream, and dwarf forms (ADF&G 1994). Populations of the North Slope are generally sea-run, with a life history pattern as follows: Dolly Varden spawn in streams from mid-July through October, laying 600-6,000 eggs in redds (ADF&G 1994; Viavant 2005), or nests, covering the eggs with gravel; they hatch in the spring and rear in the stream until they are 3-5 years old before migrating to the ocean for the first time (Armstrong 1996; Viavant 2005). However, some Dolly Varden on the North Slope remain in freshwater their whole life, never migrating to the ocean (USFWS 2008c).

After their first migration to the ocean, Dolly Varden spend the remainder of their lives migrating between the ocean and freshwater, spending summers feeding in marine waters, and overwintering in

Table 4.2. Fish species that may be found in the Beaufort Sea area.

Freshwater Species		Anadromous Species		Marine Species	
Common Name	Scientific Name	Common Name	Scientific Name	Common Name	Scientific Name
Sheefish	*Stenodus leucichthys*	Least cisco*	*Coregonus sardinella*	Pacific herring	*Clupea harengus Pallas*
Round whitefish	*Prosopium cylindraceum*	Bering cisco*	*Coregonus laurettae*	Capelin	*Mallotus villosus*
Lake trout	*Salvelinus namaycush*	Arctic cisco	*Coregonus autumnalis*	Arctic cod	*Boreogadus saida*
Arctic char	*Salvelinus alpinus*	Broad whitefish*	*Coregonus nasus*	Saffron cod	*Eleginus gracilis*
Northern pike	*Esox lucius*	Humpback whitefish*	*Coregonus pidschian*	Fourhorn sculpin	*Myoxocephalus quadricornis*
Lake chub	*Couesius plumbeus*	Pink salmon	*Oncorhynchus gorbuscha*	Arctic sculpin	*Myoxocephalus scorpioides*
Longnose sucker	*Catostomus catostomus*	Chinook salmon	*Oncorhynchus tshawytscha*	Greenland seasnail	*Liparis tunicatus*
Trout-perch	*Percopsis omiscomaycus*	Chum salmon	*Oncorhynchus keta*	Pacific sand lance	*Ammodytes hexapterus*
Burbot	*Lota lota*	Coho salmon	*Oncorhynchus kisutch*	Slender eelblenny	*Lumpenus fabricii*
Ninespine stickleback	*Pungitius pungitius*	Rainbow smelt	*Osmerus mordax*	Stout eelblenny	*Lumpenus medius*
Slimy sculpin	*Cottus cognatus*	Arctic lamprey*	*Lampetra japonica*	Eelpouts	*Lycodes spp.*
Threespine stickleback	*Gasterasteus aculeatus*	Dolly Varden*	*Salvelinus malma*	Arctic flounder	*Pleuromectes glacialis*
Alaska blackfish	*Dallia pectoralis*			Starry flounder	*Platichthys stellatus*
Arctic grayling	*Thymallus arcticus*			Arctic hookear sculpin	*Artediellus scaber*
				Arctic staghorn sculpin	*Gymmocanthus tricuspis*
				Whitespotted greenling	*Hexagrammus stelleri*
				Bering wolffish	*Anarchichas orientalis*

Notes: * Denotes freshwater-only form of species also.

Source: USFWS 2008a.

lakes or streams with deep pools (ADF&G 1994). North Slope Dolly Varden stocks generally return to their natal drainages for spawning, but probably do not spawn every year (Viavant 2005). Dolly Varden can live to be 16 years or older, but most on the North Slope are less than 10. Most have spawned for the first time by age eight, but only half survive to spawn a second time (USFWS 2008c).

Genetic studies indicate that there are multiple populations of Dolly Varden along the Arctic coast of Alaska and Canada, frequently corresponding to major river systems, and more than one population may occur within a given river system (Everett et al. 1998). Unlike Dolly Varden in other parts of Alaska, North Slope Dolly Varden appear to return to their natal drainages for overwintering as well as for spawning, and studies indicate that overwintering aggregations are primarily single stocks rather than mixed stocks from many drainages (Crane et al. 2005). Availability of overwintering habitat is considered to be the major limiting factor for Dolly Varden in the Beaufort Sea area (USFWS 2008b). They must overwinter in freshwater to avoid the below-freezing temperatures of the nearshore marine waters, but ice-free waters are scarce during the winter (Arvey 1991). Overwintering areas are generally in locations of upwelling springs.

Young Dolly Varden feed on insects, insect larvae, and small crustaceans (Morrow 1980; USFWS 2008c). The diet of older Dolly Varden depends on the age, location, time of year, and availability of food. In freshwater, food may include insects, spiders, annelids, snails, clams, fish eggs, and various small fishes. In marine waters, food consists mostly of small fishes, invertebrates, and mysids (small shrimp-like organisms) (Morrow 1980).

Detailed life history information, extent of distribution within drainages, abundance, age and size composition, and detailed knowledge of spawning and overwintering habitats are limited or lacking for Dolly Varden populations of Beaufort Sea drainages (Viavant 2005). However, a study in 2001-2003 estimated abundance of overwintering aggregations to be 49,523 (SE = 7,277) fish in 2001 and 21,634 (SE = 3,075) fish in 2002. The study also identified spawning locations in the Kongakut, Ivishak, Echooka, Kavik, Ribdon, Lupine, Saviukviayak, and Anaktuvuk rivers. Timing and location of spawning were highly variable, as was the proportion of the overwintering population that spawned; and although overwintering fish were found in a large portion of studied drainages, the overwintering locations were variable (Viavant 2005).

b. Coregonids (Whitefishes and Ciscoes)

Coregonids are one of the most abundant and important groups of fishes in the Beaufort Sea lease sale area (Armstrong 1996). They are important as forage fishes and for subsistence. Coregonid species found in the marine and freshwaters of the area include Arctic cisco, Bering cisco, least cisco, humpback whitefish, round whitefish, broad whitefish, and sheefish. Some species are anadromous while others are permanent freshwater residents. Although the life histories of whitefishes and ciscoes differ from each other in many respects, they all share common spawning behavior in which the eggs are broadcast over gravel rather than being laid in a redd, or nest, as with salmon (Morrow 1980). Detailed life history information specific to populations of the Beaufort Sea area is limited or lacking.

The ***Arctic cisco*** is an anadromous fish species that spawns in freshwater in the summer and overwinters in nearshore marine waters (Morrow 1980). They are one of the most abundant species in Camden Bay (Wiswar and Fruge 2006). They are also one of the dominant species found in Simpson Lagoon and adjacent coastal waters of the Beaufort Sea during summer (Craig et al. 1985). They tend to stay in warm, brackish nearshore waters, perhaps because they are anadromous. Citing to numerous studies, ABR Inc. et al. (2007) presented an overview of the life history of Beaufort Sea Arctic cisco (Table 4.3), which generally originate from the Mackenzie River in Canada. Arctic ciscoes feed on a wide range of organisms, including mysids, copepods, amphipods, isopods, chironomids, other insects, and various small fishes (Morrow 1980).

Table 4.3. Life history of Arctic cisco in drainages of the Beaufort Sea.

Age (years)	Season	Event
0	Spring Summer Fall Winter	Newly hatched young-of-year (YOY) Arctic cisco are flushed downstream from spawning/hatching tributaries of the Mackenzie River into ice-free coastal waters. Known spawning tributaries include the Peel, Liard, and Arctic Red rivers. Depending on the strength and persistence of easterly winds, an unknown portion of YOY passively migrate westward in nearshore coastal currents in the Beaufort Sea. In years with easterly winds on average, fish are transported as far west as Prudhoe Bay or beyond. Some unknown portion of YOY cisco (as well as ages 1–2) remain in the Prudhoe Bay / Sagavanirktok River area, while others move to overwintering habitat in the Colville River. YOY remain under ice in brackish riverine waters until spring thaw. Distribution is poorly known.
1–7	Spring/Summer	Juveniles and subadults move out into the marine environment to feed in nearshore habitat in Beaufort Sea.
	Fall	Most juveniles and subadults move up the Colville River and its tributaries to overwintering habitat.
	Winter	Juveniles and subadults remain under ice in brackish habitat until spring thaw. Distribution is poorly known.
4–8	Fall	Subadults are available to the under-ice subsistence and commercial fisheries in the Colville River.
7–8	Spring/Summer	Onset of sexual maturity occurs. Adults migrate back to the Mackenzie River and its tributaries to spawn.
8–19	Fall Winter	Post spawning and non-spawning adults overwinter in the Mackenzie River and its tributaries. In subsequent years, repeat spawning is thought to occur. Adults are believed to overwinter in brackish riverine waters until spring thaw.
	Spring/Summer	Adults move out into the marine environment to feed in nearshore habitat in the Beaufort Sea.

Source: ABR Inc. et al. 2007.

Bering cisco may be found in salt or brackish waters, where they overwinter, but they are also found far upstream in some areas (Morrow 1980). Spawning is assumed to occur in the fall, probably in clear water tributaries of major rivers. Bering cisco probably make long migrations for spawning, and probably move back downstream after spawning. However detailed information about their life history is lacking.

Least cisco are commonly found in the lakes and streams of the Arctic coast, and may also be found in brackish waters (Morrow 1980). Populations may be stream-dwelling and migratory, or lake-dwelling and non-migratory. The least cisco is one of the dominant species found in Simpson Lagoon and adjacent coastal waters of the Beaufort Sea during summer (Craig et al. 1985; Thorsteinson et al. 1991). They have a patchy distribution across the Beaufort Sea (Thorsteinson et al. 1991). Least cisco tend to be found in warm, brackish nearshore waters, probably because they are anadromous (Craig et al. 1985). Spawning occurs in the fall in late September and early October at water temperatures between 0°F and 3°F (Morrow 1980). Eggs spend the winter in the gravel, hatching in the early spring. Young-of-the-year move downstream to slower water by mid-June. Most females become sexually mature at 4 years old, and can become sexually mature at age 2. The

maximum age for least cisco is probably between 8 and 11 years. Least cisco feed on various types of zooplankton such as small copepods, cladocerans, mysids, and both adults and larvae of various insects. Predators include eagles, hawks, kingfisher, northern pike, inconnu, lake trout, and burbot. Arctic grayling and whitefish eat least cisco eggs during spawning (Morrow 1980).

Humpback whitefish are considered to be truly anadromous and have been found in the Beaufort Sea several miles offshore of the Colville and Sagavanirktok rivers (Morrow 1980). However, some populations may be freshwater resident. Humpback whitefish begin migrating to freshwater for spawning in June, and spawning takes place in October. They may spawn under the ice in some locations. They become sexually mature at 4 to 6 years. Eggs probably hatch in the late winter and spring, and then the young are assumed to move downriver (Morrow 1980).

Round whitefish are found in many freshwaters of the Beaufort Sea area (Morrow 1980). They make upstream migrations to spawn, and probably spawn annually in late September through October. Round whitefish reach sexual maturity between age 5 and 7, depending on the location, and they may live as long as 16 years.

Broad whitefish are found in most rivers draining into the Beaufort Sea (Morrow 1980). They are anadromous but while in the ocean, probably remain close to shore in relatively brackish waters. During the summer, and sometimes into the fall, broad whitefish migrate into rivers where they spawn in September through October, and possibly into November (Morrow 1980). After spawning, adults move downstream to deep overwintering areas in rivers or estuaries. Eggs hatch in the spring and the young subsequently move downstream.

Detailed life history information about broad whitefish is lacking for the Beaufort Sea area, although a few studies have been conducted. From the summer of 2001 through June 2002, a study tracked movements of broad whitefish in Fish, Judy, and Inigok creeks, and the Ublutuoch and Colville rivers, which empty into Harrison Bay. This study found that broad whitefish used main channel habitats, small off-channel systems, and numerous lakes connected to the study creeks and rivers (Morris 2003). Based on 21 radio-tagged fish, broad whitefish used the lower 15 km of the Ublutuoch River, and about 5 km of Fish Creek upstream from the Ublutuoch River. Some fish also used the Colville River, migrating into Harrison Bay and then up the Colville River where they were found from just downstream of the Itkillik River to Ocean Point. The Ublutuoch River appears to be a significant overwintering area and may also be used for spawning. Fish Creek, Judy Creek, the Colville River, and several deep lakes off of Fish, Judy, and Inigok creeks were used for over-wintering. Use of tundra lakes and small tundra drainages by the fish was significant, particularly for Fish and Judy creeks. The study also found that some broad whitefish never left the system, while others left the system briefly or for the entire winter (Morris 2003).

c. Arctic Cod

The Arctic cod is one of the most abundant species found in waters of the Beaufort Sea (Armstrong 1996; Wiswar and Fruge 2006; Thorsteinson et al. 1991). They are generally found in brackish lagoons, river mouths, and in nearshore marine waters, although they sometimes occur in deeper waters and farther offshore (Mecklenburg et al. 2002). They are one of the dominant species found in Simpson Lagoon and adjacent coastal waters of the Beaufort Sea during both summer and winter (Craig et al. 1985). Their use of nearshore versus offshore habitats is unclear and their local occurrence is highly variable (Craig et al. 1982). They are found dispersed throughout the year, but are also found in aggregations during the summer in nearshore waters (Welch et al. 1992). In Camden Bay, one study estimated 83.6 million cod in the upper 2 m of the bay, and the weight of the population was estimated to be 1.6 million kg (Thorsteinson et al. 1991).

Arctic cod are tolerant of cold water and often live along the edges of pack ice (Armstrong 1996) inhabiting narrow wedges of seawater along the melting edges of ice floes (Gradinger and Bluhm 2004). They are also found in ice-free waters during the summer (Mecklenburg et al. 2002).

Arctic cod are short-lived, mature early at age 2 or 3, and may only spawn once, in contrast to most other Arctic fishes that tend to be long-lived, be older when they reach sexual maturity, and spawn several times (Craig et al. 1982). Arctic cod spawn between late November and early February (Craig et al. 1982). Spawning occurs in the water column near the surface. Spawning Arctic cod are found under the ice close to the ice margin(Ponomarenko 2000). Eggs are found in water below 0°C to 2°C. Developing eggs are found in accumulations under the ice and hatching occurs when the ice begins melting. The larval period lasts 3-4 months (Ponomarenko 2000).

Arctic cod are a critical component of arctic food webs as they are one of the main species that transfers planktonic organisms to other fish, birds, and wildlife (Welch et al. 1992; Welch et al. 1993). They feed on planktonic copepods and amphipods, ice-associated amphipods, and epibenthic crustacean. They are important food prey for other fish, seals, beluga whales, narwhals, and seabirds (Armstrong 1996). In arctic waters of Canada, they occasionally occur in large schools where they may be preyed on by thousands of seabirds and marine mammals such as black-legged kittiwakes, northern fulmars, harp seals, beluga whales, and narwhal (Welch et al. 1993). It has been estimated that 125,000 tonnes of cod are consumed by marine mammals and 23,000 tonnes by seabirds annually in the Landcaster Sound region of arctic Canada (Welch et al. 1992). Density of aggregations of Arctic cod, which may comprise over 900 million fish (Crawford and Jorgenson 1996), may be influenced by ice cover and conditions (Crawford and Jorgenson 1993). Large concentrations of Arctic cod in nearshore waters during the winter probably play an important role in the structure of the ecosystem (Benoit et al. 2008).

2. Birds

The Beaufort Sea area is inhabited by large numbers of migratory birds (Table 4.4), especially sea ducks, during the summer for breeding, molting, migration, and foraging. Their use of the area varies by species, timing, and location (Map 4.2; Fischer and Larned 2004; Noel et al. 2005a).

The Colville River, Fish Creek, Sagavanirktok River, Kuparuk River, Ikpikpuk, Chipp, and Canning River deltas, and Simpson Lagoon are important nesting and breeding areas for waterfowl (MMS 1996, Vol. III; Earnst et al. 2006). The Colville, Sagavanirktok, Ikpikpuk, and Kuparuk river deltas provide important breeding and brood-rearing habitats for tundra swans, black brant, snow geese, and Canada geese (Earnst et al. 2006). Howe Island, located in the Sagavanirktok River delta, is the location of one of two known snow goose nesting colonies in the United States (USFWS 1992b). This island is also important for black brant nesting (USFWS 1992b). The Return Islands, Jones Islands, McClure Islands, Cross Island, and Lion Point are important for nesting common eider. Thousands of long-tailed ducks concentrate near Flaxman Island to molt (USFWS 1992a). Greater-white fronted geese are also found nesting and rearing in the major river deltas and other coastal plain areas (ADF&G 1997). Coastal tundra areas along the Beaufort and Chukchi Sea remain important brood-rearing and fall staging areas for geese, brants, swans, and loons (ARRT 1999).

The most abundant marine and coastal species include red phalarope, long-tailed ducks, glaucous gull, king eider, and common eider (MMS 2005). Nearly all of these species are migratory and are found in the Arctic seasonally, generally from May through September. Shortly after spring migration, most shorebird and waterfowl populations disperse to nesting grounds primarily on tundra and marshlands of the Arctic Slope. Beginning in mid-July large concentrations of long-tailed ducks and eider occur in coastal waters inshore of islands where the birds feed and molt before fall migration. Use of lagoons and other coastal habitats peaks in August to late September before and during the fall migration (MMS 1996, Vol. III).

Table 4.4. Birds commonly observed in the Beaufort Sea area.

Common Name	Scientific Name
Common Loon	*Gavia immer*
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Yellow-billed Loon	*Gavia adamsii*
Red-necked Grebe	*Podiceps grisegena*
Tundra Swan	*Cygnus columbianus*
Brant	*Branta bernicla nigricans*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Canada Goose	*Branta canadensis*
Green-winged Teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Anas clypeata*
American Wigeon	*Anas americana*
Greater Scaup	*Aythya marila*
Common Eider	*Somateria mollissima*
King Eider	*Somateria spectabilis*
Spectacled Eider	*Somateria fischeri*
Steller's Eider	*Polysticta stelleri*
Long-tailed Duck	*Clangula hyemalis*
Black Scoter	*Melanitta nigra*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Red-breasted Merganser	*Mergus serrator*
Northern Harrier	*Circus cyaneus*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
Peregrine Falcon	*Falco peregrinus*
Gyrfalcon	*Falco rusticolus*
Willow Ptarmigan	*Lagopus lagopus*
Rock Ptarmigan	*Lagopus mutus*
Sandhill Crane	*Grus canadensis*
Black-bellied Plover	*Pluvialis squatarola*
American Golden-Plover	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Whimbrel	*Numenius phaeopus*
Hudsonian Godwit	*Limosa haemastica*
Bar-tailed Godwit	*Limosa lapponica*

-continued-

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Common Name	Scientific Name
Ruddy Turnstone	*Arenaria interpres*
Red Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
White-rumped Sandpiper	*Calidris fuscicollis*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt Sandpiper	*Calidris himantopus*
Buff-breasted Sandpiper	*Tryngites subruficollis*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Snipe	*Gallinago gallinago*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Mew Gull	*Larus canus*
Herring/Thayer's Gull	*Larus argentatus/thayeri*
Glaucous Gull	*Larus hyperboreus*
Black-legged Kittiwake	*Rissa tridactyla*
Sabine's Gull	*Xema sabini*
Arctic Tern	*Sterna paradisaea*
Black Guillemot	*Cepphus grylle*
Snowy Owl	*Nyctea scandiaca*
Short-eared Owl	*Asio flammeus*
Horned Lark	*Eremophila alpestris*
Cliff Swallow	*Hirundo pyrrhonota*
Common Raven	*Corvus corax*
Gray-cheeked Thrush	*Catharus minimus*
Varied Thrush	*Ixoreus naevius*
Yellow Wagtail	*Motacilla flava*
Water Pipit	*Anthus spinoletta*
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
American Tree Sparrow	*Spizella arborea*
Savannah Sparrow	*Passerculus sandwichensis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*

-continued-

Table 4.4. Page 3 of 3.

Common Name	Scientific Name
Lapland Longspur	*Calcarius lapponicus*
Snow Bunting	*Plectrophenax nivalis*
Rusty Blackbird	*Euphagus carolinus*
Robin	*Turdus migratorius*
Northern shrike	*Lanius excubitor*
Wheatear	*Oenanthe oenanthe*
Bluethroat	*Luscinia avacica*
Arctic warbler	*Phyiloscopus borealis*
Wilson's warbler	*Wilsonia pusilla*
Fox sparrow	*Passereila iliaca*
Common/Hoary Redpoll	*Carduelis flammea/hornemanni*

Source: Adapted from ADNR 1991.

The spring lead system east of Point Barrow provides a long but narrow front of open water, which is utilized by millions of birds in their migration to nesting grounds. Nearly all of the king eider population of Alaska and Canada, as well as thousands of long-tailed ducks and common eiders, use this lead system (USFWS 1992b). Major concentrations of birds occur in nearshore and coastal areas such as the Plover Islands and Barrow Spit. They also concentrate at Pitt Point, and the Colville River Delta. Timing of the spring migration varies with changes in wind direction and in the availability of open-water leads (USFWS 1987, Vol. III).

Shortly after spring migration, shorebirds and waterfowl disburse to nesting grounds primarily on moist tundra and marshlands. Teshekpuk Lake, to the southeast of the lease sale area is a major nesting area. The Plover Islands, such as Cooper and Deadman Islands, are important nesting grounds for black guillemont. The nearshore and coastal areas of Elson Lagoon in the Plover Islands also support thousands of marine birds. The same is true of the pelagic areas offshore Point Barrow (USFWS 1987, Vol. III). Other species, such as common eider, glaucous gulls, black guillemots, and Arctic turns, also nest on these barrier islands.

a. Common Eider

The common eider (*Somateria mollissima*) is abundant in the Beaufort Sea area (Map 4.2; Johnson and Herter 1989). Four races of common eider inhabit North America, but only the Pacific race is found in Alaska (ADF&G 1994). They are less common than king eiders, making up only about 10 percent of the total eiders that use the Beaufort Sea area (Johnson and Herter 1989). They breed and nest at scattered locations across the Arctic coast, as well as many other locations along the Pacific and Atlantic coasts, Iceland, and Siberia. Common eiders from the Beaufort Sea area may overwinter within the Arctic Ocean (Johnson and Herter 1989), but most probably spend the winter in Russia. They may overwinter in the Bering Sea and migrate past Point Barrow during the spring and fall (USFWS 2006, citing to Dickson et al. 2005, Petersen and Flint 2002).

Abundance of common eiders of the Beaufort Sea are considered to be declining. Common eiders migrating past Pt. Barrow in the spring declined from 156,081 birds in 1976 to 72,606 birds in 1996, but reasons for the decline are unknown (Suydam et al. 2000). Aerial surveys in 2008 indicated that some population indices were increasing for some locations (Dau and Larned 2008). Some indices, such as nesting effort, are highly variable by location and year (Flint et al. 2003, Chapter 10). Some

studies have shown that common eiders are doing poorly in all stages of breeding, as evidenced by low nesting effort, small clutch sizes, poor hatch success, and poor fledging success (Flint et al. 2003, Chapter 14).

Common eiders are protected under the Migratory Bird Treaty Act, and are listed as Birds of Management Concern (USFWS 2006). Birds are included on this list if they present special management challenges because of a variety of factors such as too few, too many, conflicts with human interests, or societal demands. As a Bird of Management Concern, the common eider is considered a "game bird below desired condition", meaning the species has a population that is below long-term average or management goals, or exhibits declining population trends (USFWS 2006). An action plan has been developed by the USFWS because available information indicates that the population is decreasing and there are significant gaps in research and monitoring. The objectives of the action plan are to (USFWS 2006, p. 5):

1. Review the current state of knowledge of the species status, natural history, and possible limiting factors.
2. Define what actions need to be taken to increase our knowledge of the species and overcome limiting factors.
3. Prioritize and set a timeline for actions needed to achieve the goals of improving the species status.
4. Identify programs or entities to address the management actions identified in the plan.

There is no conclusive data to explain population declines of common eiders in the Beaufort Sea area, although it is unlikely that contaminants are the cause. Possible explanations include gull predation and disease (Flint et al. 2003, Chapter 14). Overharvesting by humans, primarily by Native peoples of northern communities, could be a significant factor in declines of common eiders (USFWS 2006). Sustainable levels of exploitation are unknown, although the current level is believed to be sustainable.

Spring migrations of common eiders begin in early March, and they pass Pt. Barrow in early May (Johnson and Herter 1989). Their eastern migrations are usually within 48 km of shore during the early morning. Early spring migrations may be negatively affected by unfavorable weather and ice conditions, and birds may succumb to starvation during the migration. The amount of open water is considered an important factor regulating the spring migration.

Common eiders nest in loose aggregations or colonies on barrier islands and spits from mid to late June (Johnson and Herter 1989). They do not generally form large colonies, unlike populations in other areas. Nesting locations include islands in coastal lagoons and in river deltas, spits, and barrier island beaches that offer protection from terrestrial predators. Nesting birds also appear to prefer locations near marine feeding areas that are relatively ice-free, and they begin nesting after ice melts enough to isolate their nesting areas from the mainland to avoid predators (Johnson and Herter 1989; ADF&G 1994). Nests are usually made in well-protected locations near logs, in driftwood, between rocks, in clumps of grass or thick vegetation, and on tundra ponds. The female usually selects the nest site, and may return each year to the same site.

Common eiders begin breeding when they are at least two years old (ADF&G 1994) and may live longer than 20 years (USFWS 2006). Clutch size is usually about four eggs, but ranges from one to ten (Johnson and Herter 1989). Timing of ice breakup affects the timing of nesting, which in turn affects the amount of nesting that takes place and clutch size (Flint et al. 2003, Chapter 14). The young hatch in mid to late July after an incubation period of 26 days (Johnson and Herter 1989). Hatching success depends on many factors, including clutch size and density of cover near the nest site (Johnson and Herter 1989), and is also strongly influenced by predation (Flint et al. 2003,

USFWS

Common eider nest with eggs.

Chapter 14). Young are usually led directly to water soon after they hatch, during which they are exposed to extreme risk of predation (Johnson and Herter 1989). The young also experience high mortality from exposure and starvation (USFWS 2006). Females may crèche their young, a process in which several females care for the young jointly, allowing the females to feed more often and regain more quickly their weight lost during egg laying and incubation (Johnson and Herter 1989). Fledging occurs from 6 to 12.5 weeks after hatching.

Males leave the nesting areas in late June and early July as incubation begins. They migrate to molting areas near Point Lay, Icy Cape, and Cape Lisburne in western Alaska (Johnson and Herter 1989). Female common eiders have been found molting in shallow, protected waters near Cape Parry northeast of the Tuktoyaktuk Peninsula, and at Harrowby Bay near Cape Bathhurst. Females and their young begin the fall migration in late August or early September, moving west to their wintering areas in the Bering Sea (Johnson and Herter 1989). The fall migration may continue into late October and early November.

Common eiders spend most their life at sea. Females are found on land only while they are laying and incubating eggs, returning to the sea to rear their brood (USFWS 2006). Common eiders dive for their food, which is gathered from bottom sediments and includes clams, mussels, crabs, shrimps, aquatic insects, and vegetation (ADF&G 1994). Predators include glaucous gulls, arctic foxes, and polar bears which may prey heavily on nesting common eiders (Noel et al. 2005b; Johnson and Herter 1989).

Biology of common eiders is poorly understood. Their annual productivity is probably low, they likely reach sexual maturity late, annual survival of adults is probably high, and stability of the population probably depends on adult survival. Natural mortality on adults may be caused by periodic die-offs from extreme weather and ice conditions, and the only known human-caused mortality is from subsistence hunting (Suydam et al. 2000).

b. Spectacled Eider

Spectacled eiders (*Somateria fischeri*) breed from northcentral Siberia to the Yukon Territory, along the Beaufort Sea coast, south to northern Bristol Bay (Map 4.2; ADF&G 1994). In Alaska, they are a relatively uncommon breeding bird of the Beaufort Sea area, although they are found in the Colville River area, and along the coast plain near Prudhoe Bay (Johnson and Herter 1989). They are more common in the Yukon-Kuskokwim Delta, probably because they prefer shallow, muddy coastal waters.

Spectacled eiders were listed as threatened under the Endangered Species Act on May 10, 1993 (58 FR 27474) because the Yukon-Kuskokwim Delta breeding population had declined 96 percent from the 1970s to the early 1990s (USFWS 2002b). On February 6, 2001, the USFWS designated critical habitat for spectacled eider (66 FR 9146), none of which is located in the Beaufort Sea area (USFWS 2004b). Causes for declines in spectacled eider populations are poorly understood, but some potential factors are lead poisoning from ingesting spent lead shot, hunting, predation, and changes to spectacled eider prey populations in the Bering Sea (USFWS 1999).

The three primary breeding grounds for spectacled eiders are the central coast of the Yukon-Kuskokwim Delta, the Arctic coastal plain of Alaska, and the arctic coastal plain of Russia (USFWS 1999). Spectacled eiders leave wintering areas in March and April, arriving at coastal nesting areas by mid-May or early June (USFWS 2002b). Nests are usually built within 3 m of shallow ponds or lakes (USFWS 1999) on slightly elevated tundra (Johnson and Herter 1989). Females lay one egg per day, with most clutches numbering five or six eggs and ranging from four to nine eggs. Hatching occurs from late June through July after about 24 days of incubation (Johnson and Herter 1989). Predation on eggs and young spectacled eiders from gulls and foxes can be heavy (ADF&G 1994).

Breeding females and their young are found on the nesting grounds until late August or early September, although females whose nests have failed return to sea by late July (USFWS 2002b). Males only remain on shore for a few weeks, returning to sea after eggs have been laid by the end of June (USFWS 2002b). The distribution of non-breeding spectacled eiders from May to October is poorly documented (USFWS 2002b). They likely inhabit shallow coastal areas in the Bering and Chukchi seas in small, scattered flocks.

Breeding spectacled eiders congregate to molt in late summer and fall and may be found in molting areas from July to October. Males begin reaching molting areas first, in late June. Non-breeding or unsuccessful breeding females begin arriving in late July, and successful breeding females arrive in late August or September (USFWS 2002b). There are four principle molting areas. Two molting areas are found on the coast of Alaska: eastern Norton Sound and Ledyard Bay, between Cape Lisburne and Point Lay. Two areas are on the coast of Russia: Mechigmenskiy Bay on the Chukotka Peninsula, and an area between the Indigirka and Kolyma river deltas (USFWS 2002b). Females nesting in northern Alaska migrate to either Ledyard Bay or Mechigmenskiy Bay to molt. Males from all three breeding areas molt in Ledyard Bay, Mechigmenskiy Bay, and in the area between the Indigirka and Kolyma river deltas (USFWS 2002b).

By late October, spectacled eiders begin migrating to overwintering areas. These migration corridors follow coastal and offshore paths through the Bering and Chukchi seas. Wintering areas are offshore, primarily in the central Bering Sea south and southwest of St. Lawrence Island. Other wintering areas have not been documented (USFWS 2002b).

Spectacled eiders are diving ducks. In their wintering areas, they feed on bottom-dwelling molluscs and crustaceans at depths of up to 70 m (USFWS 2002b). Spring feeding is particularly important, because females must accumulate enough nutrient reserves for egg-laying and incubation. While breeding and nesting, they feed on aquatic insects, crustaceans, and vegetation in ponds and wetlands.

c. Steller's Eider

Three breeding populations of Steller's eider (*Polysticta stelleri*) are recognized: two in Arctic Russia and one in Alaska (USFWS 2002a). The Alaska-breeding population has been listed as threatened under the Endangered Species Act since June 11, 1997 (62 FR 31748). On February 2, 2001, the USFWS designated critical habitat for Steller's eiders (66 FR 8850), none of which is located in the Beaufort Sea area (USFWS 2004a), and a recovery plan was published in 2002 (USFWS 2002a). Possible causes for declines in Steller's eiders remain poorly understood, but could include predation, hunting, ingestion of lead shot, and changes in the marine environment. Aerial surveys, which do not demonstrate a significant population trend from 1989-2000, indicate that Steller's eiders probably number in the hundreds or low thousands on the Arctic coastal plain (USFWS 2002a).

The Alaska breeding population intermixes with the two Russian populations during the spring migration, autumn molt, and winter (USFWS 2002a). Steller's eiders stage in the thousands to tens of thousands for the spring migration in estuaries along the north side of the Alaska Peninsula. They migrate across Bristol Bay and may spend days or weeks feeding and resting in northern Kuskokwim Bay and its smaller bays before continuing northward to nesting areas (USFWS 2002a).

Nesting of the Alaska-breeding population occurs primarily on the Arctic coastal plain (Map 4.2), and a very small subpopulation breeds on the Yukon-Kuskokwim Delta (USFWS 2002a). These subpopulations are poorly understood and historical information and current population abundance estimates are lacking. The area around Barrow is considered to be particularly important for breeding. Steller's eiders nest on tundra along the shores of lakes, ponds, and lagoons (Johnson and Herter 1989). Eggs are laid from early June to early July, with clutches ranging from 6-10 eggs. Eggs hatch after an incubation period of about 3 weeks, beginning during early July.

After breeding, Steller's eiders migrate to molting areas in marine waters from late July through late October (USFWS 2002a). Males probably depart for molting areas in mid-June, early in the incubation period; most Steller's eiders are gone from the Beaufort Sea area by early October (Johnson and Herter 1989). Large numbers of Steller's eiders molt in locations in southwest Alaska, particularly shallow areas with eelgrass beds and intertidal sand flats and mudflats that provide an environment for foraging for marine invertebrates such as molluscs and crustaceans. Steller's eiders then move to wintering areas of the Aleutian Islands, Alaska Peninsula, Kodiak Island, and Cook Inlet (USFWS 2002a).

d. King Eider

King eiders (*Somateria spectabilis*) have a circumpolar distribution, but are particularly abundant along the eastern Beaufort Sea coast (Map 4.2) and arctic islands of Canada (ADF&G 1994). From 1953-1976 the migration of king eiders passing Pt. Barrow in the spring was stable, but declined from 802,556 in 1976 to 350,835 in 1996 (Suydam et al. 2000). Reasons for this decline are unknown, but there is no corresponding indication that the number of king eiders breeding in Alaska has declined. Productivity of king eiders is affected by weather and ice conditions, and mass starvation and poor production can occur if temperatures are low and ice and snow cover persists (Johnson and Herter 1989).

King eiders winter in the Bering Sea and north Pacific Ocean (Suydam et al. 2000), including Kodiak, along the Alaska Peninsula, and the Aleutian Chain (ADF&G 1994). In the spring, they migrate north to nest in Russia, Alaska, and northwestern Canada (Suydam et al. 2000). Those nesting in Alaska and Canada migrate past Pt. Barrow and across the Beaufort Sea during the spring migration (Suydam et al. 2000). The entire western population is believed to migrate past Pt. Barrow (SDJV 2004). King Eider's transmittered on the North Slope spent at least 1 day in the Beaufort Sea after the breeding season (MMS 2005). King eiders may begin migrating into the Beaufort Sea area

as early as mid to late April, with large numbers arriving by mid-May (Johnson and Herter 1989). Migration routes and timing are determined largely by offshore lead systems in the Beaufort Sea pack ice.

Nests are usually built in vegetated areas near lakes or ponds (Johnson and Herter 1989). Clutch size ranges from two to six eggs, and eggs usually hatch by mid-July. King eiders form crèches of up to 100 ducklings, usually with two or three hens. Predators on eggs and young include arctic fox, jaegers, and glaucous gulls (SDJV 2004).

By late June through July, male king eiders migrate to molting areas in the Bering and Chukchi seas (ADF&G 1994) with females following several weeks later (SDJV 2004). During fall migrations, they move west and south, again passing Point Barrow, to the Chukchi and Bering seas (Suydam et al. 2000).

Biology of king eiders is poorly understood, but they probably have low annual productivity, reach sexual maturity relatively late, have high annual survival of adults, and stability of the population probably depends on adult survival. Causes of natural mortality on adults include periodic die-offs from extreme weather and ice conditions; the only known human-caused mortality is from subsistence hunting (Suydam et al. 2000).

e. Long-tailed Duck

The long-tailed duck (*Clangula hyemalis*) is one of the most common species of waterfowl nesting in the Beaufort Sea area. They frequently nest in clusters or colonies. Their nests consist of small, cup-like hollows that are usually surrounded by tall grass. Long-tailed duck clutches of 9-12 eggs are common, but most number 5-10 eggs. In the Beaufort Sea area most eggs hatch from July 16 to July 28. Female long-tailed ducks lead their young to the nearest water shortly after the young have hatched and dried. Fall migration begins in late September or early October (Johnson and Herter 1989).

Barrier island shorelines, lagoons, and nearshore areas are important habitat for molting long-tailed ducks. Locations of major concentrations of molting long-tailed ducks include south shorelines and lagoons near Thetis, Spy, Long, Jones, Arey, McClure, Pingok, Leavitt, Cottle, Egg, Pole, and Flaxman islands. Peak densities of long-tailed ducks molting in Simpson Lagoon were estimated at 50,000 birds, and approximately 32,000 long-tailed ducks have been recorded at a single time in the lagoon area behind Flaxman Island. The molt period extends from early June through early September (USFWS 1998).

Although the population of long-tailed ducks on the Arctic Coastal Plain has remained relatively stable, populations in northwest Canada and other regions of Alaska have declined 75 percent (USFWS 1998). The USFWS considers long-tailed ducks to be a species-at-risk (USGS 2008).

f. Red Phalarope

Red phalaropes (*Phalaropus fulicarius*) are a common migrant and breeder throughout the Beaufort Sea. They appear in the area in late May or early June. Nesting takes place in hummocky, moss seged-tundra interspersed with numerous ponds. Females usually lay four eggs. However if breeding is delayed, clutch size is reduced. Males incubate the eggs and care for the young until shortly before they are fledged. The fledging period is 16 to 18 days. The male then abandons the young and departs the breeding area. Adult migration commences from early June to mid-August. The young depart the nesting areas from mid-August to early September (Johnson and Herter 1989).

g. Glaucous Gull

The glaucous gull (*Larus hyperboreus*) is a common migrant and breeder in the Beaufort Sea area, usually arriving during May. Glaucous gulls select several types of nesting sites depending on

availability. Pairs either nest on low islands and sandbars near or on the coast or on inland river bars or small islands in lakes. They are most common on barrier islands immediately offshore from rivers that flood in the spring and thereby protect the nests from foxes. On level terrain, nests may be as much as a meter high and are composed of vegetation. Occasionally, nests consist of a simple depression in the beach and have little or no lining material. Egg laying begins in mid-June and continues through late June. The normal clutch size is three eggs and hatching begins in the second week of July. Chicks are attended by both parents until they fledge in about 45 to 50 days. During the breeding season these gulls prey heavily on the eggs and chicks of other birds. Fall migration begins in mid-September. The young remain somewhat later than most adults (Johnson and Herter 1989).

h. Tundra Swan

Tundra swans (*Cygnus columbianus*) are common breeders on the coastal plain of the Beaufort Sea area. Tundra swans begin nesting during the last week of May and the first two weeks of June. Nests are large, approximately 1 m high and up to 2 m in diameter, and widely scattered. The nests are generally located on sedge tundra. After hatching in late June or early July, broods are reared in nesting territory (Smith et al. 1993). Adults molt from mid-July through August. Fall migration occurs from late September to early October. They winter along the east and west coasts of North America, from the Aleutian Islands to California and from Maryland to North Carolina (Johnson and Herter 1989).

i. Black Brant

Black brant (*Branta bernicla nigricans*) are a common migrant and breeding bird along the Beaufort Sea coast. Black brant nest on islands in the Colville River and the Sagavanirktok River deltas. Nesting takes place in June. Black brant normally lay four to eight eggs. Black brant do not re-nest if their first attempt at nesting fails. The newly hatched geese leave the nest within 48 hours and they move to nearby tidal flats where they spend the brood-rearing period. Brood-rearing ends and the fall migration begins around the second week of August. Some brant remain in the Beaufort Sea area until late September or early October (Johnson and Herter 1989).

j. Arctic Peregrine Falcon

Arctic peregrine falcons (*Falco peregrinus tundrius*) nest south of the lease sale area primarily on bluffs along the Colville River from Umiat to Ocean Point, and at Franklin and Sagwon Bluffs in the Sagavanirktok River drainage. Additional nest sites may occur at other locations. Arctic peregrine falcons are present on the North Slope from late April through September. Nesting begins by mid-May, and the young birds fledge from late July to late August. Immature peregrine falcons from the Colville to the Sagavanirktok River drainages move toward the Beaufort Sea coast in mid to late August. Peregrine falcons generally have left the North Slope by late September (ADF&G 1997). Arctic peregrine falcons are considered a species of special concern by the State of Alaska because of population declines (ADF&G 2008b).

k. Snow Goose, Canada Goose, and Greater White-fronted Goose

Snow geese (*Chen caerulescens*) arrive in the Sagavanirktok River delta during the last week of May and occupy nesting habitat on Howe Island in the first days of June. Most adult females arriving on the breeding grounds have already paired and copulated and have well-developed eggs in their oviducts. They lay their eggs within 4 days to a week after they arrive. They build their nests of grass and bits of willow on high ground. Clutch size is three to six eggs, which usually hatch during the last week of June or the first week of July. Snow goose goslings require about 7 weeks to fledge. They leave the brood-rearing areas by about August 15 to August 20 and congregate in immense flocks on the coastal tundra to feed almost continuously. Snow geese and black brant from the Howe Island colonies often move to the Kadleroshilik River delta to rear in the salt marshes (ADF&G

1992). Half of the snow geese from the Howe Island colony take their broods to the Kadleroshilik River salt marshes for the months of July and August (USFWS 1992b). Fall migration begins in the second or third week of September (Johnson and Herter 1989).

Canada geese (*Branta canadensis*) arrive along the Arctic coast during the last two weeks of May and the first week of June. They nest primarily away from the sea coast, on bluffs along the Colville River. However, some isolated pairs have been found nesting in moderate densities in coastal wetlands near Prudhoe Bay. They usually lay their eggs during the first or second week of June. The clutch size may vary from 1-10 eggs which hatch within the first two weeks of July. After the goslings have fledged in mid-August, flocks begin dispersing along the Beaufort Sea and begin their southward migration.

The ***greater white-fronted goose*** (*Anser albifrons*) is a common breeding bird along the Beaufort Sea coast. They reach the Beaufort Sea breeding areas from the second week of May to the first week of June. The female usually selects a nest site on well-vegetated (scrub willow tundra) and well-elevated habitat near a lake or river. Eggs are laid during the last half of May or the first two weeks of June. The female lays her eggs in a slight depression and builds the nest as she completes her clutch of four to seven eggs. The incubation period varies from 23 to 28 days. Breeding adults usually molt when goslings are 2 to 3 weeks old. Fall migration may begin as early as August 10 with the last greater white-fronted geese leaving Alaska by the end of September (Johnson and Herter 1989).

I. Yellow-billed Loon

The Colville River Delta supports some of the highest densities of breeding yellow-billed loons (*Gavia adamsii*) in Alaska (Smith et al. 1993). Yellow-billed loons arrive in the Beaufort Sea area in late May. They concentrate during spring with other species of loons in early-melting areas off the deltas of the Sagavanirktok, Kuparuk, and Colville rivers. Yellow-billed loons prefer gently sloping shores of deep tundra lakes as nest sites. The nest is usually a built-up mound of turf and mud on the shoreline of a lake or occasionally on the shoreline of a large river. Egg laying begins as early as the second week of June and hatching takes place in July and early August. The normal clutch size is two eggs. The age at which yellow-billed loons fledge has not been documented but may be similar to common loon chicks which is 45 days. The peak fall migration for yellow-billed loons is in late August or early September (USFWS 1992b; Johnson and Herter 1989). In 2007, the USFWS published a notice of 90-day petition finding and initiation of status review to begin the process of determining if yellow-billed loons should be listed as threatened or endangered under the Endangered Species Act (72 FR 31256-31264). On March 25, 2009, the USFWS published an update in the Federal Register (74 FR 12932-12968) and determined that listing the yellow-billed loon under the Endangered Species act is “warranted but not precluded”. The yellow billed loon is now designated as a candidate species (USFWS 2009c).

3. Terrestrial Mammals

a. Caribou

Caribou (*Rangifer tarandus granti*) inhabit much of Alaska, occurring in a small band of terrestrial habitat included in the Beaufort Sea lease sale area. In Alaska, caribou occur in 32 herds, or groups with distinct calving areas (ADF&G 1994). Although their calving areas are separate, herds may intermingle on winter ranges. Four caribou herds use the coastal habitats adjacent to the lease sale area: the Western Arctic Herd, Teshekpuk Lake Herd, Central Arctic Herd, and the Porcupine Caribou Herd (Map 4.3).

The Teshekpuk Lake Herd (TCH) uses the area around Teshekpuk Lake for calving, grazing, and insect relief. Note that most of this area is outside the lease sale area and much of the critical habitat

is subject to development restrictions and other protections. A photocensus of this herd counted a record 64,000 caribou in 2008 (ADF&G 2009; Table 4.5). The TCH moves towards Teshekpuk Lake during May (Carroll 2007b). The northeast, east, and southeast of the lake are the primary areas used for calving, which takes place in early June. The TCH seeks relief from insects along the Beaufort Sea coast from Dease Inlet to the mouth of the Kogru River, around the edges and on islands of Teshekpuk Lake, and on sand dunes along the Ikpikpuk River and south of Teshekpuk Lake. The area north of Teshekpuk Lake is particularly important for insect relief and grazing. Narrow strips of land to the east and northwest of the lake provide important migratory corridors for traveling to and from insect relief areas. The TCH usually winters on the coastal plain, especially around Atqasuk and South of Teshekpuk Lake, but this herd may also be found in the foothills and mountains of the Brooks Range, as far south as the Seward Peninsula, and as far east as the Alaska National Wildlife Refuge (Carroll 2007b).

The Central Arctic herd (CAH) calving area lies between the Colville and Kuparuk rivers on the west side of the Sagavanirktok River and between the Sagavanirktok and the Canning Rivers on the east side (Lenart 2007c). The most recent photocensus counted 66,772 caribou in 2008, a record since 1978 (ADF&G 2009; Table 4.5). During the summer, this herd is found from Fish Creek, just west of the Colville River, eastward along the coast, and inland about 30 miles, to the Katakturuk River. Their winter range is the northern and sourthern foothills and mountains of the Brooks Range. In the summer and winter, this herd often overlaps the range of the PCH to the east, and the WACH and TCH to the west.

Table 4.5. Population estimates for the four caribou herds of the Beaufort Sea area.

Teshekpuk		Central Arctic		Porcupine		Western Arctic	
Year	Population Estimate	Year	Population Estimate[a]	Year	Population Estimate[a]	Year	Population Estimate[c]
1978-1982	3,000-4,000	1978	5,000	1961	110,000	1970	242,000
1984	11,822	1981	8,537	1972	99,959	1976	75,000
1985	13,406	1983	12,905	1977	105,000	1978	107,000
1989	16,649	1991	19,046	1979	105,683	1980	138,000
1993	27,686	1992	23,444	1982	125,174	1982	172,000
1995	25,076	1995	18,100	1983	135,284	1986	229,000
1999	28,627	1997	19,730	1987	165,000	1988	343,000
2002	45,166	2000	27,128	1989	178,000	1990	416,000
2008	64,000	2002	31,857	1992	160,000	1993	450,000
		2008	66,772	1994	152,000	1996	463,000
				1998	129,000	2003	490,000
				2001	123,000	2007	377,000
				2002-2007[b]			

[a] Estimated by several different methods.

[b] No estimates because of weather or poor aggregation

[c] Minimum estimate.

Source: Carroll 2007b; Lenart 2007c; Lenart 2007b; Dau 2007; ADF&G 2009.

The Porcupine caribou herd (PCH) migrates across a range covering 130,000 m^2 and multiple geopolitical boundaries including Alaska in the U.S. and the Yukon and Northwest Territories in Canada (Lenart 2007b), most of which is outside the Beaufort Sea lease sale area. The most recent photocensus occurred in 2001, with 123,000 caribou counted (Table 4.5). Caribou of the PCH may occur in a small band of terrestrial habitat included in the Beaufort Sea lease sale area. The PCH migrates more than 700 miles each way as it moves from wintering areas in the south of its range to spring calving grounds on the arctic coastal plain (USFWS 2009b). The calving grounds stretch from the northern foothills of the Brooks Range to the arctic coastal plain from the Tamayariak River in Alaska to the Babbage River in Canada. From 50-75 percent of calves are born in the Arctic National Wildlife Refuge between Katakturuk and Kongakut rivers (USFWS 2009a). This area provides important protection from predators, such as wolves, brown bears, and golden eagles which are more abundant in the adjacent foothills and mountains, and the area has an abundance of plant species that provide important nutritional value to pregnant cows (USFWS 2009a). By late June and early July, the herd moves along the coast, onto ice fields, and to uplands of the Brooks Range for insect relief. By mid-July, the herd begins migrating to its fall and wintering areas to the east and south (USFWS 2009b).

The Western Arctic herd (WAH) has a range covering about 140,000 m^2 (Dau 2007). In 2007, 377,000 caribou of this herd were counted (Table 4.5). Calving areas of the WAH include the Brooks Range and its northern foothills west of the Trans-Alaska Pipeline, with most calving occurring in the Utukok uplands. The herd moves west toward the Lisburne Hills and then into the western North Slope and DeLong Mountains. The herd then moves east through the Brooks Range and foothills toward Howard and Naktuvuk passes. This herd winters in the Nulato Hills as far south as the Unalakleet River drainage, and the eastern half of the Seward Peninsula.

Caribou undertake annual seasonal migrations, which begin in April when pregnant cows and some nonmaternal caribou begin migrating from winter range toward the calving grounds (Dau 2007). Cows reach calving grounds by mid to late May, and calving occurs from late May through early June. The remaining caribou follow, joining the cows and calves by mid to late June. By mid-June, aggregations of caribou begin forming and the herds begin moving in search of relief from insects (Dau 2007). These summer movements are influenced by insect abundance, which in turn depends on temperature and windspeed (Lenart 2007c). In warmer weather caribou will concentrate along the coast or on large gravel bars for insect relief. Other relief habitat includes cool, windy coastal beaches, low bluffs, sparsely vegetated river bars and deltas, mud flats, dunes, pingos, and gravel pads, roads, and the shade of elevated pipelines, buildings, and parked vehicles in the oil fields (Truett 2000, citing to multiple sources). In cooler, windy weather, they tend to be found inland. The fall caribou migration begins from mid-August through late September, and may extend through late November. Caribou are relatively sedentary through the winter, until April when the spring migration begins again (Dau 2007).

Although the calving areas tend to remain the same for each herd from year to year, migration routes may change, sometimes suddenly. These changes may occur as caribou select routes with more food (ADF&G 1994). Migrations are triggered by weather conditions such as the onset of cold weather or snowstorms.

The caribou rutting season begins in late August and early September, and calving occurs in May and June (ADF&G 1994). Female caribou reach sexual maturity between 16 and 28 months old, and they give birth annually. Mature male caribou average 350-400 lbs.

Caribou populations appear to be cyclic, although the mechanisms, timing, and population size fluctuations are not well understood. Hunting, weather patterns, overpopulation, predation, and disease appear to be the most common factors affecting caribou abundance (ADF&G 1994).

In the summer, caribou feed on grasses, sedges, flowering tundra plants, mushrooms, and the leaves of willows, dwarf birches (Smith and Walker 1995; ADF&G 1994). In the winter, they feed on lichens, small shrubs, and dried sedges which they are able to find beneath the snow. Predators on adults include wolves and bears; they are an important species for sport and subsistence hunting; and wolves and golden eagles prey on calves. Warble flies, bot flies, and mosquitoes harass caribou during the summer.

b. Moose

Moose (*Alces alces gigas*) may be found in the terrestrial portions of the Beaufort Sea lease sale area, especially along recently burned areas with willow and birch shrubs, on timberline plateaus, and along major rivers (ADF&G 1994). Counts of moose in Game Management Unit 26A (Map 4.4) ranged from 326 to 1,535 moose from 1970-2005 (Table 4.6). The moose population in Unit 26A steadily increased from 1996 through 2005, and remained stable in 2006 and 2007. The population currently numbers about 1,000 animals (ADF&G 2007). During the summer, moose inhabiting the North Slope are found along small tributaries and riparian habitat, and may disperse as far as the foothills of the Brooks Range and across the coastal plain (Carroll 2006). During late May and early June, cows generally move away from river bottoms to calve, and remain near riparian habitat through the summer. Bulls disperse widely. During the winter, moose are concentrated along the riparian habitat of river corridors, particularly inland portions of the Colville River drainage.

Moose breed annually and both sexes may begin breeding at the age of 16 to 18 months. Calving occurs from mid-May through early June. Rutting occurs during the fall from late September through early October. Moose have high reproductive potential and can reach the carrying capacity of their range if not limited by predation, hunting, or severe weather (ADF&G 1994). Food abundance and habitat are important limiting factors for moose populations (ADF&G 2008c; Lenart 2006). Disease, natural environmental factors, winter severity, predation, and insect harassment also contribute to the size of moose populations in the Beaufort Sea area (Lenart 2006). Recent trends indicate that North Slope moose populations are increasing (Lenart 2006; Carroll 2006).

Moose eat a variety of foods, particularly sedges, equisetum, pond weeds, grasses, and leaves of birch, willow, and aspen. They are preyed upon by wolves and brown bears; and they are hunted by sport and subsistence hunters (ADF&G 1994).

Table 4.6. Number of moose counted during Game Management Unit 26A censuses.

Year	Number of Moose[a]
1970	1,219
1977	1,258
1984	1,447
1991	1,535
1995	757
1999	326
2002	567
2005	1,048
2007-2008	1,000

[a] Includes adults and calves.

Notes: Includes moose counted throughout the entire game management unit, most of which is outside the Beaufort Sea lease sale area.

Source: Carroll 2006; ADF&G 2007.

c. Brown Bears

Brown bears (*Ursus arctos*) are widely distributed throughout Game Management Unit 26 (Map 4.4), with higher densities found in the foothills of the Brooks Range and eastern areas, and lower densities on the coastal plains (Lenart 2007a; Carroll 2007a). Brown bears may follow the Porcupine caribou herd to their calving areas. Availability of habitat is considered to have remained relatively constant in recent years and largely undisturbed. Brown bear populations are considered stable or increasing slowly in some areas and at high levels relative to carrying capacity in others (Lenart 2007a; Carroll 2007a).

Brown bears mate from May through July with the peak of activity in early June (ADF&G 1994). The young are born the following January or February in a winter den. Litter size ranges from one to four cubs, but two is most common. Offspring typically separate from their mothers as two-year olds in May or June. In some areas where food is scarce, females may skip one to three years before producing new litters. Other than during mating in June and July, brown bears are usually solitary, except for sows with cubs. However, concentrations of brown bears do occur where food is concentrated (ADF&G 1994).

Brown bears eat a wide variety of foods, including berries, grasses, sedges, horsetails, cow parsnip, fishand many kinds of roots; and they prey on newborn moose and caribou calves, and can also kill and eat adult moose and caribou as well as domestic animals (ADF&G 1994). Arctic ground squirrels are a particularly important stable of the brown bear diet (Shideler and Hechtel 2000). Since their reintroduction into ANWR and at Kavik in the 1970s, muskoxen have become a prey species for brown bears (Shideler and Hechtel 2000). Brown bears eat most carrion, and will also become habituated to eating garbage (ADF&G 1994).

Most brown bears hibernate during the winter and emerge from their dens in spring, often in May (ADF&G 1994).

d. Muskox

The muskox (*Ovibos moschatus*) is a stocky, long-haired animal with cloven hooves, a slight shoulder hump and a very short tail. Taxonomists classify muskoxen with the sheep and goats. Muskoxen as a species have changed little since the ice age and are perfectly adapted to live in their harsh arctic environment (ADF&G 1994).

The original Alaska muskoxen disappeared in the mid- or late-1800s as a result of over-hunting. Muskoxen were reintroduced in ANWR in 1969 and in the Kavik area in 1970. They were reintroduced near Cape Thompson in 1970 and 1977. An estimated 270 muskoxen were counted between the Colville River and ANWR, and 91 animals were recorded west of the Trans-Alaska Pipeline near the Colville River (BLM 1997, Vol. III). Muskoxen are expected to repopulate their former home-range habitats in the NPR-A in the near future. Small numbers occur in the Colville River Delta, in the area of the lower Itkillik River valley, and the headwaters of the Miluveach and Kachemack Rivers (ADF&G 1997). Known wintering areas occur along riverside bluffs in the vicinity of the Sagavanirktok and Ivishak rivers, and along the Kavik and Shaviovik river drainages near the coast. During summer they also utilize the Kadleroshilik drainage (USFWS 1992b).

Although muskoxen populations within the Arctic National Wildlife Refuge grew rapidly from 1974 to 1986, their numbers declined after 1986 from 368 to less than 200 as of 2001 (Reynolds et al. 2002).

The most important habitats for muskoxen in the Colville River Delta are riparian, upland shrub, and moist sedge-shrub meadows (BLM 1997, Vol. III). Riparian habitat is preferred by muskoxen for virtually their entire annual cycle. River systems that provide diverse low shrub-forb and tall willow

communities in proximity to relatively snow-free uplands, hillsides, and plateaus are also important habitat (USFWS 1992b).

The rutting season generally occurs in fall, from August to October (ADF&G 1994). Muskoxen eat a wide variety of plants, including grasses, sedges, forbs, and woody plants. In summer and fall, both sexes may be found along major river drainages where they feed on willows and forbs. In winter and spring, muskoxen groups of 10 to 20 animals may be found in the uplands adjacent to river drainages which afford forage of tussock sedges and have less snow cover (USFWS 1987). Muskoxen are poorly adapted for digging through heavy snow for food, so winter habitat is generally restricted to areas with shallow snow accumulations or areas blown free of snow (ADF&G 1997).

e. Furbearers

Arctic fox *(Alopex lagopus)* occur in two color phases, blue and white, with the white color phase more common in northern litters. Young of each color phase may occur in the same litter (ADF&G 1994). Arctic fox pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and river cut backs. Most dens have southerly exposure. They extend from 6 to 12 ft underground. Enlarged ground squirrel burrows with several entrances are often used as dens (ADF&G 1994).

Mating occurs in early March and early April. Gestation lasts 52 days. Litters average seven pups but may contain as many as 15 pups. Arctic foxes are monogamous in the wild. Both parents aid in bringing food to the den and in rearing the pups. Pups begin eating meat when about one month old and are fully weaned by 1 ½ months. They emerge from the den when about three weeks old and begin to hunt and range away from the den at about three months. Arctic foxes attain sexual maturity at 9 to 10 months, but many die in their first year (ADF&G 1994). Fully grown arctic foxes weigh from 6 to 10 pounds.

Arctic foxes are omnivorous. In summer, they feed primarily on small mammals, including lemmings and tundra voles. They sometimes eat berries, eggs, and scavenged remains of other animals. Many foxes venture out onto the sea ice during winter to eat the remains of seals killed by polar bears. In areas where lemmings and voles are the most important summer prey, numbers of foxes often rise and fall with cyclic changes of their prey. Fewer pups are successfully reared to maturity when food is scarce. There is evidence indicating that competition for food among young pups accounts for some of the heavy mortality in this age group (ADF&G 1994). Arctic foxes may move long distances over sea ice. A fox tagged along the coast of Russia was captured near Wainwright, Alaska a year later (ADF&G 1994).

Wolves *(Canis lupus)* are adaptable and exist in a wide variety of habitats including the Arctic tundra along the Beaufort Sea. They are highly social animals and usually live in packs averaging 6 to 7 animals (ADF&G 1994).

Wolves normally breed in February and March, and litters averaging about five pups are born in May or early June. Litters may include from 2-10 pups, but most often four to seven pups are born. Most female wolves first breed when 22 months old but usually have fewer pups than older females. Pups are usually born in a den excavated as much as 10 ft into well-drained soil, and most adult wolves center their activities around dens while traveling as far as 20 miles away in search of food, which is regularly brought back to the den. Wolf pups are weaned gradually during midsummer. In mid- or late summer, pups are usually moved some distance away from the den and by early winter are capable of traveling and hunting with adult pack members. Wolves are great travelers, and packs often travel 10 to 30 or more miles in a day during winter. Dispersing wolves have been known to move from 100 to 700 miles from their original range (ADF&G 1994).

Despite a generally high birth rate, wolves rarely become abundant because mortality is high. In much of Alaska, hunting and trapping are the major sources of mortality, although diseases,

malnutrition, accidents, and particularly preying by other wolves regulate wolf numbers (ADF&G 1994).

Wolves are carnivores, with moose and/or caribou as their primary food. During summer, small mammals including voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish are supplements in the diet. Wolves are opportunistic feeders; very young, old, or diseased animals are preyed upon more heavily than other age classes. Under some circumstances, however, such as when snow is unusually deep, even animals in their prime may be vulnerable to wolves (ADF&G 1994).

Wolverines (*Gulo gulo*) are primarily found in the wilder and more remote areas of Alaska (ADF&G 1994). They frequent all types of terrain and often utilize rivers as territorial boundaries (USFWS 1987).

Wolverines become sexually mature in their second year. Breeding takes place between May and August. After wolverines mate, the embryo floats in the uterus until late fall or early winter. This type of reproduction is known as delayed implantation, and allows a female wolverine to become pregnant when food supplies are plentiful and when she is in good physical condition. The abundance of food determines whether a pregnancy will be maintained and the number of young that will be born (ADF&G 1994).

Litters are born between January and April. In interior and northern Alaska, most young are born in snow caves. These caves usually consist of one or two tunnels that can be up to 60 yards long. Litters usually number between one to three. Baby wolverines develop rapidly and are weaned at about eight weeks of age. They leave their mothers at approximately 5 or 6 months to forage for themselves (ADF&G 1994).

Wolverines travel extensively in search of food. They are opportunistic, eating about anything they can find or kill. They are poor hunters, but are well adapted for scavenging. Wolverines can survive for long periods on little food. Their diet varies from season to season depending on food availability. In the winter, wolverines rely primarily on remains of moose and caribou killed by wolves and hunters or animals that have died of natural causes. Throughout the year, wolverines feed on small and medium-sized animals such as voles, squirrels, snowshoe hares, and birds. In the right situations, wolverines can kill moose or caribou, but these occurrences are rare (ADF&G 1994).

4. Marine Mammals

Marine mammals inhabiting the lease sale area include polar bear, bowhead whale, beluga whale, ringed seal, spotted seal, and bearded seal. Walrus are also found seen in the lease sale area.

a. Polar Bears

Polar bears (*Ursus maritimus*) inhabit the coast of the Beaufort Sea area (Map 4.5). They are marine mammals and are protected under the Marine Mammal Protection Act of 1972. On May 15, 2008, the USFWS published a Final Rule in the Federal Register listing the polar bear as a threatened species under the federal Endangered Species Act (73 FR 28212-28303). The USFWS based its listing on the loss of sea ice, which it says threatens and will likely continue to threaten polar bear habitat. The USFWS believes that this loss of habitat puts polar bears at risk of becoming endangered in the foreseeable future, the standard established by the Endangered Species Act for designating a threatened species. This final rule activates the consultation provisions of Section 7 of the Act for the polar bear. The special rule for the polar bear, also published in the May 15, 2008, edition of the Federal Register, sets out the prohibitions and exceptions that apply to this species. It recognizes the adequacy of the existing regulatory structure in protecting polar bears.

The State of Alaska has challenged the listing (Office of the Governor 2008). The state maintains that there is insufficient evidence to support a listing of the polar bear as threatened for any reason at

USFWS

Female polar bear with young along the Beaufort Sea coastline.

this time. Polar bears are currently well-managed and have dramatically increased over 30 years as a result of conservation measures enacted through international agreements and the Marine Mammal Protection Act.

Polar bears are distributed throughout the Arctic circumpolar region. Within this region, it is estimated that there are currently 20,000 to 25,000 polar bears (IUCN 2005), a substantial increase from the early 1970s. Although no Distinct Population Segments have been identified across the Arctic circumpolar region, the IUCN (International Union for Conservation of Nature and Natural Resources) has established 19 management units for purposes of research and management (IUCN 2005). Two of these overlap Alaska, the Southern Beaufort and the Chukchi Sea sub-populations.

Polar bears and brown bears evolved from a common ancestor and are closely related, as demonstrated by matings and production of fertile offspring in zoos (ADF&G 1994). At least one successful pairing has occurred in the wild, as confirmed in 2006 by DNA analysis of a hybrid bear from the southern tip of Banks Island, Northwest Territories (Roach 2006). Adaptations by the polar bear to life on sea ice include a white coat with water-repellent guard hairs and dense underfur, short furred snout, short ears, teeth specialized for a carnivorous diet, and hair nearly completely covering the bottom of the feet (ADF&G 1994).

Polar bears breed from late March to May (ADF&G 1994). During late October and November, pregnant females search for banks, slopes, or rough ice in which to dig a den, either on land or on sea ice (ADF&G 1994). Litters of one to three cubs are born in December or January (Smith and Walker 1995). In late March or early April, polar bears emerge from the den with their cubs and begin making excursions to drifting sea ice (ADF&G 1994). The young remain with the mother until they are about 28 months old (ADF&G 1994). Females can produce litters about every third year, and polar bears can live to be about 25 years old (ADF&G 1994).

Radio collar surveys indicate that the Beaufort Sea population dens locally, and is not dependent on reproduction from other known denning areas outside of the region (Amstrup and Gardner 1994). Polar bears do not exhibit site fidelity in denning, but return only to the general substrate and geographic area upon which they had previously denned: on ice or on land, and in the eastern or the western Beaufort respectively. The most preferred region for land denning is located in the northeast corner of Alaska and adjacent to Canada (Amstrup and Gardner 1994).

Regehr et al. (2006) compared production indices between two time periods, 1967-1989 and 1990-2006. They found that, in the spring, the proportion and number of adult females with cubs of the year increased significantly between the two periods, but that yearling production was not significantly different. In the autumn, they found that the proportion and number of adult females with cubs of the year was significantly lower in the second time period, but yearling production was not significantly different. Litter size was not significantly different between the two time periods. Continued vigilance in monitoring the polar bear population of the area was suggested (Regehr et al. 2006).

Polar bears are usually found near coastlines and the southern edge of sea ice, and they may make extensive seasonal movements related to the ice edge (ADF&G 1994). This is because their primary food is the ringed seal, which inhabits the Arctic ice (ADF&G 1994). Bears capture seals by waiting for them at breathing holes and at the edge of leads or cracks in the ice, by stalking resting seals on top of the ice, and by breaking into pupping chambers on top of the ice in the spring (ADF&G 1994). However, Regehr et al. (2006) found that survival was not clearly related to sea ice coverage. Other prey includes bearded seals, walruses, and beluga whales, and polar bears will eat small mammals, bird eggs, and vegetation. Polar bears also feed on whale, walrus and seal carcasses (ADF&G 1994).

Regehr et al. (2006) estimated the southern Beaufort Sea polar bear population to be 1,526 (95 percent CI = 1,211; 1,841) in 2006, which was not significantly different from a 1986 estimate of about 1,800 polar bears.

b. Bowhead Whales

Bowhead whales (*Balaena mysticetus*) are found only in Arctic waters of the Northern Hemisphere where they are often associated with pack ice in shallow waters (NMFS 2008c). Bowhead whales inhabit five general areas, and are classified by stock based on these areas: north of Europe; between Canada and Greenland; the Hudson Bay area; the Okhotsk Sea; and the Bering, Chukchi and Beaufort seas. The Western Arctic stock, which is found in Alaska, migrates between the Bering, Chukchi, and Beaufort seas and the eastern waters of Russia (Angliss and Outlaw 2008),(NMFS 2008b) The Western Arctic stock is also known as the Bering-Chukchi-Beaufort stock or the Bering Sea stock.

Bowhead whales are listed as endangered under the Endangered Species Act and are considered depleted under the Marine Mammal Protection Act. The Western Arctic bowhead whale stock has been increasing since 1980. With over 10,000 whales in 2001 (Table 4.7), the stock may be approaching carrying capacity (Angliss and Outlaw 2008). Recent high counts of calves provide further evidence that the Western Arctic population is healthy and increasing. NMFS, in 2002, issued a determination within the Federal Register deciding against designating critical habitat for bowheads. NMFS determined that (1) the population decline was due to overexploitation by commercial whaling, and habitat issues were not a factor in the decline; (2) the population is abundant and increasing; (3) there is no indication that habitat degradation is having any negative impact on the increasing population; and (4) existing laws and practices adequately protect the species and its habitat (67 FR 55767, August 30, 2002.).

NMFS has concluded that leasing and exploration are not likely to jeopardize the continued existence of the bowhead whale (NOAA 2006).

Table 4.7. Estimates of abundance of the Western Arctic stock of bowhead whales available for 1978-2001.

	Abundance			Abundance	
Year	Estimate	CV[a]	Year	Estimate	CV[a]
1978	4,765	0.305	1987	5,298	0.327
1980	3,885	0.343	1988	6,928	0.120
1981	4,467	0.273	1993	8,167	0.017
1982	7,395	0.281	2001	10,545	0.128
1983	6,573	0.345			

a Coefficient of variation.

Source: Angliss and Outlaw 2008.

Bowhead whales are insulated by a very thick layer of blubber that provides insulation, food storage, buoyancy, padding and thermoregulation (ADF&G 1994), (Fish 2000). Bowheads are able to travel through ice covered waters because the heavy bone structure of their skulls is capable of breaking through ice up to 2 ft thick if they cannot find open water. Bowhead whales communicate vocally while traveling, feeding, and socializing. These underwater sounds may also be used in navigating (ADF&G 1994). Bowheads have excellent sight and hearing (ACS 2004)

Bowhead whales spend their entire lives in far northern waters, and unlike other baleen whales, they do not migrate to temperate or tropical waters to calve (ADF&G 1994). In Alaska, bowhead whales spend November through March in wintering areas of the northern Bering Sea (Map 4.6; Angliss and Outlaw 2008). In the spring, from March through June, they follow fractures in the ice, moving north and east along the coast through the Chukchi Sea to the Beaufort Sea (Angliss and Outlaw 2008). By mid-summer they are found in the ice-free waters of the southeastern Beaufort Sea and west Amundsen Gulf (Map 4.7; Richardson and Thomson 2002). In August and early September, large numbers of subadults are sometimes seen feeding in shallow waters along the north coast of the Yukon (Richardson and Thomson 2002). Bowhead whales are also occasionally seen around Barrow in the summer, indicating that there may be important summer feeding grounds in that area (Angliss and Outlaw 2008). Bowheads have also been spotted far offshore in the eastern part of the Alaskan Beaufort Sea in August (Richardson and Thomson 2002).

In the fall months of September through November, bowhead whales make a return migration to the Bering Sea to overwinter (Angliss and Outlaw 2008). They spend an average of 3 to 8 days transiting the eastern Beaufort Sea area (from Flaxman Island to Herschel Island), although this average is variable. In some years most, if not all whales, may travel steadily across this area without stopping to feed or for other purposes, with an overall residence time of 5 days for the population (Thomson et al. 2002).

Bowhead whales usually travel alone or in small groups of up to six whales. They may be found in larger concentrations on feeding grounds (ACS 2004). Many factors contribute to the timing and path of bowhead whale migrations and their use of feeding areas. These include oceanographic characteristics, ice pack movements, wind-driven ocean currents, and upwellings (Schick and Urban 2000).

Bowheads whales filter their food through long baleen plates (NMFS 2008c). A single bowhead needs an estimated 100 metric tons of krill annually, consisting of copepods, amphipods,

euphausiids, and other small crustaceans (NMFS 2008c; ACS 2004). Bowheads feed at all depths, from the surface to the bottom (ADF&G 1994), and sometimes even bring mud to the surface (Richardson and Thomson 2002). Bowheads concentrate for feeding at places and depths of zooplankton concentrations (Richardson et al. 1995 citing to Griffiths and Buchanan 1982, Bradstreet et al. 1987, and Richardson 1987). Copepods that are important food for bowheads undergo annual cycles that vary by location and may be influenced by timing of ice breakup in the spring (Richardson et al. 1995 citing to Longhurst et al. 1984, Sameoto et al. 1986). The only predators of bowhead whales are killer whales; and they are hunted by Alaska Native subsistence hunters (Smith and Walker 1995).

Bowhead whales feed seasonally in response to food abundance, however much of the bulk of their annual food intake occurs in the fall, winter, and early spring (Lee et al. 2005). Some studies have found that in the spring, fewer stomachs of harvested bowheads are found with food (Lowry and Sheffield 2002; Carroll and Smithhisler 1980). Studies have also found that bowhead whale stomachs generally contain food in the fall (Carroll and Smithhisler 1980). Richardson and Thomson (2002) found that bowhead whales feed regularly in the nearshore waters of the eastern, central, and western Alaskan Beaufort Sea during September – October as they make their fall migration. Lowry et al. (2004) concluded that in the autumn, bowheads feed regularly in the eastern, central and western Alaskan Beaufort Sea. Some studies have indicated that most of the annual food requirement of adults and subadults is obtained from the Bering and Chukchi seas, and that only a minority of their food comes from the eastern and central Beaufort Sea (Lee and Schell 2002). Lee et al. (2005) found that most food for the bowhead whales comes from Bering-Chukchi Sea waters. The bowhead whale population is estimated to consume only about 2.4 percent of its annual energetic requirements in the eastern Beaufort Sea area from Flaxman Island to Herschel Island (Thomson et al. 2002).

Mating bowhead whales have been observed from March to August, but mating is believed to occur primarily in March (Braham 1984). After a gestation period of about 13 months, most bowheads give birth in May, although calves may be born from March through July. Data from harvests indicate that bowhead whales produce a calf every 3-6 years (Braham 1984).

The life span of bowhead whales is considered to be about 50-60 years, but it may be much longer (Smith and Walker 1995) perhaps in excess of 100 years in some cases (George et al. 1999). Historically, the age of bowhead whales have been difficult to determine; current methods including aspartic acid racemization (ARR) have improved the process, yet methods for assessing age, length-at-age, and age of sexual maturity remain undeveloped (Lubetkin et al. 2008).

c. Beluga Whales

Beluga whales (*Delphinapterus leucas*) are a medium-sized cetacean related to narwhales, sperm and killer whales, dolphins, and porpoises (ADF&G 1994). They are found in the Northern Hemisphere throughout arctic and subarctic waters, both coastal and offshore (NMFS 2008a). Five stocks of beluga whale are recognized in Alaskan waters: Cook Inlet, Bristol Bay, eastern Bering Sea, eastern Chukchi Sea, and Beaufort Sea (Angliss and Outlaw 2008). The Beaufort Sea stock is estimated to be about 40,000 beluga whales, but population trends for the stock are unknown (Angliss and Outlaw 2008). The Beaufort Sea stock is not listed as depleted under the MMPA, or as threatened or endangered under the Endangered Species Act.

Distribution of beluga whales varies by season and region, and is affected by a range of conditions such as temperature, ice cover, tides, and prey availability (NMFS 2008a). Summering concentrations of belugas are found in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and Mackenzie Delta. However, except for the Cook Inlet concentration, all these are thought to overwinter in the Bering Sea (Angliss and Outlaw 2008).

The Beaufort Sea beluga stock may undertake annual migrations of thousands of kilometers (Map 4.8 and Map 4.9). In the winter, this stock is found in offshore waters associated with pack ice. In the spring, they migrate to warmer waters of coastal estuaries, bays, and rivers for molting and calving (Angliss and Outlaw 2008). Belugas travel in groups, or pods, of 2-10 animals, although large pods of up to 100 individuals are not uncommon (Smith and Walker 1995). Radio telemetry studies have found that during summer and fall movements, belugas are somewhat segregated by sex. These studies also found that although belugas spend some time in estuaries, they spend far more time well offshore, far into the permanent ice pack (Richard et al. 2001).

Adult beluga males range in size from 11-15 ft and in weight from 1,000-2,000 lbs. Females tend to be smaller than males, usually no more than 12 ft in length (ADF&G 1994). Female belugas attain sexual maturity between 4 and 5 years old, and males mature slightly later. Females may produce a calf about every three years. Breeding occurs in March or April, and the gestation period is about 14.5 months. Calving occurs in May-July, usually near or in summer concentration areas. Belugas can live to be about 40 years old (ADF&G 1994).

Belugas are predators and consume a wide range of prey, probably influenced by both seasonal prey abundance and preference (Hobbs et al. 2006). Over 100 species of marine organisms have been documented as beluga prey (Smith and Walker 1995), including herring, capelin, smelt, Arctic and saffron cods, salmon, flatfishes, sculpins, octopus, squid, shrimps, crabs, and clams (ADF&G 1994). Predators of belugas include killer whales and polar bears; and they are hunted by Alaska Native subsistence hunters (Smith and Walker 1995).

d. Bearded Seal

Bearded seals (*Erignathus barbatus*) are circumpolar in distribution (Angliss and Outlaw 2008). In Alaska, they are distributed over the continental shelf of the Bering, Chukchi, and Beaufort seas (Map 4.10), with concentrations over the northern part of the Bering sea shelf in January-April. They appear to prefer areas with 70-90 percent ice coverage, and tend to be found over shallow waters less than 200 m. In winter, they tend to inhabit broken pack ice but they are also found on shorefast ice (Angliss and Outlaw 2008). During the summer, bearded seals are broadly distributed. They may remain in open water and rarely haul out on land. All bearded seals found in Alaska are considered to be from one Alaska stock. There is no reliable estimate of abundance for the Alaska stock of bearded seals (Angliss and Outlaw 2008). Bearded seals are protected under the MMPA but they are not listed as depleted (Angliss and Outlaw 2008). They are not listed as threatened or endangered, but on March 28, 2008 NMFS initiated a status review to determine if listing under the Endangered Species Act is warranted (73 FR 16617-16619).

Bearded seals are usually associated with ice, although young seals may be found in ice-free areas such as bays and estuaries (ADF&G 1994). Bearded seals undertake seasonal migrations following the sea ice, moving northward through the Bering Strait in spring. They are generally solitary animals and tend to be widely dispersed during late winter when sea ice is widespread. However, during spring migrations they are more concentrated, as well as during late summer when the sea ice has receded to the Arctic Ocean

Female bearded seals give birth in late April or early May after a gestation period of about 11 months. Females become sexually mature at about 5 or 6 years of age, and males at about 6 or 7 years of age. Adult bearded seals may weight over 750 lbs and average about 93 inches in length (ADF&G 1994). Their lifespan can exceed 25 years (NMFS 2009a).

The diet of bearded seals is composed of a wide variety of invertebrates such as crabs, shrimp, clams, snails, and octopus, and some fishes including Arctic cod (ADF&G 1994; NMFS 2009a).

L. Labunski, USFWS

Bearded seal.

e. Ringed Seal

Ringed seals (*Phoca hispida*) are circumpolar in distribution (Angliss and Outlaw 2008). They are found in all seas of the Arctic Ocean including the northern Bering, Chukchi, and Beaufort seas (ADF&G 1994), and as far south as Bristol Bay in years of extensive ice coverage (Angliss and Outlaw 2008). They are found throughout the Beaufort Sea (Map 4.10; Angliss and Outlaw 2008).

All ringed seals in U.S. waters are considered to be from a single Alaska stock (Angliss and Outlaw 2008). Abundance of the Alaska stock is estimated to be about 249,000 animals (NMFS 2009c), however trends for the stock are unknown (Angliss and Outlaw 2008). Ringed seals are protected under the MMPA although they are not listed as depleted (Angliss and Outlaw 2008). They are not listed as threatened or endangered, but on March 28, 2008 NMFS initiated a status review to determine if listing under the Endangered Species Act is warranted (73 FR 16617-16619).

Ringed seals appear to prefer ice-covered waters and remain in contact with ice for most of the year (Angliss and Outlaw 2008), which may provide some protection from predators (NMFS 2009b). They live on and under extensive, largely unbroken, shorefast ice (Frost et al. 2002). They are generally found over water depths of about 10-20 m (Moulton et al. 2002). Density of ringed seals varies greatly depending on area and season and changes in seasonal distribution appear to be correlated with changes in sea ice characteristics but are poorly understood (Frost et al. 2002). They begin appearing along coastal areas as shorefast ice forms in the fall and then disappear in the spring at ice breakup (ADF&G 1994). During breakup, more ringed seals are found near the ice edge; their densities are less in areas of high ice deformation and extensive melt water. There does not appear to be a relationship between time of day and density of hauled out ringed seals. The peak of the spring haulout is in early June (Moulton et al. 2002). When hauled out on the ice, they are solitary, maintaining separation from each other by hundreds of yards (NMFS 2009c).

Behavior of ringed seals is poorly understood because both males and females spend much of their time in lairs built in pressure ridges or under snowdrifts for protection from predators and severe weather (ADF&G 1994). They make and maintain breathing holes in the ice from freeze-up until breakup (Frost et al. 2002). In the spring, as day length and temperature increase, ringed seals haul out in large numbers on the surface of the ice near breathing holes or lairs. This behavior is associated with the annual May-July molt.

Mating occurs in late April and May (Moulton et al. 2002). After a gestation period of about 11 months, ringed seals give birth to pups in March and April in lairs on landfast or drifting pack ice (ADF&G 1994). Females become sexually mature at about 4 years old; males become sexually mature at about 7 years old (NMFS 2009c). The life span of ringed seals is 25 to 35 years (Smith and Walker 1995).

Ringed seals feed on a wide variety of small prey (NMFS 2009c). Important food species for ringed seals are primarily invertebrates such as shrimps and other crustaceans, and fish such as Arctic cod and saffron cod (ADF&G 1994). They may also feed on the same krill that makes up the bowhead whale diet (Smith and Walker 1995). There are differences in the diet content of male and female ringed seals, and Arctic cod becomes more prevalent in the diet of ringed seals as they age (Dehn et al. 2007). Polar bears are the main predator of ringed seals, but other predators include Arctic and red foxes, walruses, wolves, wolverines, and ravens; and they are hunted by Alaska Native subsistence hunters (ADF&G 1994).

f. Spotted Seal

Spotted seals are distributed along the coast of Alaska, along the continental shelf of arctic and sub-arctic waters of the North Pacific Ocean (Angliss and Outlaw 2008; NMFS 2009d). They are found in the Bering, Chukchi, and Beaufort seas (Map 4.10), and in the seas of Japan and Okhotsk (Angliss and Outlaw 2008; NMFS 2009d). The Alaska stock is the only recognized stock in U.S. waters. Abundance of the stock is estimated to be about 59,000 seals (NMFS 2009d), although relatively few are found in the Beaufort Sea (ADF&G 1994). Spotted seals are protected under the MMPA but they are not listed as depleted (Angliss and Outlaw 2008). They are not listed as threatened or endangered. On March 28, 2008 NMFS initiated a status review to determine if listing under the Endangered Species Act was warranted (73 FR 16617-16619); on October 20, 2009, it was announced that listing Alaskan spotted seals under the ESA was not warranted (74 FR 53683-53696).

Spotted seals undertake an annual migration (Angliss and Outlaw 2008). They overwinter in the Bering Sea along the ice edge, making east-west movements along the edge. As spring arrives, they mainly inhabit the southern margin of the ice where they tend to be found on small floes less than 20 m in diameter. After the sea ice retreats, spotted seals move to coastal habitats. In summer and fall, they use coastal haulouts, including areas of the Beaufort Sea. In October, spotted seals move south from the Chukchi Sea, passing through the Bering Strait in November.

Eight breeding areas of spotted seals are known: three in the Bering Sea and five in the Okhotsk Sea and Sea of Japan (Angliss and Outlaw 2008). Spotted seals breed annually from January to mid-April (NMFS 2009d). After a gestation period of about 10 months (NMFS 2009d), females give birth from early April to early May, peaking during the first two weeks of April (ADF&G 1994). Females reach sexual maturity at 3-4 years of age, and males at 4-5 years of age. The average life span of spotted seals is about 25 years and the maximum age is about 35 years.

The diet of spotted seals is highly varied, depends on life stage and location, and consists primarily of schooling fishes (ADF&G 1994). Their prey includes Arctic cod, sand lance, sculpins, flatfishes, octopus, shrimps, Pollock, and capelin. Juveniles feed on krill and small crustaceans.

g. Pacific Walrus

Pacific walrus (*Odobenus rosmarus divergens*) are found primarily west of Barrow in the Bering and Chukchi seas (ADF&G 1994), which is outside the lease sale area. They inhabit pack ice during the winter, and during the summer are found near the coast. Males occupy terrestrial haulouts during the summer (USFWS 2008d). Walrus found in Alaska are considered a single Alaska stock, but their abundance is unknown (Angliss and Outlaw 2008). They are not listed as depleted under the MMPA, and are not listed as threatened or endangered under the Endangered Species Act.

Breeding occurs in the winter from December through March (USFWS 2008d). Females give birth in late April or May after a gestation period of about 15 months (ADF&G 1994). Females reach sexual maturity at about 4-5 years of age, and males at about 5-7 y ears of age (USFWS 2008d). They can live to be 30-35 years old and males may reach sizes of 10 ft in length and 4,000 lbs (Smith and Walker 1995).

Pacific walrus are benthic feeders, foraging in the sediments of the sea floor (USFWS 2008d). Common food species include clams, sea cucumbers, crabs, and segmented worms. Although they rarely consume fish, about 10 percent of walrus stomachs sampled contain seals. Predators of walrus include polar bears and killer whales; and they are hunted by Alaska Native subsistence hunters.

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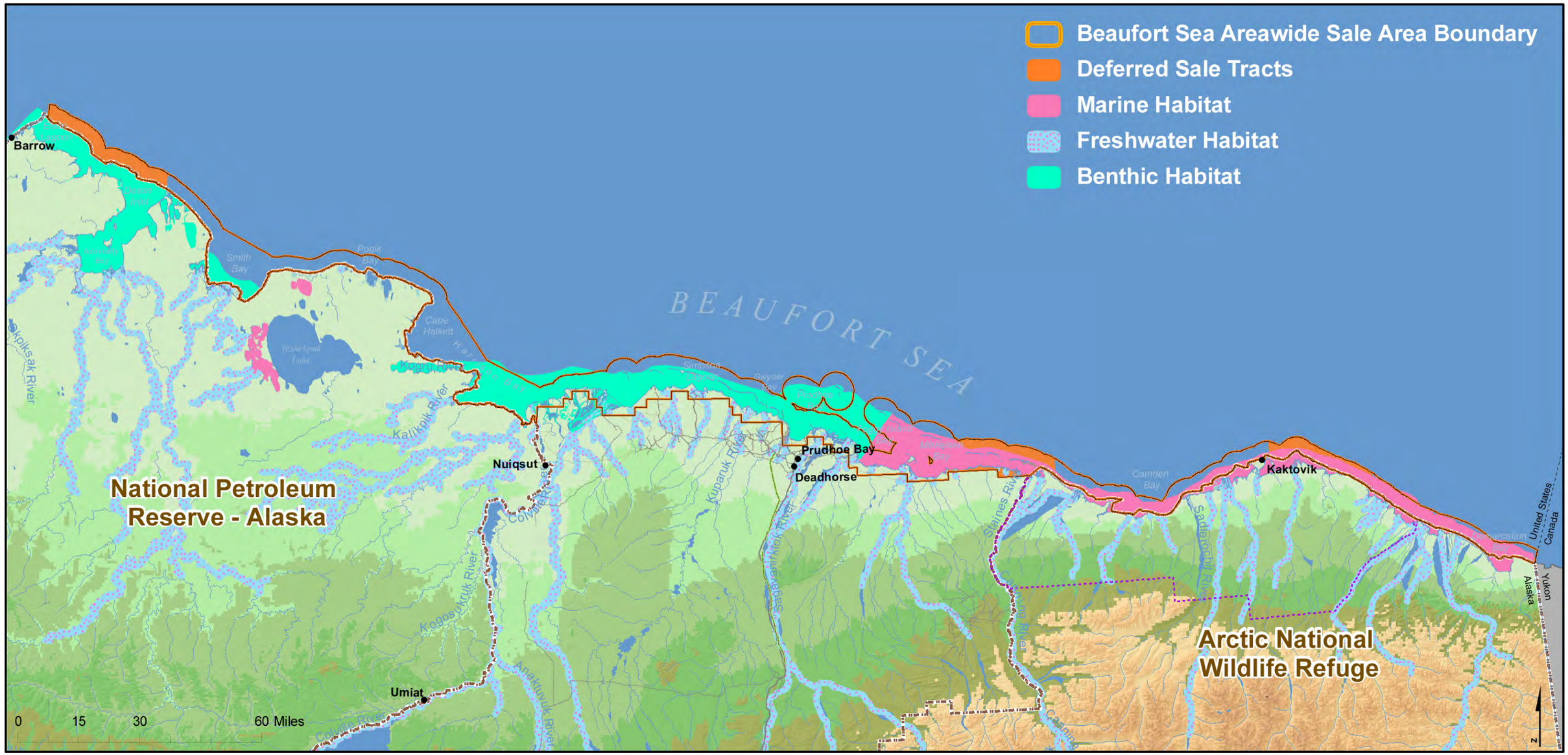
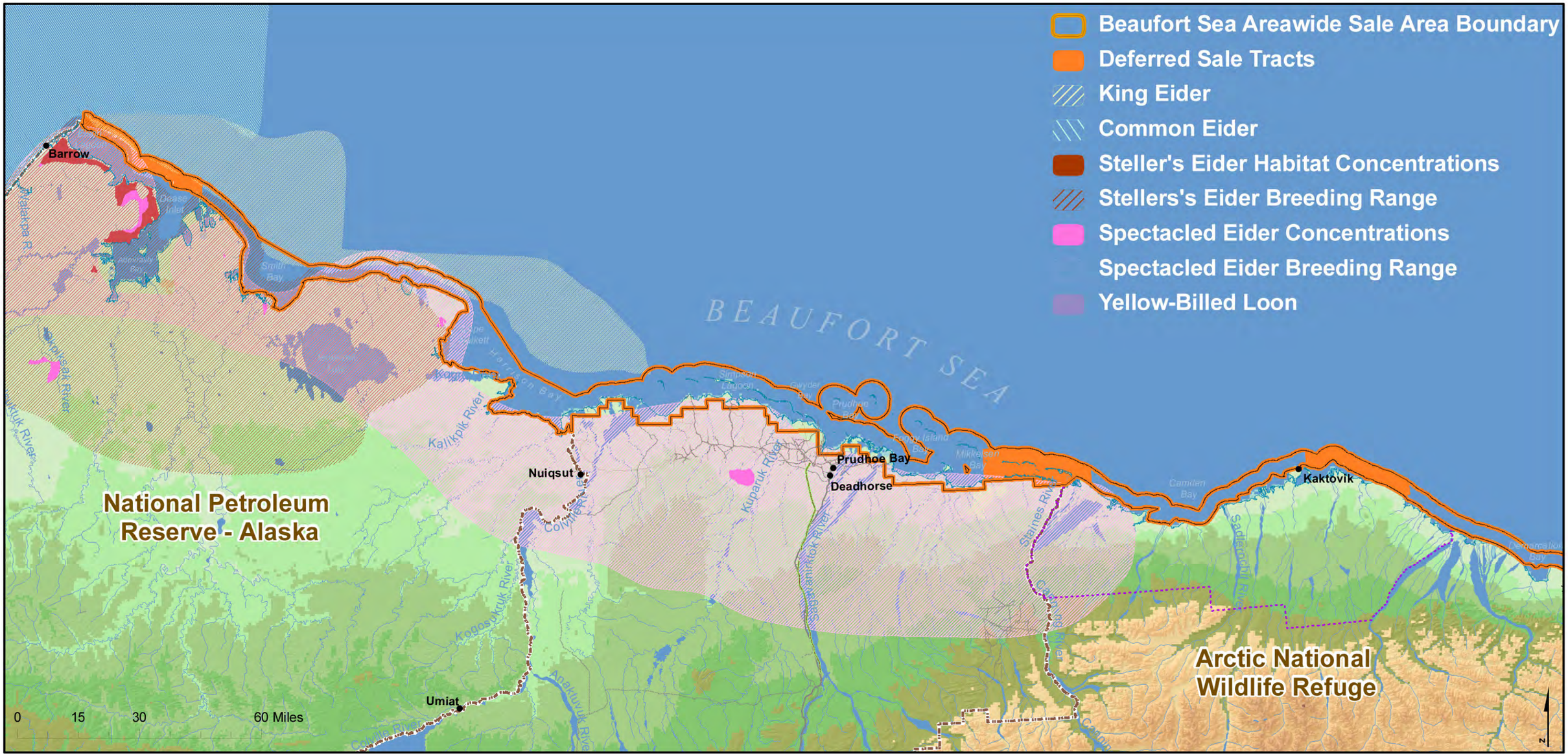
Maps



Notes: Information on this map is depicted only at a township or section level resolution. For detailed information regarding any specific area, interested individuals may consult the land records of one or more of the following agencies: ADNR, BLM, MMS, and NOAA. Discrepancies in boundary alignments are the result of merging multiple data sets from these various sources.

Map 4.1. Important fish habitat in the Beaufort Sea area.



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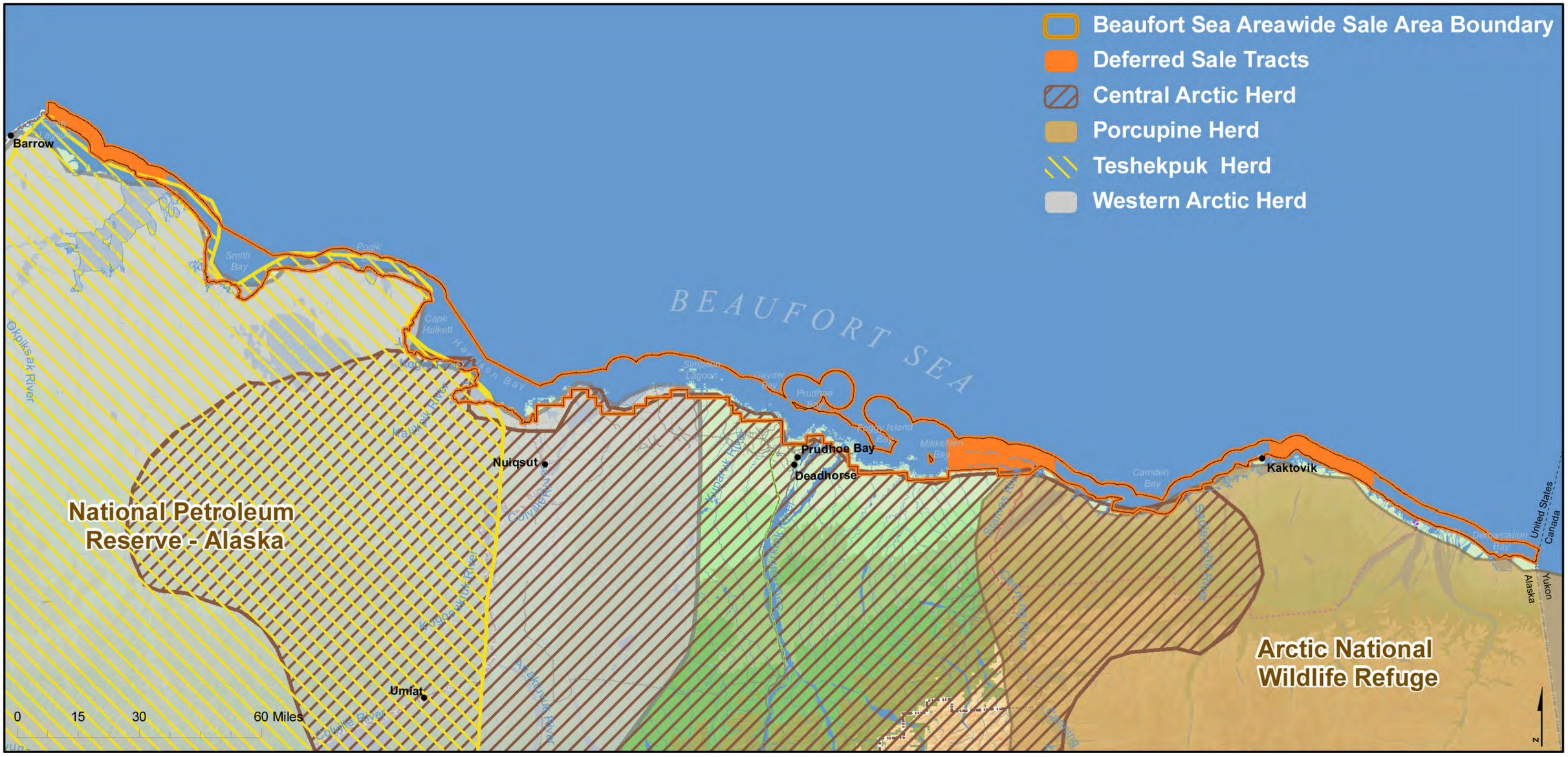
Map 4.2. Important habitat for king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon in the Beaufort Sea area.



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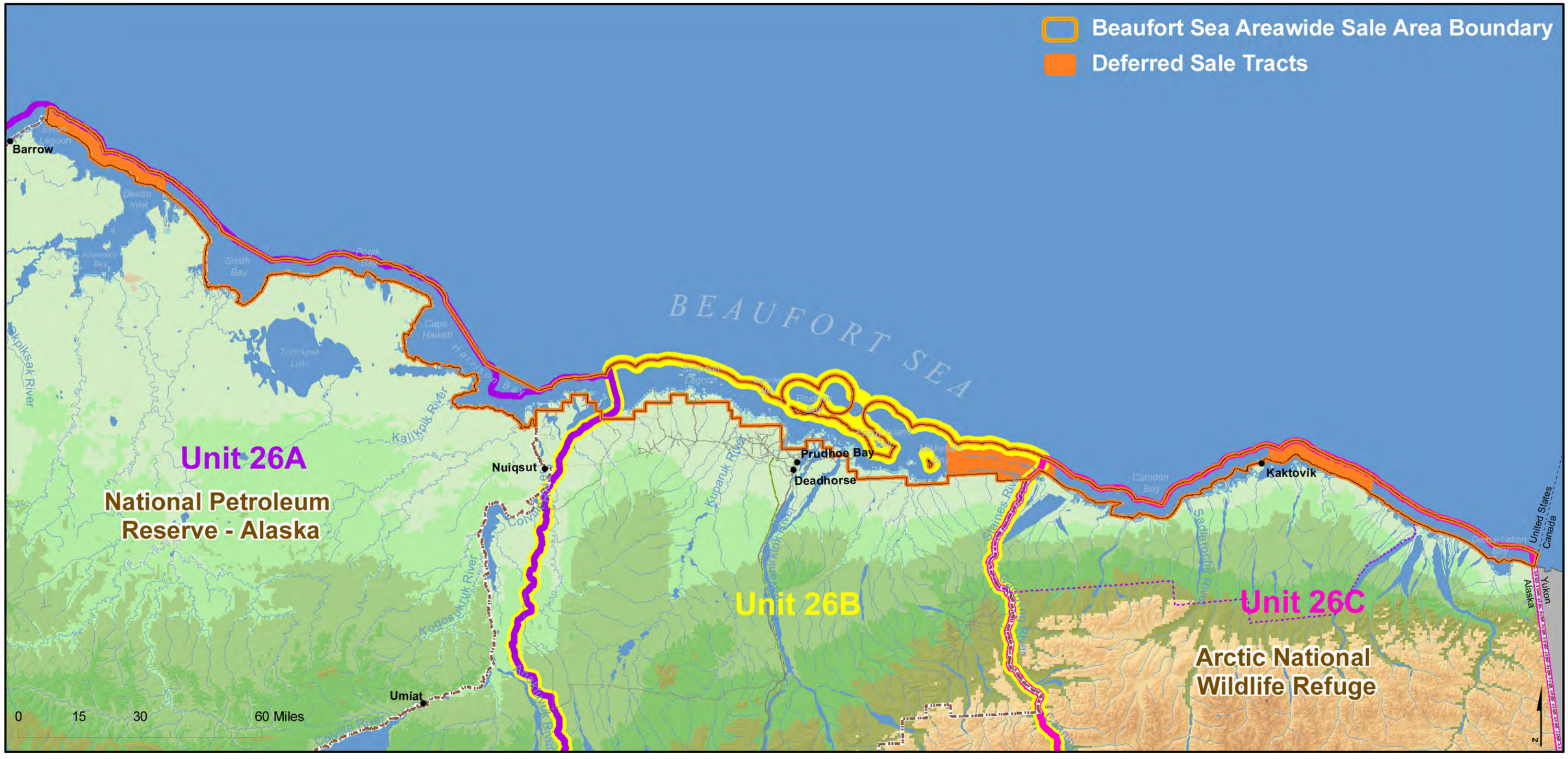
Map 4.3. Locations of the four Alaska caribou herds of the Beaufort Sea area.



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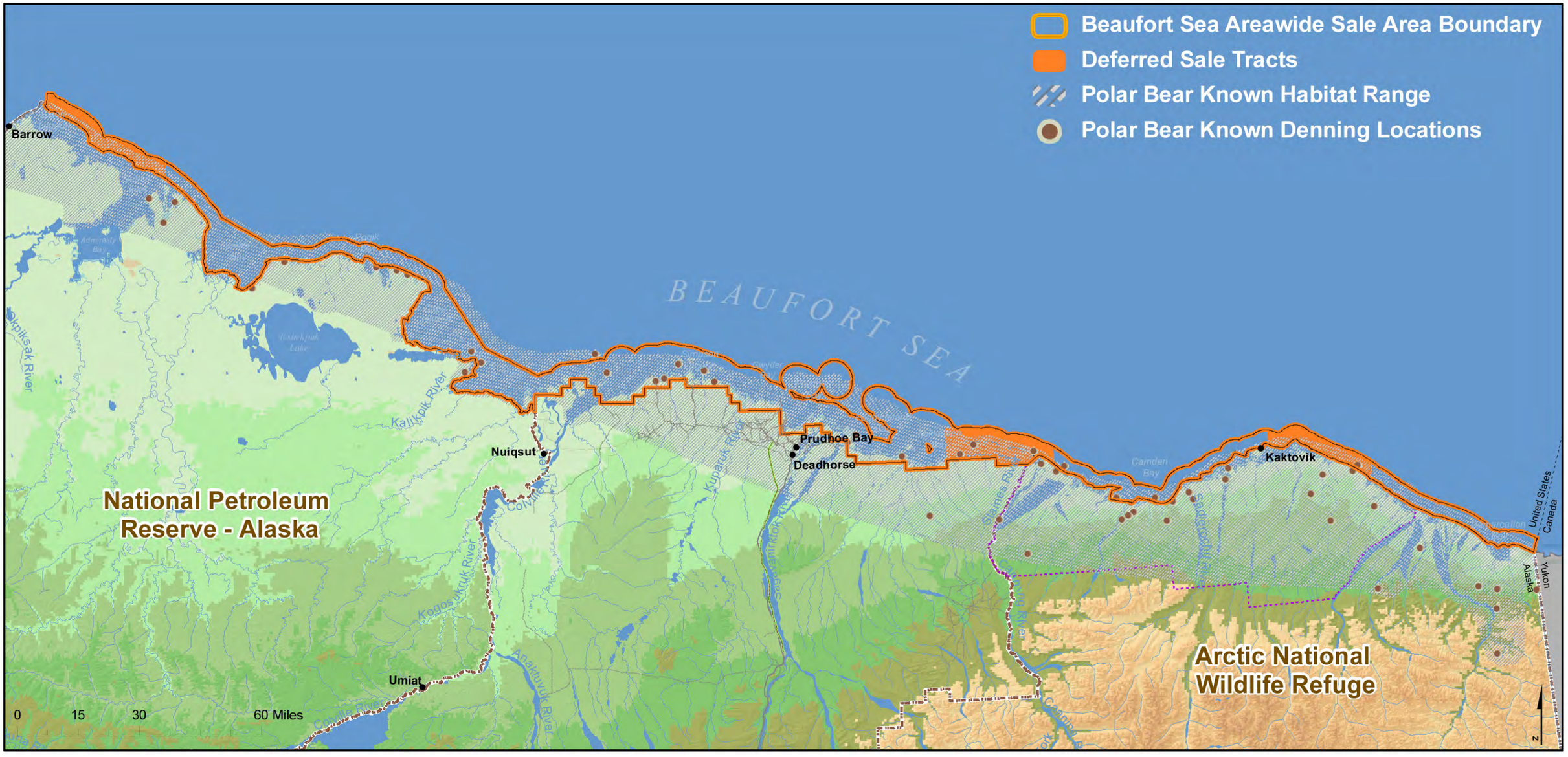
Map 4.4. Locations of ADF&G Game Management Units 26A, 26B, and 26AC



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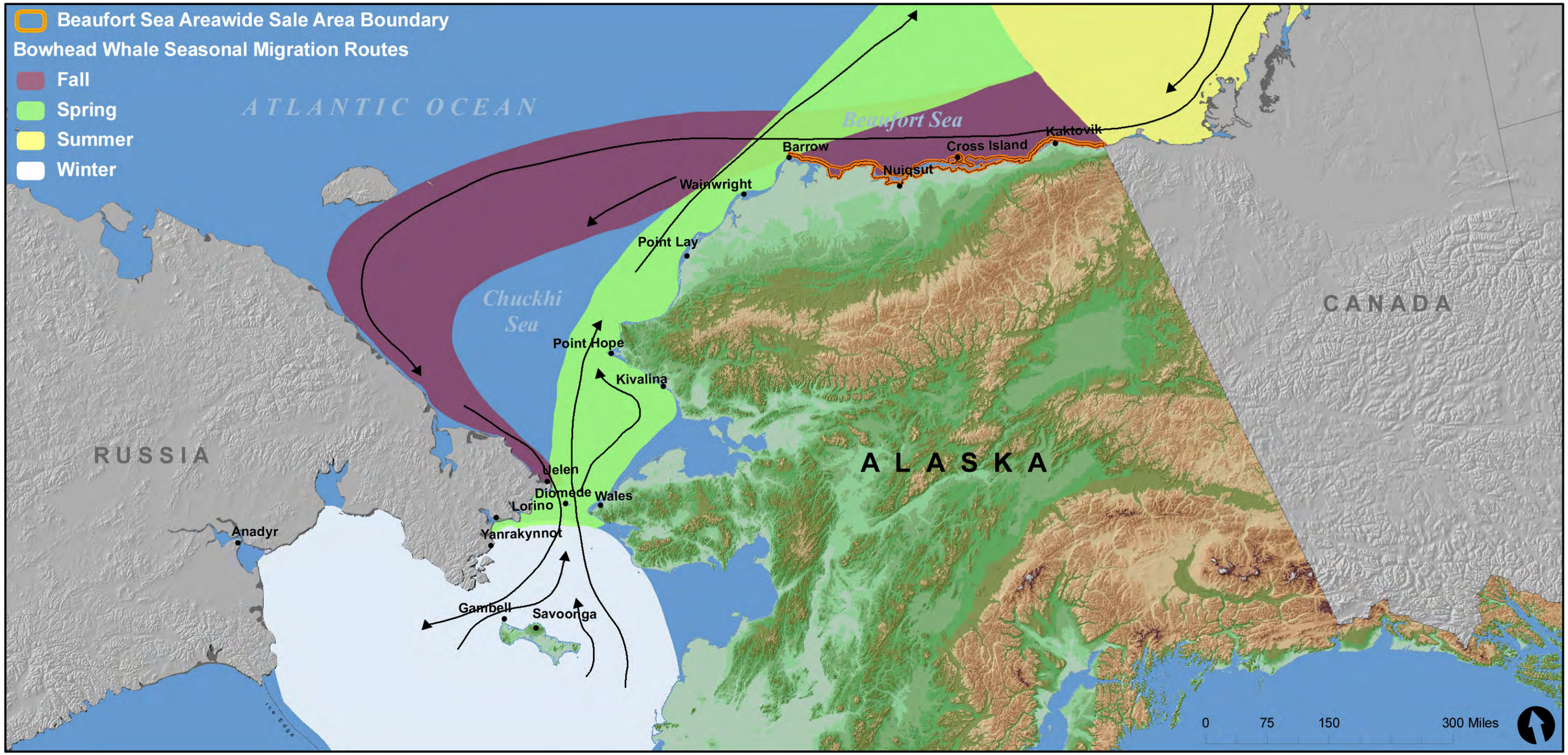
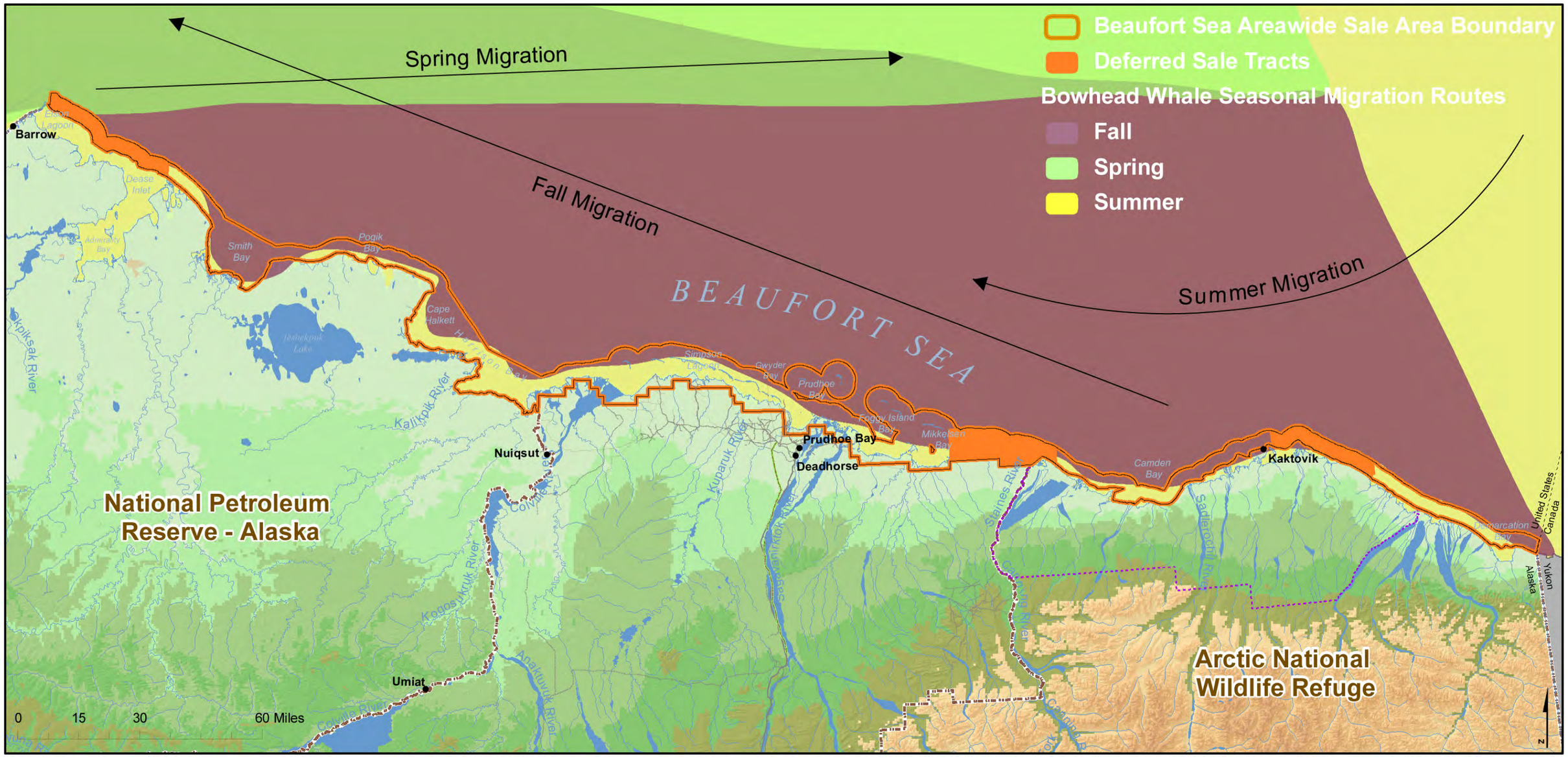
Map 4.5. Important polar bear habitat in the Beaufort Sea area.



Source: EDAW/AECOM 2007.

Notes: Information on this map is depicted only at a township or section level resolution. For detailed information regarding any specific area, interested individuals may consult the land records of one or more of the following agencies: ADNR, BLM, MMS, and NOAA. Discrepancies in boundary alignments are the result of merging multiple data sets from these various sources.

Map 4.6. Migration route of bowhead whales in the Arctic.



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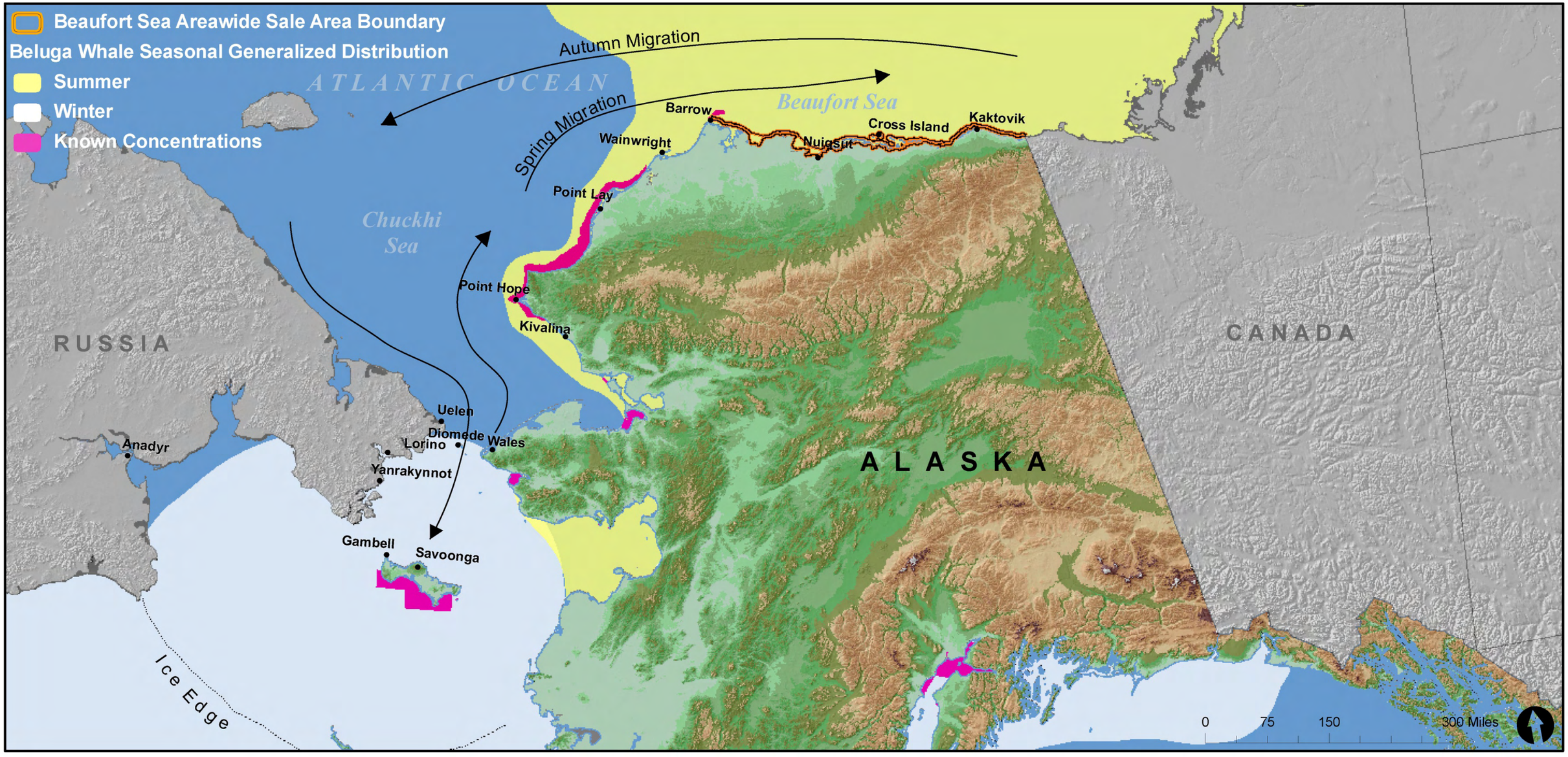
Map 4.7. Migration route of bowhead whales in the Beaufort Sea.



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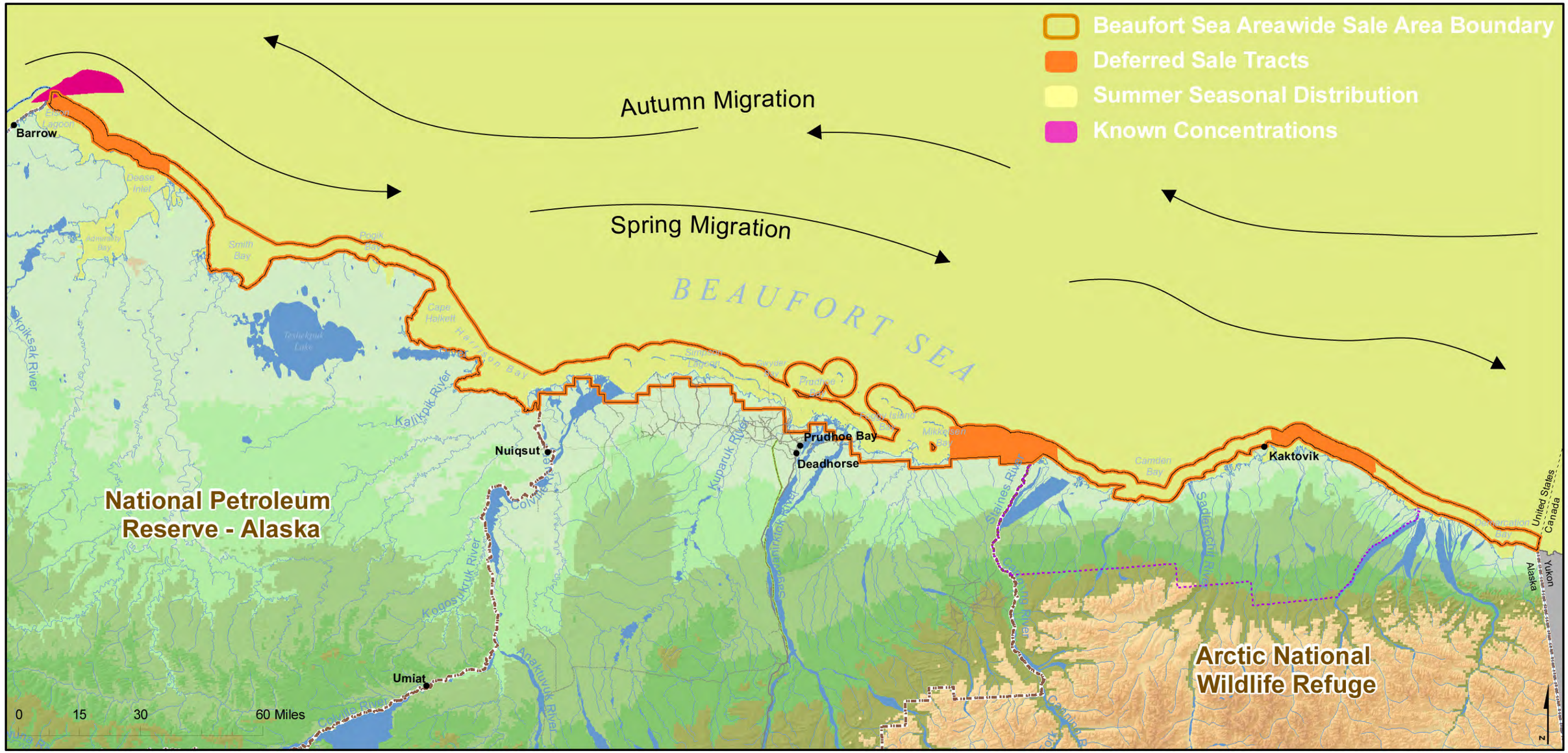
Map 4.8. Seasonal distribution of beluga whales in Alaska.



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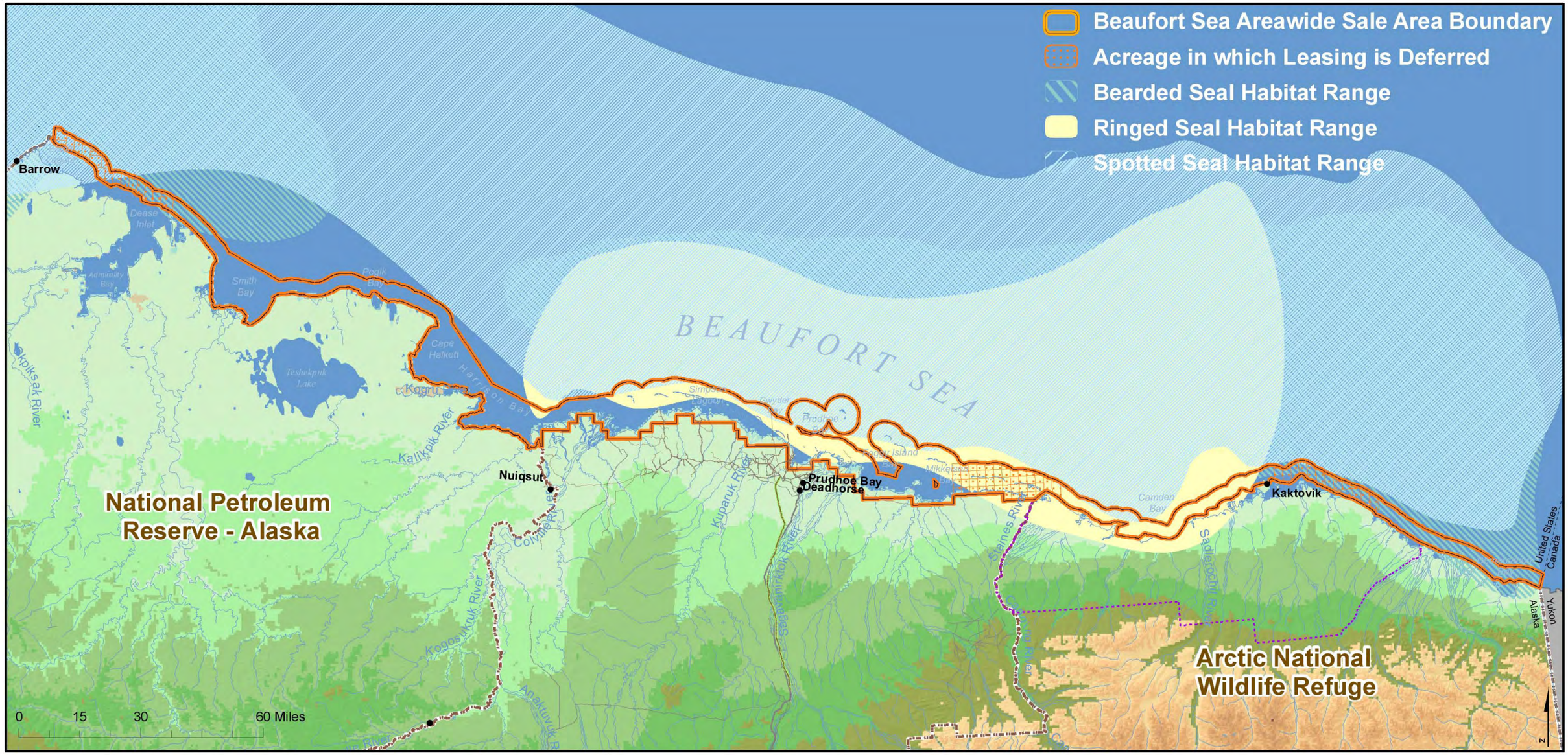
Map 4.9. Seasonal distribution of beluga whales in the Beaufort Sea area.



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Map 4.10. Distribution of bearded, ringed, and spotted seals in the Beaufort Sea.