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 Cook Inlet area includes a wide variety of habitats and a broad diversity of fish and wildlife species that support a host of economic, recreational, and subsistence activities for residents and visitors to the area. 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 recent population growth (ADF&G 2008a).

A. Major Habitats of the Cook Inlet Area

1. Terrestrial Habitats

Terrestrial vegetation in the Cook Inlet area is composed of several overlapping systems that provide important habitat for fish, wildlife, and humans. These habitats vary greatly depending on local conditions. The Cook Inlet lease sale area falls primarily within the marine west coast forests ecoregion (EPA level 1, ecoregion 7; EPA 2008). Habitats of this area range from forests to alpine tundra with vegetation including trees, shrubs, herbs, lichens, and mosses (EPA 2008).

a. Forest

Forests occurring in the Cook Inlet area are considered transition forests between the coastal temperate rain forests of Southeast Alaska, Kodiak, and Prince William Sound, and the boreal forests of interior Alaska (ADF&G 2006). The forests of the Cook Inlet area are divided into several forest habitat types, including coastal western hemlock-Sitka spruce forest, bottomland spruce-poplar forest, upland spruce-hardwood forest, and lowland spruce-hardwood forest (UAA-ISER 2008).

E. Schneider, Alaska Div. of Tourism

Forest habitat on the Kenai Peninsula.

Coastal western hemlock-Sitka spruce forests are composed of Sitka spruce, western hemlock, and mountain hemlock. Other tree species include cedar, poplar, and cottonwood (UAA-ISER 2008). Shrubs of this area include species such as alder, devil's club, salmonberry, willow, and blueberry.

Bottomland spruce-poplar forests are dense forests found at elevations lower than 1,000 ft, such as level floodplains, low river terraces, and some south-facing slopes (UAA-ISER 2008). These forests are composed primarily of white spruce, although poplar, cottonwood, Alaska paper birch, quaking aspen, and black spruce are also found in these forests. Some shrub species include alder, willow, raspberry, blueberry, and high bush cranberry, and plants such as fireweed, horsetail, and ferns are found there as well.

Dense upland spruce-hardwood forests are generally found at lower to mid-elevations on deeply thawed, south-facing slopes that are well drained (UAA-ISER 2008). These forests include a mixture of species such as white spruce, Alaska paper birch, quaking aspen, black cottonwood, and balsam poplar. Black spruce tends to be found in poorly drained areas; stands of white spruce, or stands of black cottonwood and balsam poplar, may be found along streams; and stands of all these species combined are found along well-drained, south-facing slopes. Shrubs characteristic of this forest type include willow, alder, rose, high bush cranberry, and currant.

Lowland spruce-hardwood forests range from dense to open, and include both evergreen and deciduous trees (UAA-ISER 2008). This type of forest is usually found on shallow peat, glacial deposits, outwash plains, and north-facing slopes. Tree species include black and white spruce, Alaska paper birch, quaking aspen, balsam poplar, and black cottonwood; shrubs include willow, dwarf arctic birch, lingonberry, blueberry, and crowberry.

b. High Brush

High brush habitats are found throughout the Cook Inlet area, including along streams, above timberline, in avalanche paths, on floodplains, in old forest burns, between beaches and forests, and between treeline and alpine tundra (UAA-ISER 2008). Trees such as quaking aspen, Alaska paper birch, and white spruce may be scattered thinly throughout the habitat. Shrubs composing this habitat include alder, devil's club, willow, currant, blueberry, raspberry, lingonberry, salmonberry, and dogwood. Other plant species include grasses, lupine, horsetail, fireweed, and several species of fern. Three subsystems of high brush habitats have been identified: coastal alder thickets, floodplain thickets, and birch-alder-willow thickets.

c. Tundra

Three types of tundra are found in Southcentral Alaska: moist tundra, wet tundra, and alpine tundra (UAA-ISER 2008). Moist and wet tundras are found mostly along the Denali Highway (outside the lease sale area) and along the eastern foothills of the Talkeenta Mountains (on the edge of the lease sale area). Alpine tundra usually occurs above forests and brush habitats at elevations above 2,500 ft. Shrubs of this habitat include resin and dwarf arctic birch, arctic willow, crowberry, labrador tea, mountain heather, rhododendron, and dwarf and alpine blueberry. Other grass and herb species include mountain avens, moss campion, arctic sandwort, alpine azalea, sedges, and lichens.

d. 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 (ADF&G 2006). Grass wetlands are found throughout the Cook Inlet area. Over 50 percent of the plant species are water-tolerant grasses (ADF&G 2006). 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 many areas of Southcentral, such as very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, and sloughs, and in depressions of upland areas (ADF&G 2006). 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).

Karen Laubenstein, USFWS

Potter Marsh near Anchorage.

Other similar habitats include low brush bogs and muskeg, habitats characteristic of wet, flat basins with ponds and standing water where trees cannot grow (UAA-ISER 2008). Dwarf shrubs are prolific, growing over a mat of sedges, mosses, and lichens. The coastal muskeg form of this habitat, which tends to be drier, includes western hemlock and Alaska cedar, while the interior bog form does not usually include trees because of the wetter conditions. Other tree species include black

spruce, and shrubs include Labrador tea, bog cranberry, willow, crowberry, blueberry, dwarf arctic birch, and bog rosemary. Cottongrass, sedges, rushes, lichens, and mosses are also found in this habitat.

M. LaCroix, ADF&G

Wetlands of O'Brien Creek, Matanuska-Susitna Valley.

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 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.

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

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

2. Freshwater Habitats

The streams, rivers, and lakes of Southcentral Alaska provide a wide variety of freshwater habitats for fish and wildlife of the area. They serve as migratory corridors, provide habitat for spawning, rearing and overwintering, vegetative cover, are a significant source of detritus, and are frequently migrations corridors for wildlife (ADF&G 2006). Freshwater habitats range from small, intermittent streams to large rivers, and from ponds to large lakes. Water sources for these habitats include glacial melt, snowmelt, precipitation, and groundwater such as springs and upwelling areas. Lake and pond habitats are influenced by substrate, bathymetry, and shoreline contour (ADF&G 2006).

The type of habitat provided by streams and rivers is defined by the substrate, which includes large boulders, cobble, gravel, glacial silt, clay, and mud. Stream and river morphology also contributes to defining the habitat, including such characteristics as straight, meandering, or braided; and morphologic complexity is an important contributor to habitat quantity and quality (ADF&G 2006). Large woody debris in rivers and streams is important for stabilizing banks and substrates, provides cover, creates pool habitats, and increases stream productivity (ADF&G 2006).

Many of the freshwaters of Southcentral Alaska provide important spawning, rearing, or migration habitats for anadromous fishes such as salmon, trout, and char. Waters that have been identified as important for anadromous species (Table 4.1) receive special protection under AS 16.05.871. The Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes, the official listing of these waters, is updated annually (Johnson and Daigneault 2008).

3. Marine Habitats

Marine waters of Cook Inlet provide a wide variety of habitats for fish, wildlife and other aquatic organisms. Habitat types include rocky intertidal areas, mudflats and beaches, eelgrass beds, and nearshore, and benthic environments (ADF&G 2006).

E. Schneider, Alaska Div. of Tourism

Turnagain Arm.

Rocky intertidal areas are exposed to moderate to strong wave actions, and provide a rocky substrate for communities of invertebrates algae, rockweed, mussels, and barnacles. Cracks, crevices, overhangs, and rock bottoms provide microhabitats. Macroalgal species are prolific, especially during the spring and summer (ADF&G 2006). Mudflats and beaches are characterized by five habitat types: fine-grained sand, coarse-grained sand, mixed sand and gravel, exposed tidal flats, and sheltered tidal flats (ADF&G 2006). Each type supports specific communities of marine plants, fish, birds, and other animals. Eelgrass beds are found in low intertidal and shallow subtidal sandy mudflats. They provide substrate and cover for a wide diversity of marine life. Eelgrass beds are affected by season, with the blades dying off in the fall. The roots and rhizomes, which are dormant during the winter, stabilize the soft substrate, and provide a buffer from tides and storms (ADF&G 2006).

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." 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 2008c; NMFS 2008d).

Table 4.1. Catalogued anadromous streams within the Cook Inlet Areawide lease sale area.

Stream Number	Name	Stream Number	Name
241-14-10660	Fox Creek (upper and Caribou Lake)	247-41-10200	Susitna River
244-10-10010	Anchor River (and tributaries)	247-41-10200-2015	Alexander Creek
244-10-10050	Stariski Creek	247-41-10200-2020	Fish Creek
244-20-10090	Ninilchik River	247-41-10200-2030	unnamed
244-20-10100	Deep Creek (and tributaries)	247-41-10200-2043	Anderson Creek
244-30-10010	Kenai River (and lower tributaries)	247-41-10200-2050	unnamed
244-30-10010-2025	Beaver Creek	247-41-10200-2053	Yentna River
244-30-10010-2030	Slikok Creek	247-41-10200-2060	unnamed
244-30-10010-2039	Soldotna Creek	247-41-10200-2081	Deshka River/Kroto Creek
244-30-10010-2050	Funny River	247-41-10200-2120	Willow Creek
244-30-10010-2063	Moose River	247-41-10200-2130	Little Willow Creek
244-30-10010-2076	Killey River	247-41-10200-2180	Kashwitna River
244-30-10010-2082	Upper Killey River	247-41-10200-2190	Caswell Creek
244-30-10050	Kasilof River (and tributaries)	247-41-10200-2200	Sheep Creek
245-20-10170	Johnson River	247-41-10200-2230	Goose Creek
245-30-10010	Crescent River	247-41-10200-2250	Montana Creek
245-40-10010	Harriet Creek	247-41-10210	unnamed
245-40-10020	Redoubt Creek	247-50-10046	Fish Creek
245-40-10030	unnamed	247-50-10050	Chester Creek
245-40-10040	unnamed	247-50-10060	Ship Creek
245-40-10050	Polly Creek	247-50-10090	Sixmile Creek
245-40-10050-2002	Little Polly Creek	247-50-10095	unnamed
245-40-10065	unnamed	247-50-10110	Eagle River
245-50-10010	Kustatan River	247-50-10150	Fire Creek
245-50-10020	Bachatna Creek/Johnson Slough	247-50-10160	Peters Creek
245-50-10040	unnamed	247-50-10175	Eklutna River
245-50-10050	Big River (and tributaries)	247-50-10180	unnamed
245-50-10060	Seal River	247-50-10200	Knik River
245-50-10070	Montana Bill Creek	247-50-10220	Matanuska River (and tributaries)
245-50-10085	Drift River	247-50-10260	Rabbit Slough (and tributaries)
245-50-10090	Cannery Creek/Rust Slough	247-50-10270	Wasilla Creek
245-50-10110	Little Jack Slough	247-50-10300	Cottonwood Creek
245-50-10120	unnamed	247-50-10305	Crocker Creek
245-50-10140	unnamed	247-50-10320	O'Brien Creek
246-10-10010	unnamed (Kalgin Is.)	247-50-10330	Fish Creek
246-10-10020	Packers Creek (Kalgin Is.)	247-50-10360	Goose Creek
246-10-10030	unnamed (Kalgin Is.)	247-50-10500	Mule Creek
247-10-10070	Middle River (and tributaries)	247-60-10090	Bedlam Creek
247-10-10080	McArthur River (and tributaries)	247-60-10100	Pincher Creek
247-10-10200	Nikolai Creek	247-60-10110	Chickaloon River
247-20-10002	Three-mile Creek (and tributaries)	247-60-10120	Big Indian Creek
247-20-10008	unnamed	247-60-10130	Little Indian Creek
247-20-10010	Chuitna River (and tributaries)	247-60-10310	Potter Creek
247-20-10020	Indian Creek	247-60-10316	unnamed
247-20-10030	unnamed	247-60-10318	Little Rabbit Creek
247-20-10040	Tyonek Creek	247-60-10320	Rabbit Creek
247-20-10050	Old Tyonek Creek (and tributaries)	247-60-10320-2012	Little Survival Creek
247-30-10010	Ivan River	247-60-10340	Campbell Creek

-Continued-

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247-30-10070	Lewis River	247-80-10005	Miller Creek
247-30-10080	Theodore River	247-80-10010	Seven Egg Creek
247-30-10090	Beluga River	247-80-10015	Otter Creek
247-30-10120	unnamed	247-80-10018	unnamed
247-41-10080	unnamed	247-90-10020	Swanson River
247-41-10100	Little Susitna River	247-90-10030	Bishop Creek (and tributaries)
247-41-10180	unnamed		

Source: Johnson and Daigneault 2008.

Nearshore and benthic marine habitats are highly affected by the seasons, including extreme variations in light and ice cover, as well as temperature. Phytoplankton, with tens of thousands of species, is the main factor in productivity in these habitats, and because of seasonal light conditions, ideal growing conditions for any given species may be only a few weeks (ADF&G 2006). Upwelling and wind mixing of nutrients may also be an important factor in the abundance and distribution of phytoplankton. Nearshore habitats tend to have variable salinity, temperature, suspended sediment concentrations, and ice scouring, as well as high wave energy (ADF&G 2006). Seasonal cycles of mixing and turnover are affected by winds, freshwater input, ice currents, and tides. Factors such as salinity and turbidity are also important. Benthic, or seafloor, habitats can be soft-bottom, composed of mud, sand, shell, or gravel, or they can be rocky; the composition determines the type of community that develops there (ADF&G 2006).

J. Palardy, Kachemak Bay Research Reserve

Bull kelp, Kachemak Bay.

Kelp forests in nearshore habitats are important for providing structure, living substrate, cover, microhabitats, and primary production (ADF&G 2006). Bull kelp is the predominant kelp species in the Cook Inlet area, and is also one of the largest fastest-growing marine algae, attaining lengths of 40 m during the growing season (Schoch 2001). Kelp beds are characterized by tight trophic relationships, including rockfish, sea urchins, octopuses, sea otters, diving seabirds, herbivorous snails, diatoms, and understory algae. A complex array of physical, chemical, and biological factors affect dynamics of kelp beds and their annual fluctuations. These include water motion, temperature, salinity, nutrients, light intensity, available habitat, and invertebrate predation (Schoch 2001). In Kachemak Bay, located outside the Cook Inlet lease sale area, a total of 30.6 km^2 of kelp canopy was measured; an additional 17 km^2 were measured from Anchor Point to point Pogibshi (Schoch 2001).

4. Designated Habitat Areas

The area encompassed by the Cook Inlet lease sale includes many areas established by state or federal law to protect and preserve natural habitat and wildlife populations and to maintain public use of these resources (Figure 4.1). The lease sale area includes all or portions of several legislatively designated special areas, and is adjacent to or near others. About 1 million acres are included in these legislatively designated areas, many of which have legislatively defined restrictions. Additional restrictions to oil and gas exploration, development, and production activities in designated habitat areas are included in mitigation measures in Chapter 9.

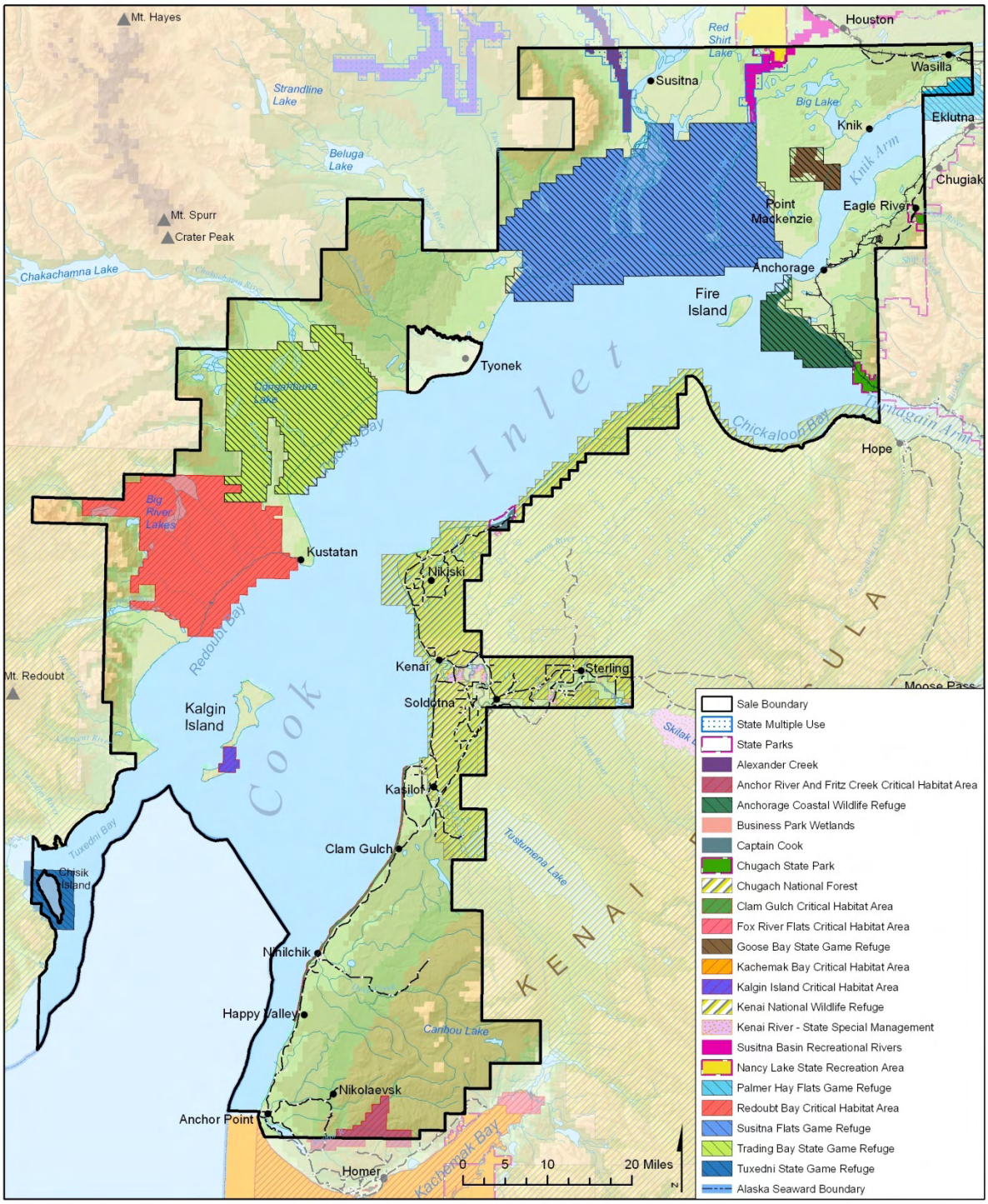

Figure 4.1. Legislatively designated areas in or near the Cook Inlet lease sale area.

a. State-Designated Areas

i. Susitna Basin Recreational Rivers

The Recreation Rivers Act of 1988 established mile-wide river corridors along the Little Susitna, Deshka, Talkeetna, and Talchulitna rivers and Lake, Moose, Kroto, and Alexander creeks, totaling about 243,000 acres of state-owned land along 460 river miles (ADNR 1991). The Act specifies that these rivers remain in public ownership, identifies purposes and management intent of the designation, and provides a management plan and advisory board that guide access, commercial uses, and development within the recreational rivers area.

One of the main purposes of the plan is "to manage, protect, and maintain fish and wildlife populations and habitat on a sustained yield basis. Areas that are important for fish and wildlife are identified and specific guidelines are designed to protect these important areas. The plan sets guidelines for reducing bear conflicts, protecting eagle and swan nesting sites, and enhancing habitat" (ADNR 1991). The plan includes riparian management areas, including guidelines to mitigate potential negative effects from overuse and development. To limit degradation of the water, recreational experience, and fish and wildlife habitats, the plan also includes guidelines for shoreline development, such as erosion control, diversion channels, docks, bridges, culverts, river crossings; and guidelines for upland development such as powerlines, pipelines, and airstrips. Motorized boat access is limited on some portions of some rivers to provide for a range of recreational experiences, especially during the summer fishing season.

ii. Nancy Lake State Recreation Area

Nancy Lake State Recreation Area was established in 1966 and includes 22,600 acres of prime recreational habitat. This recreation area is dotted with lakes and supports fishing, wildlife viewing, canoeing, and camping in summer, and skiing and snow machining in winter. There are some private land inholdings, and cabins on several lakes. Some residents live year-round on Nancy Lake. The northern boundary of the lease sale area overlaps the southern tip (1,720 acres) of the recreation area at Skeetna Lake.

iii. Susitna Flats State Game Refuge

The Susitna Flats State Game Refuge was created in 1976 to "ensure the protection of fish and wildlife populations, particularly waterfowl nesting, feeding, and migration; moose calving areas; spring and fall bear feeding areas; and salmon spawning and rearing habitats. It was also established for public use of fish and wildlife and their habitat, particularly waterfowl, moose, and bear hunting; viewing; photography; and general public recreation in a high quality environment" (ADF&G 1988). The refuge covers about 300,800 acres.

D. Rosenberg, ADF&G

Susitna Flats State Game Refuge.

The refuge is particularly important for waterfowl nesting, feeding and migration. Large numbers of mallards, pintails, Canada geese, and Tule geese are found on the refuge by mid-April, and in May, as many as 100,000 waterfowl are present feeding, resting, conducting courtship, and preparing for nesting (ADF&G 2008f). The refuge also supports several thousand sandhill cranes and more than 8,000 swans. An abundance of shorebirds uses the refuge, including northern phalaropes, dowitchers, godwits, whimbrels, snipe, yellowlegs, sandpipers, plovers, and dunlin. About 10,000 mallards, pintails, and green-winged teal ducks, as well as Tule geese, nest in the ponds and meadows. In the

fall, the refuge's sedge meadows, marshes, and intertidal mud flats are used heavily by migrating waterfowl and shorebirds for resting and feeding (ADF&G 2008f).

The refuge also provides habitat for calving moose, feeding bears, and spawning salmon. In the spring, the area is used by moose for calving; in the winter, moose move into the refuge to find food and respite from deep snow at higher elevations. Brown and black bears, beaver, mink, otter, muskrat, coyote, and wolf are also found on the refuge. Beluga whales congregate near the mouth of the Susitna River to calve, breed, and feed on hooligan in late May and June (ADF&G 2008f).

iv. Palmer Hay Flats State Game Refuge

Located at the head of Knik Arm in the Matanuska-Susitna Valley and just 30 miles north of Anchorage, the Palmer Hay Flats State Game Refuge was established by the legislature in 1975 and expanded in 1985 for the purpose of protecting and preserving the natural habitat and game populations (ADF&G 2002a). About 17 percent of the refuge's 28,000 acres are included in the lease sale area north of Palmer Slough. Habitat of this refuge includes marsh and bog communities, forests, lakes, wetlands, and tidal sloughs and flats (ADF&G 2008f). The refuge is an important resting area for tens of thousands of migrating ducks in the spring in late April through May, and in the fall. Species include dabbling ducks such as pintails, mallards, green-winged teal, and diving ducks such as canvasback, lesser scaup, and common goldeneye. Some ducks remain to nest during the summer. Other species that use the refuge include lesser Canada geese, greater white-fronted geese, snow geese, trumpeter and tundra swans, and sandhill cranes (ADF&G 2008f).

The refuge provides important habitat for moose calving and wintering. Muskrats are also abundant because of the feeding and denning habitat supplied by plentiful sloughs and marshes (ADF&G 2008f). Sockeye, Chinook, coho and pink salmon spawn and rear in the creeks and rivers of the refuge, along with rainbow trout, Dolly Varden and whitefish (ADF&G 2002a).

v. Goose Bay State Game Refuge

In 1975, the legislature established this game refuge which encompasses 11,000 acres of tidelands and salt marsh habitat important to waterfowl and fish. Located across from Eagle River Flats on Knik Arm, the refuge is surrounded by residential development. From mid-April to mid-May, this refuge is an important resting and feeding area for migrating waterfowl. Over 20,000 geese, including Canada, snow, and white-fronted geese, rest and feed here during their northward migration (ADF&G 2008f). Other species such as trumpeter and tundra swans, mallards, green-winged teal, pintails, northern shovelers, snipe, yellowlegs, and sandhill cranes also use the area. Canada geese stop to rest in the refuge's wetlands in the fall during their return migration. The refuge provides important habitat for moose calving. Beavers, muskrat, mink, black and brown bears, coyote, red fox, and lynx are found in the refuge also (ADF&G 2008f). Coho salmon, rainbow trout, long-nosed sucker, and stickleback inhabit Goose Creek.

vi. Anchorage Coastal Wildlife Refuge

The Anchorage Coastal Wildlife Refuge, established in 1988, encompasses over 32,400 acres along Turnagain Arm from Potter Creek to Point Woronzof. The purpose of the refuge is "to protect waterfowl, shorebirds, salmon, and other fish and wildlife species and their habitat, and for the use and enjoyment of the people of the state" (ADF&G 1991).

Habitat of the refuge consists of extensive tidal flats, marshes, and alder-bog forests (ADF&G 2008f). Ducks, geese, and shorebirds are the most visible species on the refuge. Species include lesser Canada geese, mallards, northern pintails, northern shovelers, American wigeons, canvasbacks, red-necked grebes, horned grebes, yellowlegs, northern phalaropes, Arctic terns, mew gulls, trumpeter and tundra swans, snow geese, short-eared owls, Pacific loons, northern harriers, and bald eagles. Several species of anadromous and freshwater fish are found in the refuge (ADF&G

2008f). Moose are encountered frequently, and lynx, river otter, red fox, and black and brown bears infrequently. Other mammals inhabiting the area include least weasels, mink, snowshoe hare, red squirrels, voles, and shrews.

vii. Trading Bay State Game Refuge

The Trading Bay State Game Refuge, encompassing 160,960 acres, is located along the northwest shore of Cook Inlet. It was created in 1976 "to protect fish and wildlife populations; waterfowl nesting, feeding, and migration; moose calving areas; spring and fall bear feeding areas; salmon spawning and rearing habitats; public use of fish and wildlife (waterfowl, moose, and bear hunting); viewing; photography; and general recreation in a high quality environment" (ADF&G 1994b).

The refuge's low-relief coastal wetlands and tide flats provide habitat for many migrating bird species, including lesser, cackling, and Taverner's Canada geese, lesser snow geese, Pacific white-fronted geese, Tule white-fronted geese, trumpeter and tundra swans, and Pacific brant (ADF&G 2008f). High concentrations of trumpeter swans nest along the Kustatan River. Other nesting birds include ducks such as mallard, pintail, green-winged teal, wigeon, shoveler, common eider, mergansers, scoters, scaup, and goldeneye; and loons, shorebirds, Tule geese and bald eagles also nest on the refuge (ADF&G 2008f). The refuge is also used in the fall by waterfowl as they prepare to migrate southward.

The refuge provides important habitat for moose calving, as well as wintering habitat. Brown and black bears, coyote, mink, land otter, weasels, and wolves also inhabit the refuge. Coho, Chinook, sockeye, rainbow trout, Dolly Varden and smelt are found in the rivers and creeks of the refuge (ADF&G 2008f).

viii. Redoubt Bay Critical Habitat Area

The Redoubt Bay Critical Habitat Area was created in 1989. It lies on the west side of Cook Inlet immediately to the south of the Trading Bay State Game Refuge and covers 171,500 acres. The purpose of the designation is "to ensure the protection and enhancement of fish and wildlife habitat and populations, especially Tule geese; the continuation of fish and wildlife harvest; and public use and enjoyment of the area in a high quality environment (ADF&G 1994b).

D. Rosenberg, ADF&G

Redoubt Bay Critical Habitat Area.

The Redoubt Bay area provides critical habitat for hundreds of thousands of migrating waterfowl in the spring and fall, supporting the world's largest concentration of Tule white-fronted geese (ADF&G 2008f). Other birds that use the area during migrations include cackling Canada geese, Taverner's Canada geese, lesser Canada geese, snow geese, and tundra and trumpeter swans. During the summer, tens of thousands of breeding ducks also use the area; species include pintail, mallard, green-winged teal, wigeon, shoveler, scaup, canvasback, and common eider. Other species found in the Redoubt Bay area include yellowlegs, snipe, godwits, whimbrels, several species of sandpipers, plovers, dunlin, phalaropes, sandhill cranes, bald eagles, ravens, gulls, and passerines (ADF&G 2008f).

Moose use the Redoubt Bay wetlands for winter habitat. Other mammals inhabiting the area include black bears, coyote, fox wolf, mink, river otter, marten, muskrat, wolverine, weasel, lynx, and beaver (ADF&G 2008f). Beluga whales can be found feeding at the river mouths, and harbor seals haul out at stream mouths. All five species of Pacific salmon spawn and rear in the rivers and lakes of

Redoubt Bay, and rainbow trout and Dolly Varden also inhabit the streams, rivers and lakes (ADF&G 2008f).

ix. Kalgin Island Critical Habitat Area

Located 20 miles southwest of Kenai on Kalgin Island in lower Cook Inlet, Kalgin Island Critical Habitat Area was established in 1972. It is a small expanse of wetlands encompassing about 3,520 acres surrounding Swamp Creek. This area provides habitat in the spring and fall for migrating swans, geese, ducks, and shorebirds and is an important alternative habitat for nearby Redoubt Bay wetlands (ADF&G 2008f). Other birds found in the Kalgin Island Critical Habitat Area include greater yellowlegs, common snipe, northern harriers, bald eagles, and Arctic terns. Kalgin Island provides haul out habitat for harbor seals, and other small mammals inhabit the island as well, including river otter, beaver, red-backed and tundra voles, and red squirrels. Moose and fox were introduced to the island. The mouth of Swamp Creek provides an estuarine staging area for coho salmon (ADF&G 2008f).

x. Clam Gulch Critical Habitat Area

Clam Gulch Critical Habitat Area was created in 1976 and includes 3,820 acres of tide and submerged lands from Cape Kasilof south to Happy Valley. The purpose of this area is "to ensure the public continues to have the opportunity to enjoy its prolific razor clam beds" by providing a healthy, unpolluted beach (ADF&G 2008f). Birds found in the area include migrating Canada geese, snow geese, sandhill cranes, mallards, pintails, green-winged teal, goldeneyes, mergansers, buffleheads, and white-fronted goose; shorebirds inhabit the area, as well as eiders, oldsquaws, scoters, loons, Arctic terns, glaucous-winged, mew gulls, and bald eagles. All five species of salmon occur in nearshore waters during summer (ADF&G 2008f).

xi. Anchor River and Fritz Creek Critical Habitat Area

The Anchor River and Fritz Creek Critical Habitat Area was established in 1985, and encompasses 19,000 acres of Anchor River and Fritz Creek drainages, located on the southern Kenai Peninsula north of Homer. This area was established for the purpose of "protecting natural habitat critical to the perpetuation of fish and wildlife, especially moose" (ADF&G 1989). Portions of two of the most important moose ranges on the southern Kenai Peninsula are included in this area, providing one of the only major overwintering areas for moose (ADF&G 2008f). Habitat of the Anchor River/Fritz Creek area includes river bottoms, muskegs, upland spruce forests, and subalpine meadows. The riparian habitat of the area provides willow browse for moose during the winter, as well as good cover and moderate snow levels. The area also provides habitat for spring calving. Other mammals found in the area include brown and black bear, beaver, river otter, coyote, and wolf (ADF&G 2008f).

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Anchor River Critical Habitat Area.

The Anchor River/Fritz Creek area provides important habitat for birds such as willow ptarmigan, goshawks, snowy owls, sandhill cranes, trumpeter swans, snipe, yellowlegs, long-billed dowitchers, bald eagles, spruce grouse, chickadees, thrushes, sparrows, kinglets, grosbeaks, redpolls, crossbills, and woodpeckers (ADF&G 2008f). Chinook, coho, and pink salmon spawn and rear in the Anchor River, and steelhead and rainbow trout and Dolly Varden inhabit both the Anchor River and Fritz Creek.

b. Other Designated Areas Near the Lease Sale Area

i. Matanuska Valley Moose Range

This state moose range lies to the east of the lease sale area in the southern foothills of the Talkeetna mountains, north of the Matanuska River. Established in 1984, the 132,500 acre range provides a wide variety of important habitats, including river floodplains; riparian areas; deciduous, coniferous, and mixed forests and woodlands; shrublands; grasslands; forb communities; muskegs; rivers; streams; lakes; wetlands; and a variety of tundra plan communities (ADNR and ADF&G 1986). The area provides critical habitat for moose particularly, but also many other mammals, birds and fish.

ii. Chugach State Park

Chugach State Park, created in 1970, lies adjacent to the eastern boundary of the lease sale area in the Chugach Mountains near Anchorage. The park's 495,000 acres of wilderness provide important habitat for moose, sheep, mountain goat, brown and black bear, wolves, porcupines, and other furbearers and riparian animals (ADNR 1980).

iii. Kenai National Wildlife Refuge

Originally established in 1941 as the Kenai National Moose Range, this area was expanded from 1.73 million acres to 1.92 million acres through the Alaska National Interest Lands Conservation Act in 1980, and renamed the Kenai National Wildlife Refuge (USFWS 2008c). The refuge, which lies east of the lease sale area throughout the Kenai Peninsula, consists of relatively undisturbed wilderness and supports habitat for Kenai wildlife, including caribou, moose, brown and black bear, mountain goat, Dall sheep, wolves, lynx, wolverines, bald eagles, trumpeter swans, and thousands of shorebirds and waterfowl (USFWS 2008b). The headwaters of several important salmon streams are located in the refuge, including the Kenai, Russian, Kasilof, Anchor and Fox rivers.

iv. Kachemak Bay and Fox River Flats Critical Habitat Areas

The Kachemak Bay Critical Habitat Area was established in 1974 and includes approximately 222,000 acres of tide and submerged lands; Fox River Flats was established in 1972 and covers 7,100 acres of wetlands and tide flats at the head of Kachemak Bay (ADF&G 1993). These two areas are components of the International Reserve of the Western Hemisphere Shorebird Reserve and the Kachemak Bay National Estuarine Research Reserve (ADF&G 2008f). Both lie outside the lease sale area. They were designated critical habitat areas because of their diverse and productive habitats that support a wide variety of fish, shellfish, waterfowl, shorebird, seabirds, and marine mammals.

v. Tuxedni Refuge

Tuxedni Refuge, part of the Alaska Maritime National Wildlife Refuge, encompasses 5,566 acres and includes Chisik, Egg, and Duck islands (USFWS 2008a, d). The southern extension of the lease sale area surrounds Chisik Island in Tuxedni Bay. This marine region provides important habitat for shorebirds, marine birds, seals, sea otter, Steller sea lion, and beluga and killer whales.

B. Fish and Wildlife Populations

The Cook Inlet area is home to a wide diversity of fish and wildlife species representing a broad spectrum of life histories and habitat requirements. Abundance of these various populations depends on many factors, including ecological parameters such as food and predator abundance, reproductive success and survival, habitat availability, and ocean dynamics, as well as on human factors such as harvest rates. A few species, such as salmon and some large game species, have been studied extensively, but lack of essential information such as distribution, abundance, and habitat requirements has been identified as an issue for many other species, especially those that are not targeted by fisheries or sport hunting (ADF&G 2006).

Most populations of fish and game in Alaska are healthy but a few have been identified as threatened or endangered under the federal Endangered Species Act or as species of special concern by ADF&G (Table 4.2).

Table 4.2. Wildlife populations of Cook Inlet identified as threatened or endangered under the federal Endangered Species Act, or as species of special concern by ADF&G.

Species	Status
Fin whale	Endangered
Steller sea lion (western stock)	Endangered, ASSC
Beluga whale (Cook Inlet stock)	Endangered, ASSC
Humpback whale	Endangered
Steller's eider (Alaska breeding population)	Threatened, ASSC
Olive-sided flycatcher	ASSC[a]
Gray-cheeked thrush	ASSC[a]
Townsend's warbler	ASSC[a]
Blackpoll warbler	ASSC[a]
Brown bear (Kenai Peninsula population)	ASSC[a]
Harbor seal	ASSC[a]
Sea otter	ASSC[a]

[a] ASSC = Alaska species of special concern.

1. Fish and Shellfish

The waters of the Cook Inlet area abound with a wide variety of fresh and saltwater fishes. Species that have important recreational, commercial, or subsistence value are described below.

a. Freshwater Species

Rainbow and steelhead trout (*O. mykiss*) are actually the same species, and they are in the same genus as Pacific salmon. Steelhead trout migrate to the ocean; rainbow trout remain in freshwater for their entire life, either in streams or lakes. Rainbow trout spawn in the spring, and many spawn yearly, up to five times (Morrow 1980). The migratory patterns of rainbow trout vary and appear to be related to whether the population is stream or lake resident. Stream resident rainbow trout tend to remain in the same generally short sections of stream, while lake resident populations migrate to streams to spawn in the spring and then return to the lake within a few weeks (Morrow 1980).


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Rainbow trout.

After hatching, steelhead spend one to four years, but usually about two, in freshwater before migrating to the ocean where they are found throughout the North Pacific (Morrow 1980). The length of time they remain in marine waters ranges from a few months to as much as four years, after which they return to their home streams to spawn.

Dolly Varden (*Salvelinus malma*) are found in many rivers and streams throughout the Cook Inlet area. They are closely related to **Arctic char** (*S. alpinus*), and in fact, distinguishing the two species requires counting gill rakers and pyloric caeca (Morrow 1980). 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 1994a). Many sea-run Dolly Varden populations in the Cook Inlet area have a life history pattern as follows: in the fall, 600-6,000 eggs are laid in redds (ADF&G 1994a), or nests, in streams and covered with gravel; they hatch in the spring and rear in the stream for 2-5 years before migrating to the ocean for the first time (Armstrong 1996).

Dolly Varden.

After their first migration to the ocean, Dolly Varden may spend the remainder of their lives overwintering in lakes and migrating between the ocean and fresh water (ADF&G 1994a). Dolly Varden that are hatched and reared in a lake system migrate to the ocean to feed and return annually to a lake or river to overwinter. Dolly Varden that hatch in non-lake systems seek out a lake for overwintering. They search for a lake randomly, migrating from system to system until they find a system with a lake. After overwintering in the lake, Dolly Varden may also migrate annually to sea in the spring, and may search for food in other stream systems. When Dolly Varden reach sexual maturity, usually between age 5-9 (or younger for stream resident populations), they migrate directly from their overwintering areas to their home stream to spawn (ADF&G 1994a; Armstrong 1996). All forms of Dolly Varden may spawn more than once, although there is generally a high mortality rate after spawning (ADF&G 1994a). Their life span can be up to 18 years, but usually it is less than 10 years (Armstrong 1996). In freshwater, Dolly Varden eat unburied salmon eggs and young, insects and crustaceans (Armstrong 1996). While in the ocean, their diet includes a wide variety of small fishes and invertebrates (Morrow 1980).

A few populations of Dolly Varden in the Cook Inlet area have been studied. A long-term study was conducted by ADF&G on Dolly Varden of the Anchor River (Larson 1997). From 1987-1990, Dolly Varden were counted as they migrated upstream through a weir on the Anchor River. Counts ranged from about 8,000-18,000 Dolly Varden, with the migration peaking in mid- to late July. Most fish were age 4, 5 or 6 although there were a few fish over age 10. Dolly Varden spawning in the Anchor River probably spend the winter there, then migrate to the ocean the next spring. Subadults probably also leave the river in the spring, spend the summer feeding in Cook Inlet, and then migrate back to freshwater for the winter, perhaps to systems other than the Anchor River such as English Bay Lakes, Packers Lake, the Kenai River, the Kasilof River, and others. When these fish reach sexual maturity, they migrate back to the Anchor River to spawn. The study found that mature Dolly Varden that had already spawned in another system that year also migrated into the Anchor River in the fall, probably to overwinter; these fish were likely from other nearby streams such as Sariski Creek. At any given time, Dolly Varden in the Anchor River are likely composed of a variety of stocks, ages, and maturities (Larson 1997).

Burbot.

Burbot (*Lota lota*) are found in deep rivers and lakes throughout the Cook Inlet area. They spawn in moderately shallow waters of rivers or lakes under the ice in the winter, February through March (Armstrong 1996). Burbot do not build nests for their eggs, but are broadcast spawners averaging about 1 million eggs per female (Sisinyak 2005; Armstrong 1996). Eggs settle to the bottom and hatch in about 30 days (Morrow 1980). Young burbot feed on invertebrates;

as they grow, their diet also includes fish such as slimy sculpin, lampreys, and young salmon; by age 5 their diet is primarily fish (Armstrong 1996). Burbot become sexually mature at about age 6 or 7 (Armstrong 1996), and can spawn multiple times. They grow slowly, but have a long life span, up to 24 years (Armstrong 1996). Burbot have been studied extensively in northern Alaska (Bernard et al. 1993), but few studies are available specific to the Cook Inlet area.

Three species of **sculpin** are found in freshwaters of the Cook Inlet area: slimy sculpin (*Cottus cognatus*), prickly sculpin (*C. aster*) and coastrange sculpin (*C. aleuticus*). They are generally found on the bottom of lakes and streams. Sculpin mature at 2 to 4 years, and spawn in the spring, laying their eggs in nests guarded by the male (Armstrong 1996). Their lifespan is about 7 years. They feed mostly on insects, although occaisionally they eat fish and fish eggs

Three-spine stickleback (*Gasterosteus aculeatus*) are abundant in lakes, ponds, and slow-moving streams. They spawn in June and July, with the female laying eggs in a nest built by the male (Armstrong 1996). Their life span is only 2 years. Stickleback feed on zooplankton, insects, and occasionally on their own eggs and young.

b. Pacific Salmon

Five species of Pacific salmon are found in the Cook Inlet area: Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*). Although salmon life histories can vary widely depending on species and population, most salmon spawn in freshwater streams between June and September. Some pink salmon also spawn in intertidal areas. Eggs are laid in the gravel where they remain through the winter. Growth and development of eggs and alevins in the gravel depends on water temperature, and requires good flow of clean water through the subsurface gravel (Armstrong 1996). Young salmon emerge from the gravel in the spring, and most species spend one or more subsequent years in freshwater. Juvenile salmon undergo significant physiological changes in preparation for migrating to the ocean, which usually occurs from mid-April through mid-July. Young salmon spend varying time in nearshore waters and then most move further offshore.

During their ocean residence, salmon grow quickly as they feed on abundant marine food supplies. Some salmon species make long migrations on the high seas that span thousands of miles and up to seven years. When they reach maturity, salmon migrate back to their natal stream. Navigation mechanisms for salmon while at sea are poorly understood but may involve the earth's magnetic field (ADF&G 1994a). As they near freshwater, salmon use olfactory cues to find their home stream with great precision. Salmon die after spawning, but their decomposed bodies provide essential nutrients that contribute to the productivity of the entire stream ecosystem (Walker and Davis 2004).

In 2000, the Alaska Board of Fisheries adopted the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) which strengthened long-time principles of salmon management by ADF&G and provided a systematic approach for evaluating the health of salmon populations. Criteria were included to identify three levels of concern for salmon populations. As of spring 2006, of the many populations of salmon in Alaska, only three were characterized in the lowest concern level, five were of intermediate concern, and none were at the highest level of concern. None of the eight populations of concern were in the Cook Inlet area (Clark et al. 2006). However, in 2008, the Susitna River sockeye salmon stock was designated a "stock of yield concern" by the Alaska Board of Fisheries because of failure to meet targeted escapement goals (ADF&G 2008k).

Fish hatcheries, which include private non-profit hatcheries for commercial fisheries and state hatcheries for sport fisheries, supplement wild stocks and can help divert fishing pressure from wild stocks. Two state hatcheries (Ft. Richardson and Elmendorf) and three non-profit hatcheries (Trail Lakes, Tutka Bay, and Pt. Graham) operate in the Cook Inlet area (Clark et al. 2006). Strict policies on transporting, possessing, raising, and stocking fish, as well as on genetics and pathology, ensure

that wild stocks are not negatively affected by stocking. Species stocked by ADF&G include salmon, rainbow trout, Arctic grayling, Arctic char, and lake trout (ADF&G 2008e).

Chinook (king) salmon are the largest of the Pacific salmon species at maturity, frequently exceeding 50 lbs (ADF&G 1994a). They return to Cook Inlet area streams from early May through early August (ADF&G 2008g, h, i). Females lay 3,000-14,000 eggs (Armstrong 1996). After hatching and emerging from the gravel, juvenile Chinook feed on plankton and insects while in freshwater (ADF&G 1994a). Most Chinook salmon remain in freshwater for one or two years before their seaward migration, and they spend 3-5 years in the ocean (Armstrong 1996). In the ocean, Chinook feed on herring, pilchard, sandlance, squid and crustaceans as well as other available fish and shellfish (ADF&G 1994a).

Chinook salmon.

Chinook salmon are distributed widely throughout the Cook Inlet area with particularly large runs to the Kenai and Deshka rivers, and Alexander, Lake and Prairie creeks (Fair et al. 2007). Escapement goals have been set for three stocks in lower Cook Inlet and 21 stocks in upper Cook Inlet (Table 4.3).

Table 4.3. Chinook salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet	
Anchor River	Alexander Creek	Lake Creek
Deep Creek	Campbell Creek	Lewis River
Ninilchik River	Chuitna River	Little Susitna River
	Chulitna River	Little Willow Creek
	Clear (Chunilna) Creek	Montana Creek
	Crooked Creek	Peters Creek
	Deshka River	Prairie Creek
	Eagle River-S. Fork	Sheep Creek
	Goose Creek	Talachulitna River
	Kenai River - Early Run	Theodore River
	Kenai River - Late Run	Willow Creek

Source: Otis and Szarzi 2007; Fair et al. 2007.

Sockeye (red) salmon are unique in that after emerging from the gravel, they usually spend one to two years in lakes as juveniles (Armstrong 1996). Important food sources in lakes include plankton and insects. Some important lakes in the Cook Inlet area for sockeye rearing are Tustamena Lake and Upper and Lower Kenai Lakes. After moving to the ocean, sockeye migrate through the Gulf of Alaska and into the North Pacific Ocean, but they do not enter the Bering Sea (Burgner 1991). However, sockeye stocks from central Alaska (which includes the Cook Inlet area) have been found west of 175°E (west of the Aleutian Islands; Burgner 1991). Some populations of sockeye, called kokanee, remain in lakes for their entire life cycle. After 2 or 3 years at sea, mature sockeye salmon

return to Cook Inlet area streams to spawn in mid June, and runs continue through August (ADF&G 2008g, h, i). Escapement goals have been set for eight stocks in Lower Cook Inlet (Otis and Szarzi 2007) and eight stocks in Upper Cook Inlet (Fair et al. 2007; Table 4.4). The Susitna River sockeye salmon stock was designated a "stock of yield concern" by the Alaska Board of Fisheries in 2008 because of failure to meet targeted escapement goals (ADF&G 2008k). The stock will be managed conservatively while research is conducted to better understand this stock's productivity. There are many other stocks of sockeye in the Cook Inlet area for which escapement goals have not been set, either because data are unavailable or harvest levels are low.

Table 4.4. Sockeye salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet
English Bay	Crescent River
Delight Bay	Fish Creek (Knik)
Desire Bay	Kasilof River
Bear Lake	Kenai River
Aialik Lake	Packers Creek
Mikfik Lake	Russian River-Early Run
Chenik Lake	Russian River-Late Run
Amakdedori Creek	Yentna River

Source: Otis and Szarzi 2007; Fair et al. 2007.

Coho (silver) salmon begin entering rivers and streams of the Cook Inlet area in mid-July through late September (ADF&G 2008g, h, i). Females deposit from 2,400-4,500 eggs in stream gravel (Armstrong 1996). Most coho remain in freshwater until the following spring. During fall and winter, juvenile coho seek out deep pools and side channels in which to overwinter (ADF&G 1994a). In Cook Inlet, smolt usually migrate to the ocean from March through June, but in some systems such as the Kenai River and Deep Creek, the smolt migration is protracted, lasting all summer (King and Breakfield 1998). Coho salmon usually spend just one year at sea, although there is variability (Sandercock 1991). Escapement goals have been set for three coho stocks in Upper Cook Inlet (Table 4.5); there are no escapement goals for Lower Cook Inlet stocks (Otis and Szarzi 2007; Fair et al. 2007). However, there are many other stocks of coho in the Cook Inlet area for which escapement goals have not been set, either because data are unavailable or harvest levels are low.

Table 4.5. Coho salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet
No Escapement Goals	Campbell Creek
	Jim Creek
	Little Susitna River

Source: Otis and Szarzi 2007; Fair et al. 2007.

Pink salmon are the smallest of the five species of Pacific salmon. They return to freshwater to spawn from early July through August in the Cook Inlet area (ADF&G 2008g, h, i). Pink salmon generally spawn in the lower reaches of streams within a few miles of the ocean, and may even spawn in intertidal areas (ADF&G 1994a). Females deposit from 1,500-2,000 eggs in the gravel of spawning streams (Armstrong 1996). Juvenile pink salmon do not rear in freshwater. Rather, after emerging from the gravel, they immediately migrate downstream (ADF&G 1994a). Young pink salmon form large schools in estuarine areas where they remain for several months before migrating out to sea in the fall (ADF&G 1994a).

Pink salmon remain at sea for one year, feeding mainly on zooplankton, squid, and fish (Armstrong 1996). Because pink salmon migrate to sea shortly after emerging from the gravel and spend only one year at sea, they have a distinct two-year life cycle from egg to spawning; therefore, populations are characterized as either odd- or even-year (ADF&G 1994a). In the Cook Inlet area, most populations are even-year, but there are also odd-year populations (Shields 2007). In 2007, there were escapement goals for 21 stocks in Lower Cook Inlet (Otis and Szarzi 2007) and no stocks in Upper Cook Inlet (Fair et al. 2007; Table 4.6).

Table 4.6. Pink salmon stocks with escapement goals in 2007.

Lower Cook Inlet		Upper Cook Inlet
Humpy Creek	Island Creek	No Escapement Goals
China Poot Creek	S. Nuka Island Creek	
Tutka Creek	Desire Lake Creek	
Barabara Creek	Bear & Salmon Creeks	
Seldovia Creek	Thumb Cove	
Port Graham River	Humpy Cove	
Port Chatham	Tonsina Creek	
Windy Creek Right	Bruin River	
Windy Creek Left	Sunday Creek	
Rocky River	Brown's Peak Creek	
Port Dick Creek		

Source: Otis and Szarzi 2007; Fair et al. 2007.

Chum (dog) salmon are found in many systems of the Cook Inlet area. They enter the Cook Inlet area beginning in mid-July, and runs continue through mid-August (ADF&G 2008i). On average, females lay 2,000-4,000 eggs (Armstrong 1996). After hatching in the spring, young chum immediately migrate to the ocean. They form large schools and remain in estuaries and near-shore waters feeding on plankton until fall, when they migrate to the open ocean (ADF&G 1994a). After three to six years at sea, chum return to their home streams to spawn. Lower Cook Inlet stocks with escapement goals include the McNeil River, Big Kamishak River, Little Kamishak River, and Island Creek (Table 4.7; Otis and Szarzi 2007); only Clearwater Creek of Upper Cook Inlet has an escapement goal for chum salmon (Fair et al. 2007).

Table 4.7. Chum salmon stocks with escapement goals in 2007.

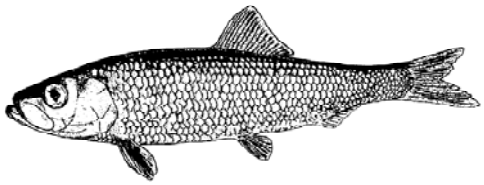
Lower Cook Inlet		Upper Cook Inlet
Port Graham River	Little Kamishak River	Clearwater
Dogfish Lagoon	McNeil River	
Rocky River	Bruin River	
Port Dick Creek	Ursus Cove	
Island Creek	Cottonwood Creek	
Big Kamishak River	Iniskin Bay	

Source: Otis and Szarzi 2007; Fair et al. 2007.

c. Marine Forage Fishes

Forage fishes are an important group of fish that provide food for a wide range of marine animals, including 2-3 million seabirds, marine mammals, and other fish species (LGL and BioSonics 1999). Some forage species are also important for commercial or personal use fisheries. In Cook Inlet, forage fishes include Pacific herring, walleye pollock (see Groundfish section), capelin, Pacific sand lance, and eulachon (LGL and BioSonics 1999) and three-spine stickleback (Pentec Environmental 2005). Nearshore fish communities may change dramatically, apparently related to large-scale regime shifts in the North Pacific (Robards et al. 1999).

Pacific herring *(Clupea pallasii pallasii)* are an important commercial fish species, and are also important prey for many other species of fish and marine mammal (Armstrong 1996). Herring spawn in the spring in vegetated areas in shallow, intertidal and subtidal areas (ADF&G 1994a). Herring, with a life span of about 8 years, reach sexual maturity at about 3 or 4 years and spawn annually thereafter.



ADF&G

Pacific herring.

Eulachon *(Thaleichthys pacificus)* also known as candlefish or hooligan are anadromous, returning annually to river mouths of the Cook Inlet area to spawn. They move into nearshore waters in early May and spawn in drainages throughout Cook Inlet. The eggs are deposited on stream gravel, and they hatch in about 30 to 40 days, depending on water temperature (Morrow 1980). The larvae then move downstream to enter marine waters. Eulachon are important food for marine birds and eagles; fishes, including salmon; and marine mammals, including beluga whales (Armstrong 1996).

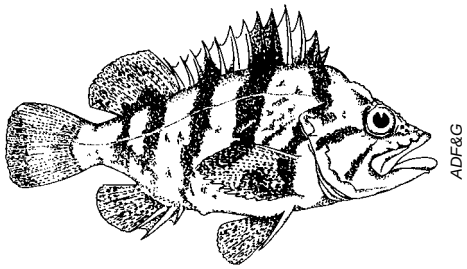
Pacific sand lance is a critical food source for seabirds, marine mammals, salmon, Pacific halibut, cod, Dolly Varden, and herring (Armstrong 1996). They occur in large schools in nearshore areas, including sandy beaches, channels, and intertidal sloughs, as well as in offshore areas. They bury themselves in the sand at night. Sand lance mature at the age of 2 or 3, and spawning occurs in October. They may live up to 5 years.

d. Groundfish

Walleye pollock *(Theragra chalcogramma)* and **Pacific cod** (*Gadus macrocephalus*) are important prey for a wide range of fish and marine mammals, including Steller sea lions. Walleye pollock and Pacific cod occur in large schools, inhabiting waters between 100-300 m deep (NMFS 2008e; NMFS 2008h). They generally reach sexual maturity at about 3-5 years, and have a lifespan of up to 17-18

years. Spawning usually occurs between March and May for walleye pollock and late winter to early spring for Pacific cod (NMFS 2008e; Armstrong 1996).

Sablefish *(Anoplopoma fimbria),* commonly called blackcod, also occur in large schools, usually on or near sandy or muddy ocean floors (Armstrong 1996). After reaching sexual maturity at 4-6 years, sablefish spawn in late winter, from January through March. They have a lifespan of up to 55 years. Their diet includes invertebrates, squid, and fish such as Pacific herring and rockfish. They are also an important food source for Pacific cod, Pacific halibut, lingcod, seabirds, and marine mammals (Armstrong 1996).



Tiger rockfish.

At least 35 **rockfish** species, genus *Sebastes*, are found in the Gulf of Alaska (Armstrong 1996). Based on incidence in sport harvests, the most common are black, dusky, and yelloweye rockfish (Szarzi et al. 2007). Rockfish can be categorized into three groups, or assemblages, based on habitat preference: pelagic, demersal shelf, and slope assemblages (Szarzi et al. 2007). Rockfish are very longlived, with maximum ages exceeding 100 years for some species (Armstrong 1996). Rockfish populations are highly vulnerable to overfishing because of their longevity (which translates into low productivity), age at which they reach sexual maturity (as old as 23 years), high site fidelity in which fish remain in the same area, preference of some species for structures such as pinnacles and reefs that are easily located by fishers, and an unvented swim bladder that is easily injured by decompression when fish are brought to the surface from depths greater than 15 m (ADF&G 1994a; Meyer 2000).

Pacific halibut (*Hippoglossus stenolepis*) are bottom-dwelling flat fish that also swim closer to the surface when feeding (Armstrong 1996). Pacific halibut spawn in deep waters at 600-1,500 ft. Ocean currents are an important factor in their life history, carrying fertilized eggs and young halibut to inshore areas where they settle to the ocean floor. Pacific halibut tend to migrate back into deeper waters after about three years, for overwintering, and then return to shallow coastal waters during the summer (Armstrong 1996). They are long-lived, up to 42 years; they mature at about age 8 for males and age 12 for females. Pacific halibut grow to very large sizes, up to 500 lbs. They prey on cod, Pacific sand lance, crabs, clams, squids, and other invertebrates (Armstrong 1996).

e. Shellfish

Shellfish species inhabiting intertidal and subtidal areas of Cook Inlet include sea urchins, chitons, limpets, whelks, mussels, clams, cockles, polychaetes, bryozoans, sponges, sea stars, sea cucumbers, snails, octopus, skate, barnacles, and crabs. Species in nearshore and offshore waters include sea cucumbers, many species of sea star, nudibranches, octopus, tunicates, worms, and sea leeches.

Clams are abundant along many Cook Inlet beaches. Stocks of razor clams (*Siliqua patula*) are concentrated in the Polly Creek area on the west side of Cook Inlet, and along the east side from Anchor Point to the Kasilof River. Razor clams are usually found on sandy beaches from about 4 ft above mean low water to depths of 180 ft (ADF&G 1994a). Razor clams become sexually mature between 3 and 7 years old. Breeding, which occurs in the summer between May and September, is closely associated with temperature. After hatching, microscopic larvae, which bear little resemblance to adult clams, spend 5 to 16 weeks in a free-swimming form, then begin to develop shells and settle into the sand (ADF&G 1994a). Razor clams can live to be as old as 18 years. Razor clams are filter feeders, obtaining their food by straining plankton from seawater (ADF&G 1994a).

Other clam species include littleneck (*Protothaca staminea*) and butter clams (*Saxidomus giganteus*), which are prolific in Kachemak Bay (Szarzi et al. 2007) south of the lease sale area, as well as species such as *Axe sp., Mya sp., Tresus sp*., *Spisula sp., Telina sp.*,and *Macoma sp*. Migrating birds

and resident shorebirds may depend on stocks of a small bivalve, *Macoma balthica*, perhaps exclusively for rock sandpipers (Gill and Tibbitts 1999). Densities of littleneck clams were low in 2005, based on surveys at two islands (Trowbridge and Goldman 2006).

Tanner crabs (*Chionoecetes bairdi* and *C. opilio*) are found on the soft bottom of deep waters (Field and Field 1999). Tanner crabs reproduce at 5 or 6 years of age, and may brood up to 450,000 eggs each year. Eggs incubate for a year on the female's abdominal flap, hatching in spring (ADF&G 1994a). Tanner crab hatch into free-swimming larvae, molt many times through distinct stages, then settle to the ocean bottom. They may live up to 14 years. Their prey includes mussels, clams, snails, crabs, shrimps, and worms, and they scavenge on dead fish (Field and Field 1999). Although little is known of their migration patterns, males and females are found in separate areas for much of the year, and migrate to the same area during the reproductive period (ADF&G 1994a).

S. Kilka, ADF&G

Tanner crab.

Several species of **shrimp** are found in Cook Inlet, including pink (*Pandalus borealis*), sidestripes (*P. dispar*), humpy shrimp (*P. goniurus*), coonstripe shrimp (*P. hypsinotus*), and spot shrimp (*P. platyceros*) (ADF&G 2002b). Shrimp typically hatch in the spring into planktonic, free-swimming larvae. After undergoing several molts, they settle to the bottom where they live for a few years before maturing into adults (ADF&G 1994a). Depending on species and life stage, shrimp inhabit a wide range of habitats and water depths, ranging from rock piles, coral, debris-covered bottoms, and muddy bottoms; and depths ranging from shallow waters of a few fathoms to deep waters up to 800 fathoms (ADF&G 1994a). Shrimp may undergo seasonal migrations, from deep to shallow waters and vertically in the water column. Shrimp eat a wide variety of foods, including worms, diatoms, detritus, algae, and invertebrates. They are preyed upon by fish such as Pacific cod, walleye pollack, flounders, and salmon (ADF&G 1994a).

Other shellfish species include octopus, green urchin, sea cucumber, and scallops. The predominant octopus species in Cook Inlet is the giant Pacific octopus (*Enteroctopus dofleini*) (Trowbridge and Goldman 2006). Maximum age for octopus is probably 3-5 years and they reach sexual maturity at 1.5 to 2 years. Octopus spawn only once. They stop feeding and die soon after spawning. Abundance of green urchins (*Strongylocentrotus droebachiensis*) and sea cucumbers (*Parastichopus californicusappears*) are low (Trowbridge and Goldman 2006). Sea cucumbers are benthic detritus feeders. They are important in the marine food web because they recycle detritus into nutrients for primary producers by ingesting significant amounts of fine substrate (ADF&G 2008j). Weathervane scallop (*Patinopecten caurinus*) stocks declined sharply in 1987 in the Kamishak area, but by 1993 there appeared to be a small but healthy stock in the Kamishak area (Trowbridge and Goldman 2006). Sharp declines were observed in 2003, but based on age composition appear to be healthy (Trowbridge and Goldman 2006).

2. Birds

Over 450 species of birds are found in Alaska, most of which can be found living in the Cook Inlet area year round, or migrating through or breeding in the area (BLM 2006). These include waterfowl, seabirds and shorebirds, and land and water birds.

a. Waterfowl

Waterfowl of the Cook Inlet area include geese, swans, ducks, cranes and eiders. Cook Inlet is critical to these birds for nesting, molting, and staging.


USFWS

Tule white-fronted geese.

Tule white-fronted geese (*Anser albifronsis gambelli*), a subspecies of the white-fronted goose, are found in the Cook Inlet area. The population is currently estimated to be about 6,000 birds, a 90 percent decrease since the early 1980s (ADF&G 2007, citing to Campbell 1992). Although their entire breeding range has not been fully determined, it is known that they breed in the coastal flats of upper Cook Inlet (ADF&G 2007; Figure 4.2). Nesting and molting habitat has been identified in the Bachatna Flats and Big River area, along the McArthur River drainage, (ADF&G 2007, citing to Trasky 1998); and in the Susitna Flats State Game Refuge, Trading Bay State Game Refuge, and the Redoubt Bay State Critical Habitat Area (ADF&G 2007). There is only one other area where Tule geese are known to nest, which is north of the Cook Inlet area along the Kahiltna River.

Studies indicate that Tule geese arrive in the Cook Inlet coastal areas and interior marshes from mid-April to early May, and then move to nesting areas (ADF&G 2007, citing to Ely et al. 2006, Densmore et al. 2006). Important locations include freshwater wetlands in the Susitna Valley and lowlands along Cook Inlet between the Susitna and Theodore rivers for nesting; and a molting area in a sub-glacial lake system in upper Cook Inlet (ADF&G 2007, citing to Densmore et al. 2006). Tule geese start to leave for wintering grounds in California by early fall, and are gone from Alaska by the end of September (ADF&G 1994a).

Abundance of **trumpeter swans** (*Cygnus buccinators*) in the Cook Inlet area has increased, from 1,545 in 2000 to 2,670 in 2005 (Table 4.8; ADF&G 2007). In 2005, 995 swans were observed in the Cook Inlet census unit and 182 were observed in the Kenai unit (Conant et al. 2007; Figure 4.3; Figure 4.4). Nesting is widespread in the Trading Bay and Redoubt Bay areas, with the most concentrated use occurring in the drainages of the Kustatan River, Bachatna Creek, North Fork Big River, and the lower Big and Chakachatna rivers (ADF&G 2007). Trumpeter swans prefer secluded regions, where they frequent shallow bodies of water and build their nests in extensive areas of marsh vegetation (ADF&G 1985). Most breeding pairs are at their nest sites by early May and the first hatching dates range from June 16 to June 29. In Alaska, young swans are unable to fly until 13 to 15 weeks of age.

After leaving the breeding areas, large numbers of trumpeter swans congregate on ponds and marshes along the coast in late summer and early fall. Most swans depart by mid-October but in some years may remain until freeze-up in November (ADF&G 1985). They winter on ice-free freshwater outlets. However, they may utilize saltwater, during extremely cold periods, when freshwater locations freeze (ADF&G 1985). Maintaining the present distribution of trumpeter swans in Alaska, losses of wintering habitat along the Pacific coast, and losses of swans to lead poisoning on the Pacific coast are of continued concern (ADF&G 2007, citing to Conant et al. 2005).

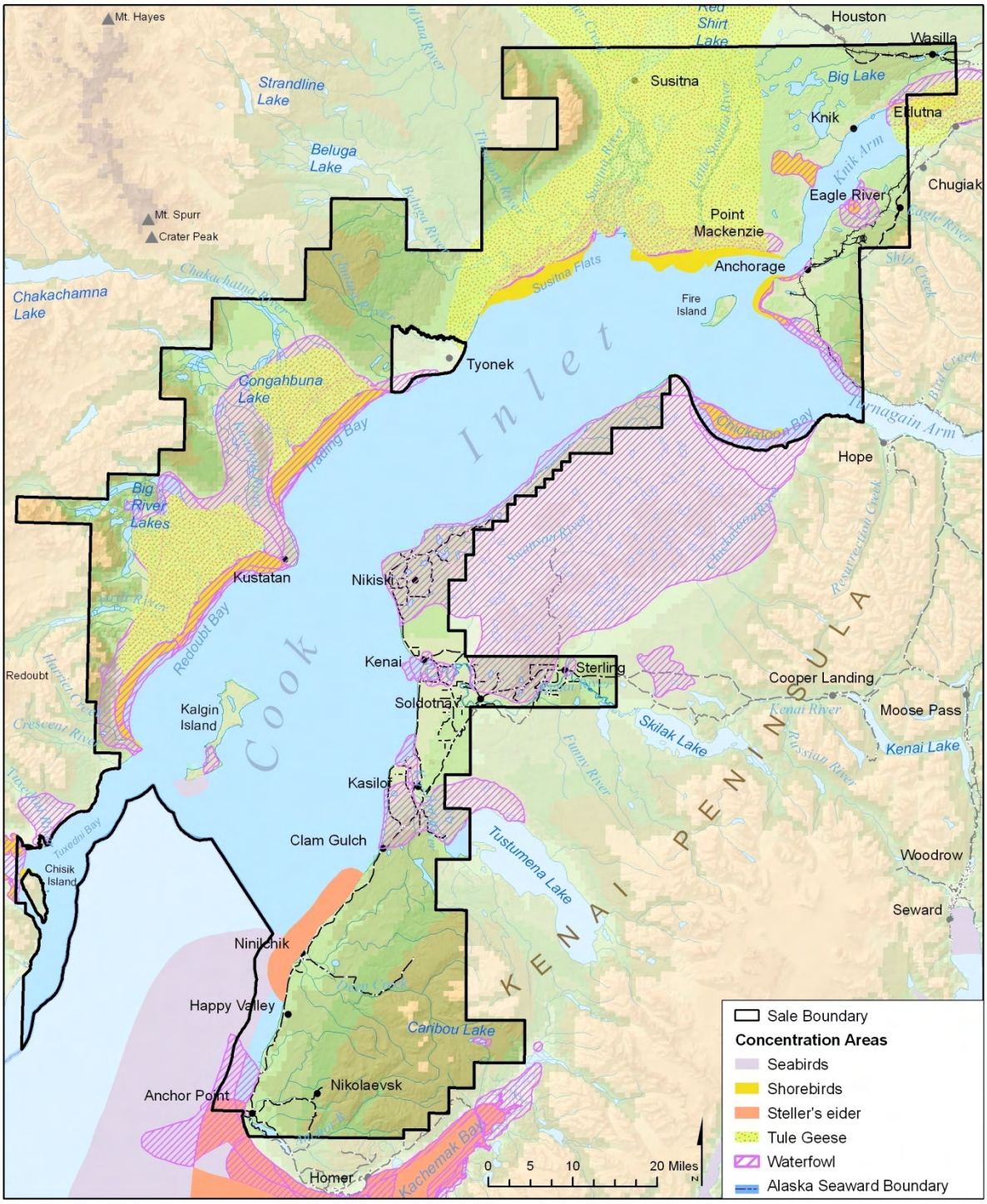
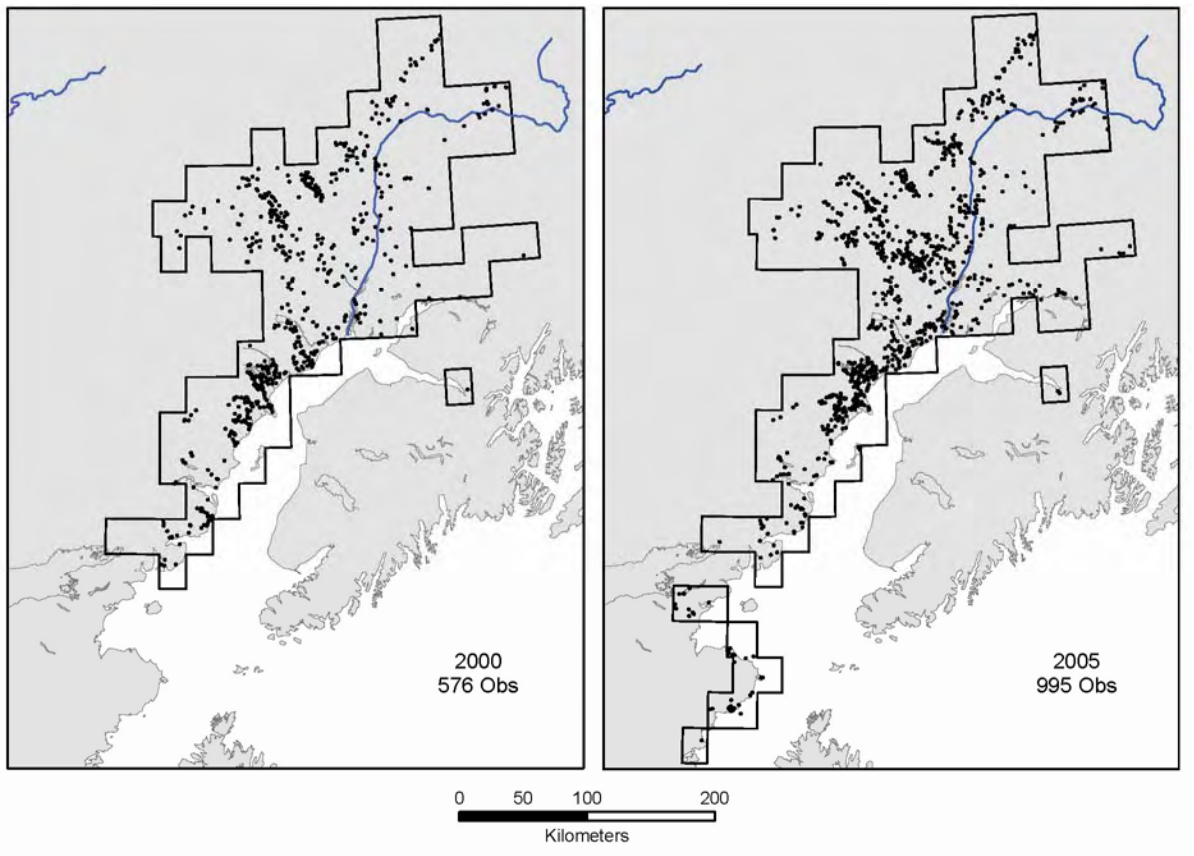


Figure 4.2. Important bird habitat.

Table 4.8. Summary of trumpeter swans in Cook Inlet from censuses during August – early September

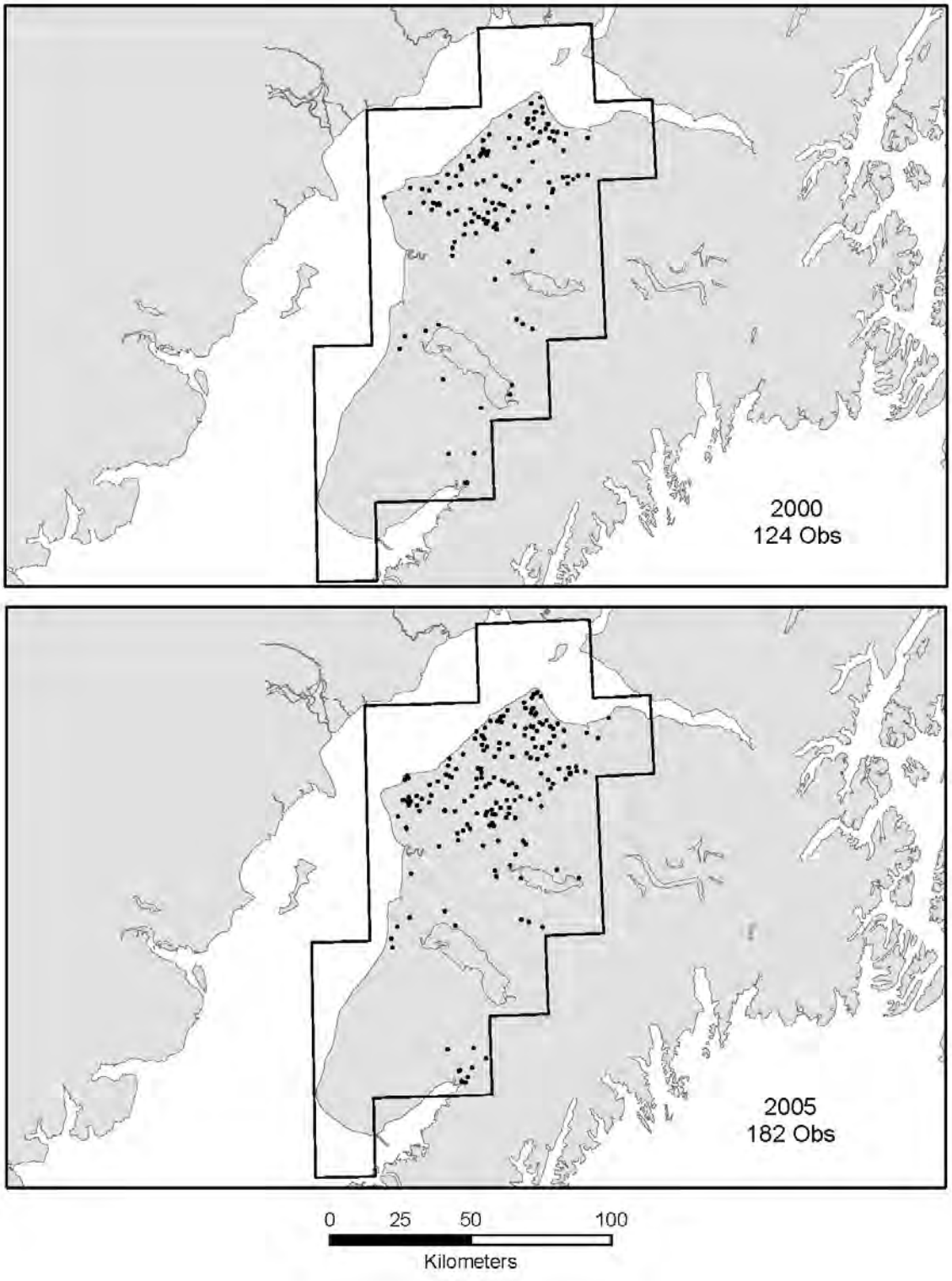
Year	White Swans				Cygnets	Total Swans
	In Pairs	As Singles	In Flocks	Total		
1968	224	19	50	293	124	417
1975	340	36	60	436	181	617
1980	608	38	186	832	369	1,201
1985	800	66	454	1,320	241	1,561
1990	904	79	162	1,145	516	1,661
1995	838	91	269	1,198	330	1,528
2000	938	57	219	1,214	331	1,545
2005	1,470	196	310	1,976	694	2,670

Source: ADF&G 2007, citing to Conant et al. 2005.



Source: Conant et al. 2007.

Figure 4.3. Comparison of swan distribution in the Cook Inlet area as depicted by point locations of observations from trumpeter swan censuses in Alaska in 2000 and 2005.



Source: Conant et al. 2007.

Figure 4.4. Comparison of swan distribution on the Kenai Peninsula as depicted by point locations of observations from trumpeter swan censuses in Alaska in 2000 and 2005.

Steller's eiders (*Polysticta stelleri*), a species of sea duck, winter from the eastern Aleutian Islands to lower Cook Inlet. The Steller's eider, the smallest of the eiders, is approximately 18 inches long and usually weighs about 2 lbs. The Steller's eider is unusually colorful and has a unique plumage pattern for a sea duck (ADF&G 1994a). ADF&G listed the Alaska breeding population as a species of special concern in 1993 (DO&G 2004). The USFWS listed the Steller's eider as threatened on June 11, 1997 because of apparent declines in abundance of nesting birds, but the reasons for the decline are unknown (ADF&G 2007; USFWS 2008e).


USFWS

Steller's eider.

Steller's eiders are the least abundant eider in Alaska. They generally nest in northeastern Siberia, but also breed in Alaska along the coast from the Alaska Peninsula northward, including the Seward Peninsula, St. Lawrence and Nunivak islands, and the Beaufort Sea coast (ADF&G 1994a). Three breeding populations are recognized: two in Arctic Russia and one in Alaska but it is unknown if birds wintering in Cook Inlet are part of the Alaska breeding population (ADF&G 2007). Steller's eiders winter from the eastern Aleutian Islands to lower Cook Inlet, as well as islands in southeastern Russia. They are usually found in protected nearshore waters that are less than 10 m in depth. From mid- to late-April, they leave wintering areas and migrate to their Arctic nesting areas. The species was most abundant on the Yukon Delta where 3,500 pairs were thought to nest, but sightings are now rare and no nests have been found in the region since the mid-1970s (ADF&G 2007). The unexplained disappearance of Steller's eiders from the Yukon-Kuskokwim Delta has caused great concern and recently stimulated intensive research into the problem (ADF&G 2007, citing to USFWS 2002).

Cook Inlet is the easternmost extent of the molting and winter range for Steller's eider. Molting Steller's eiders arrive from late August, and they may remain through the winter, departing for breeding grounds in April (ADF&G 2007). Several surveys of wintering Steller's eiders have been conducted, including shoreline and aerial surveys from 1997-2003 that were conducted from the mouth of Kachemak Bay to Kenai. Counts ranged from 252-2,370, most within 2 km of shore. Additional surveys counted over 4,000 birds (ADF&G 2007). Within the lease sale area, substantial numbers of Steller's eiders were observed in nearshore areas from Anchor Point to 25 km north of Ninilchik. South of the lease sale area, substantial numbers were observed in nearshore areas from Homer Spit to Anchor Point; nearshore areas in southern Kamishak Bay from Douglas River to Bruin Bay, including the shoreline between Bruin Bay and Ursus Cove; a shoal 12 km southeast of Bruin Bay; and the mouth of Iniskin Bay (Figure 4.2; ADF&G 2007; Larned 2006).


USFWS

Chisik Island seabird colony.

b. Seabirds and Shorebirds

i. Seabirds

Seabirds are birds that spend most of their lives at sea, including feeding, resting, and sleeping, although all nest on land (USGS 2008c). There are many species of seabirds in the Cook Inlet area, including murres, gulls, kittiwakes, cormorants, murrelets, and puffins. Lower Cook Inlet is one of the most productive areas for seabirds in Alaska, with 2.2 million seabirds foraging in the area

in July 1992 (Piatt 1994). Shallow coastal habitats are particularly important for seabirds at sea, as these areas have high densities of forage fish (Piatt and Roseneau 1997), and the east side of lower Cook Inlet is particularly productive and important habitat for seabirds (Piatt and Harding 2007). Important food items include small fish, squid, and crustaceans such as krill and crabs (USGS 2008c).

Seabirds tend to nest in colonies on islands and bluffs, with nesting sites including beach rubble and boulders, cracks in cliff faces, rocky ledges, burrows in soft soil at a cliff edge, or flat ground (USGS 2008c). Important nesting sites include Chisik Island and Duck Island, located near Tuxedni Channel; Gull Island, located in Kachemak Bay outside the lease sale area; and Barren Islands and Shuyak Island, located south of the lease sale area (USGS 2008b; Piatt 1994). About 5,000 seabirds use Duck Island, including about 3,000 horned puffins, and more than 16,000 use Gull Island (USGS 2008a).

Population trends in seabird colonies appear to be related to differences in food availability (USGS 2008a). In the late 1970s, a significant regime shift occurred in the Gulf of Alaska, characterized by changes in seawater temperature and decreases in abundance of forage fish; this resulted in reduced food availability to seabirds, lower reproductive success, large-scale die-offs, and long-term decreases in some populations (Piatt and Harding 2007). In fact, although the 1989 Exxon Valdez oil spill had a serious and immediate impact on seabird populations, effects of the regime shift are considered to have had an even more significant effect (Piatt and Harding 2007).

ii. Shorebirds

The Cook Inlet area is important for many species of shorebirds as a stopover site during migrations and a wintering area; 28 species have been identified in the area (Table 4.9; Gill and Tibbitts 1999). Migrating shorebirds appear suddenly in the Cook Inlet area in early May, their numbers increase rapidly, and then they depart abruptly by late May. In excess of 150,000 birds have been counted in surveys during that time period (Gill and Tibbitts 1999). The Cook Inlet area supports from 11-21 percent of the Pacific flyway population of dunlin, and perhaps the entire population of rock sandpiper (Gill and Tibbitts 1999). Southern Redoubt Bay, with 73 percent of all shorebirds during the spring, is a particularly important area (Figure 4.2). Also important is Tuxedni Bay, which averaged over 6,000 birds per day in the spring (Figure 4.2; Gill and Tibbitts 1999). Few shorebirds use the intertidal habitat of Knik Arm (URS Corp. 2006).

USFWS

Sandpipers and dunlins, Kachemak Bay.

The Cook Inlet area is also an important wintering area for many species, including rock sandpipers, migrating western sandpipers and dunlin, and for breeding and migrating Hudsonian godwits, greater yellowlegs, solitary sandpipers, and short-billed dowitchers (ADF&G 2007; Gill and Tibbitts 1999). In the winter, the Susitna Flats is a particularly important area, with 82 percent of the shorebirds found there (Gill and Tibbitts 1999). Tidal flats are important to shorebirds, providing their food supply of bivalves, *Macoma balthica* (a small clam) and *Mytilus* (a mussel) (Gill and Tibbitts 1999). Sandpipers forage in the winter on mudflats kept free of ice, such as the Susitna Flats near the Beluga and Ivan rivers. Trading Bay, off Nikolai Creek, also provides important alternate foraging habitat in the winter, as well as mudflats in the area south of Redoubt, Tuxedni, and Kachemak bays and Homer Spit.

Few shorebirds use the area during the summer breeding season, except for the Hudsonian godwit, for which the Cook Inlet drainage is the preferred nesting site. The Cook Inlet area may be critical to a major portion of the continental population of the Hudsonian godwit (Gill and Tibbitts 1999).

Solitary sandpipers, rock sandpipers, and marbled godwit have been identified by ADF&G as featured species for conservation (ADF&G 2006). Breeding habitat of **solitary sandpipers** (*Tringa solitaria cinnamomea*) includes wooded wetlands in muskeg bogs, spruce forests, and deciduous riparian woodlands, and occasionally riparian shrub thickets (ADF&G 2007, citing to Muskoff 1995). Concerns for solitary sandpipers include low abundance estimates, rapid declines in counts for Alaska and Canadian Breeding Bird Surveys, and uncertainty in abundance estimates and indices (ADF&G 2007).

Rock sandpipers (*Calidris p. ptilocnemis*), the only shorebird known to overwinter in the Cook Inlet area, depend on intertidal habitats of upper Cook Inlet for foraging. It was identified as a featured species for conservation because of its limited distribution, low abundance, and potential threats during the nonbreeding season (ADF&G 2007). A few surveys have been conducted to estimate abundance of rock sandpipers. About 20,000 were estimated in a 1996 survey of the Beluga River flats during winter; 17,500 were counted in upper Cook Inlet in the winter of 2002-2003, and about 16,000 during the winter of 2003-2004 (ADF&G 2007). Rock sandpipers may move to southern Cook Inlet, such as Kamishak Bay, or out of Cook Inlet to the Kodiak Archipelago during very cold periods (ADF&G 2007, citing to Gill and Tibbitts 2003).

A small population of **marbled godwits** (*Limosa fedoa beringiae*), probably numbering less than 3,000 birds, breeds only on the Alaska Peninsula, with the remainder of the species wintering along the Atlantic and Pacific coasts between the U.S. and Central America (ADF&G 2007). During migration, birds from this population occasionally pass through the Cook Inlet area. Although this population does not breed in Cook Inlet, birds that do pass through the area represent a portion of this small population. Loss of wetland habitats on the U.S. Pacific coast is a concern.

Table 4.9. Shorebird species using the Cook Inlet area.

Black-bellied Plover	Whimbrel	Red Knot	Rock Sandpiper
American Golden-Plover	Hudsonian Godwit	Sanderling	Dunlin
Pacific Golden-Plover	Bar-tailed Godwit	Semipalmated Sandpiper	Ruff
Semipalmated-Plover	Marbled Godwit	Western Sandpiper	Short-billed Dowitcher
Greater Yellowlegs	Ruddy Turnstone	Least Sandpiper	Long-billed Dowitcher
Lesser Yellowlegs	Black Turnstone	Baird's Sandpiper	Common Snipe
Solitary Sandpiper	Surfbird	Pectoral Sandpiper	Red-necked Phalarope

Source: ADF&G 2000b, citing to Gill and Tibbitts 1999.

c. Land Birds and Waterbirds

A large variety of other birds rely on the land and freshwater habitats of the Cook Inlet area. These include eagles, hawks, owls, ravens, grouse, ptarmigan, loons, chickadees, and many others.

Bald eagles (*Haliaeetus leucocephalus*) are a common and visible raptor in the Cook Inlet lease sale area (Figure 4.5). These birds are protected by the federal Bald Eagle Act of 1940, which makes possession of an eagle, either alive or dead, illegal (ADF&G 1994a). Bald eagles are usually found near shorelines and river areas, which is probably related to food supply, as well as near prominences which are used for perches and nests (ADF&G 1985). Fish are the main diet of bald eagles, including

salmon, herring, flounder, and pollock; they also prey on waterfowl, small mammals, sea urchins, clams, crabs, and carrion. They tend to congregate along salmon-spawning streams and shorelines where they search for stranded or dead fish. Bald eagles also take live fish from lakes, streams, and the ocean (ADF&G 1994a).

Bald eagles nest in trees that are close to water, with a clear view of the surrounding area, often in old cottonwoods (ADF&G 1994a). They tend to use and rebuild the same nest. Nest building begins in April, eggs are usually laid by late April, young hatch after about 35 days, and leave the next after about 75 days. Bald eagles reach sexual maturity at about 4 or 5 years of age (ADF&G 1994a).

Nest sites have been documented at numerous locations along the Cook Inlet coast, with the highest nest densities occurring outside the lease sale area, in and along the southern shore of Kachemak Bay (ADF&G 2007). Eagles congregate at the mouths of major rivers where salmon and hooligan school, such as the 20-Mile, Placer, Eagle, Knik, Matanuska, Susitna, Beluga, Fox, and other rivers. During a partial nest survey conducted in June 1992, the USFWS counted 55 active and 84 inactive nests around Kachemak Bay (ADF&G 2007). Hundreds of eagles also winter in Kachemak Bay and, to a lesser extent, other areas around Cook Inlet (ADF&G 2007).

Golden eagles (*Aquila chrysaetos*), also protected by the Bald Eagle Act, are also found throughout the Cook Inlet area. These raptors feed primarily on ground squirrels, hares, and birds, such as ptarmigan, cranes, and owls (ADF&G 1994a).

Both the **sharp-shinned hawk** (*Accipiter striatus*) and the **northern goshawk** (*Accipiter gentilis*) are abundant in Alaska, but rarely seen. These birds nest in woodland forests, most frequently in middle age (20-45 years old) spruce trees (ADF&G 1994a). Eggs hatch in late May or early June. Goshawks eat snowshoe hares, grouse, ptarmigan, ducks, squirrels, voles, shrews, and some songbirds and shorebirds. Sharp-shinned hawks eat songbirds, small mammals and large insects. While hawks have few natural predators, bears, lynx, and other climbing predators can sometimes reach their nests (ADF&G 1994a).

The **boreal owl** (*Aegolius funereus*) and **northern hawk owl** (*Surnia ulula*) inhabit the Cook Inlet area. They lay their eggs in cavities or old woodpecker nest cavities in old trees (ADF&G 1994a). The boreal owl feeds at night on voles, mice, shrews, and small birds; population cycles of voles are a limiting factor in owl populations. Marten are the main predator of the boreal owl. The northern hawk owl hunts mostly during the day, is noted for its unusual tolerance of human activity, and will nest close to human settlements. Its main predators are the great horned owl and northern goshawk (ADF&G 1994a).

The **common raven** (*Corvus corax*) is a member of the Corvidae family, which also includes jays, crows, and magpies. Ravens use a wide variety of habitats. Ravens feed on a variety of both plant and animal foods, and are also scavengers. Ravens breed at age 3 or 4 years, mate for life, and can live up to 30 years. Ravens congregate near human settlements during non-breeding times (ADF&G 1994a).

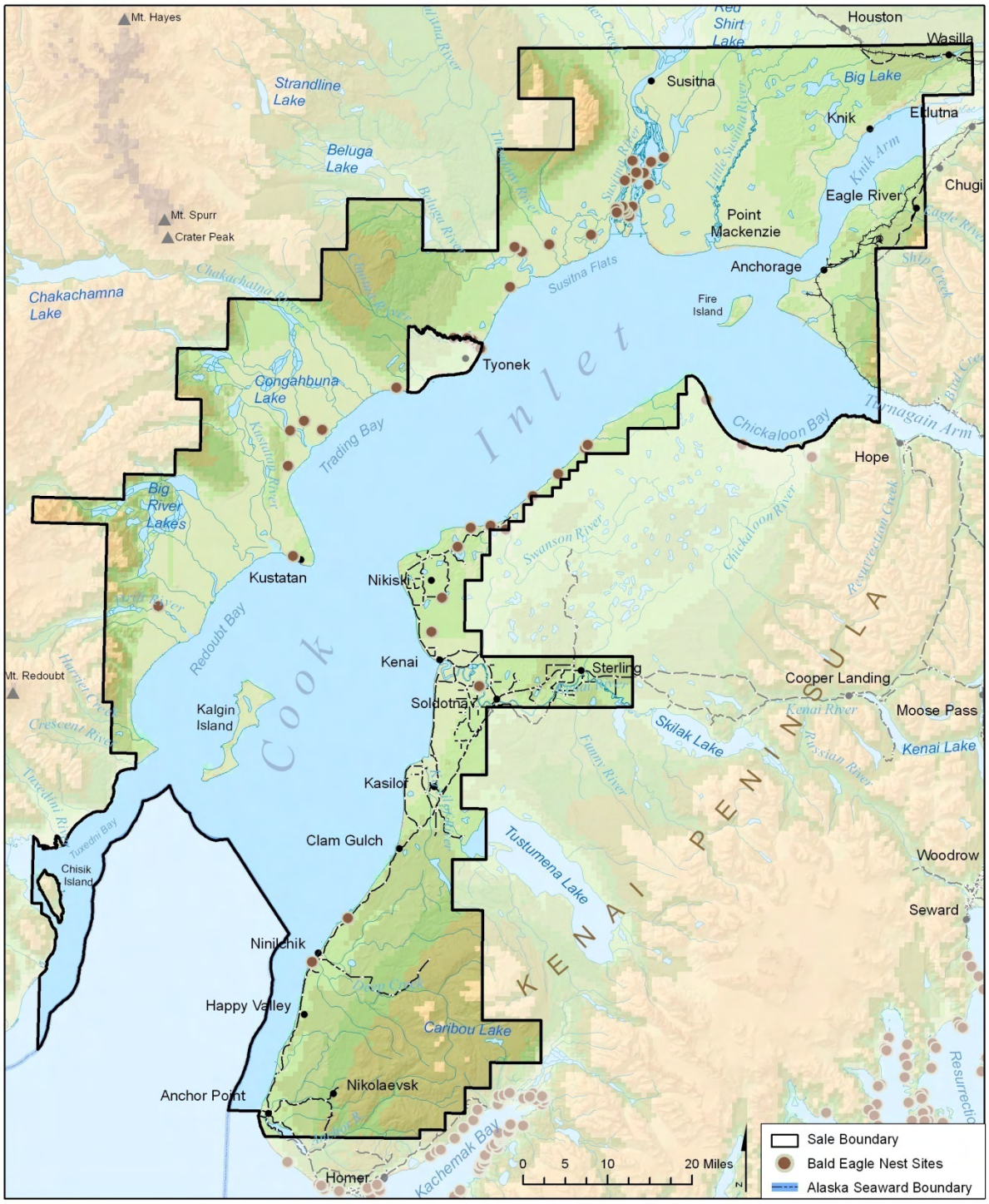


Figure 4.5. Bald eagle nest sites.

Spruce grouse (*Canachites canadensis*), also known as **spruce hens,** are common throughout the Cook Inlet area. Preferred habitat includes spruce-birch forest with a thick understory of cranberry, blueberry, crowberry, and spirea, above a moss-covered ground (ADF&G 1994a). During summer, spruce grouse eat flowers, green leaves, and berries. Insects provide food for newly hatched chicks. **Ruffed grouse** (*Bonnasa umbellus*) are common to woodlands along interior Alaska rivers, but were recently introduced to the Matanuska-Susitna Valley, where they are now abundant. Summer foods include blueberries, high-bush cranberries, rose hips, and aspen buds. In winter, they feed primarily on the buds and twigs of aspen, willow, and soapberry. Game bird populations in Alaska fluctuate widely, but rarely in a 10-year cycle, and are probably influenced by climate, food and cover conditions, predators, and genetic factors (ADF&G 1994a).

Willow ptarmigan (*Lagopus lagopus*), Alaska's state bird, are found throughout the Cook Inlet area in high, treeless areas, along with rock and white-tailed ptarmigan (*L. mutus* and *L. leucurus*). Willow ptarmigan tend to live closest to the tree line. Hens nest on the open ground after snowmelt and hatchlings arrive in late June or early July. Ptarmigan populations fluctuate dramatically and the causes remain unknown (ADF&G 1994a).

USFWS

Willow ptarmigan.

Common loons (*Gavia immer*) are found on lakes throughout the Cook Inlet area during the summer, and they winter along the coast from the Aleutians to Baja California. The **Pacific loon** (*G. pacifica*) is distributed widely throughout the Cook Inlet area, and is the most common wintering loon on the coasts of Southcentral Alaska. **Red-throated loons** (*G. stellata*) are also common throughout the lease sale area. Loons migrate to coastal areas in September or early October, and return to their freshwater nesting habitat in May. Loons mate for life and return each year to the same area to breed. Breeding success may be related to the presence of gulls, jaegers, and foxes. Loons are excellent divers and feed on small fish, aquatic vegetation, insects, mollusks, and frogs (ADF&G 1994a).

Several species of other land birds have been identified as species of conservation concern by ADF&G, including the olive-sided flycatcher, rusty blackbird, blackpoll warbler, gray-cheeked thrush, and Townsend's warbler (ADF&G 2007). Populations of Alaskan breeding **olive-sided flycatchers** have declined 2.3 percent per year from 1980-2004, and survey data show a consistent and widespread decline of 3.5 percent across the U.S. and Canada from 1966-2004, probably due to deforestation and forest fire suppression activities in their wintering habitat of Central and South America (ADF&G 2007). Populations of **rusty blackbird** breeding in Alaska have declined 5.2 percent per year, and have also declined across North America and Canada at a rate of 10.3 percent per year. Causes of the decrease in abundance are unknown (ADF&G 2007). **Blackpoll warbler** populations have also declined in Alaska and across North America at similar rates. They are especially vulnerable to removal of tropical forests, and are of concern in Alaska because a high percentage of the species' global breeding range is found here (ADF&G 2007).

USFWS

Blackpoll warbler.

Townsend's warbler is found in the Cook Inlet area in May and June, and breeds in northern coniferous forests. This species may be sensitive to disturbances to its habitat of mature boreal forests (ADF&G 2007). **Gray-cheeked thrush** breed in northern spruce forests, and are found in early summer in upland mixed-species deciduous and coniferous forests of the Cook Inlet area. Surveys indicate that populations have declined in eastern North America, and they are particularly vulnerable to alterations to their breeding habitat of tropical broadleaf forests in Central America (ADF&G 2007).

Chickadees (*Parus sp.*) are common throughout Alaska's forests with some species associated with conifers and others with deciduous forest cover. These small birds live an average of 2 to 3 years, and feed on insects, including several considered to be forest pests (ADF&G 1994a). Hawks and other flying predators eat chickadees.

3. Mammals

a. Terrestrial Mammals

Numerous species of terrestrial mammals inhabit the Cook Inlet area. Big game species include moose, caribou, black bear, brown bear, Dall sheep, and mountain goat. Other terrestrial mammals include furbearers, such as wolves, lynx, marten, otters, beaver, mink, wolverines, and small game.

Moose (*Alces alces gigas*) are found throughout Southcentral Alaska (Figure 4.6), especially along recently burned areas with willow and birch shrubs, on timberline plateaus, and along major rivers (ADF&G 1994a). They generally calve between mid-May and early June. Moose have high reproductive potential and can reach the carrying capacity of their range if not limited by predation, hunting and severe weather (ADF&G 1994a). Food abundance is an important limiting factor for moose populations (ADF&G 2008c). Moose populations throughout the Cook Inlet area are significantly affected by winter weather conditions (Del Frate 2004a, c, d; Sinnott 2004; Selinger 2004a; McDonough 2004a, b).

USFWS

Moose.

In the Matanuska Valley (ADF&G management unit 14A), where moose were once scarce, agricultural activities, a 37,000 acre fire, land clearing for construction and roads, and habitat enhancement projects have resulted in population increases (Del Frate 2004a). Populations have also increased in the Anchorage area (unit 14C) with the abundance of prime moose browse found on burned-over and rehabilitated military lands, and in parks, greenbelts, residential areas, and quality riparian habitat along urban streams and rivers. However, winter habitat is expected to decrease in the long-term as urban development continues and habitat enhancement options are limited (Sinnott 2004).

On the Kenai Peninsula (units 15A, 15B, 15C), a lack of large wildfires has resulted in less moose browse, although small wildfires and some habitat projects have resulted in a temporary reversal of decreasing moose abundance (Selinger 2004a). Large portions of the Kenai Peninsula were infested and killed by the spruce bark beetle, which is expected to affect the quality of moose habitat, but the nature of the effects remains uncertain (McDonough 2004a, b). Important winter habitat on the southern Kenai Peninsula includes the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, lower reaches of the Fox River and Sheep Creek, and the Homer Bench (McDonough 2004b).

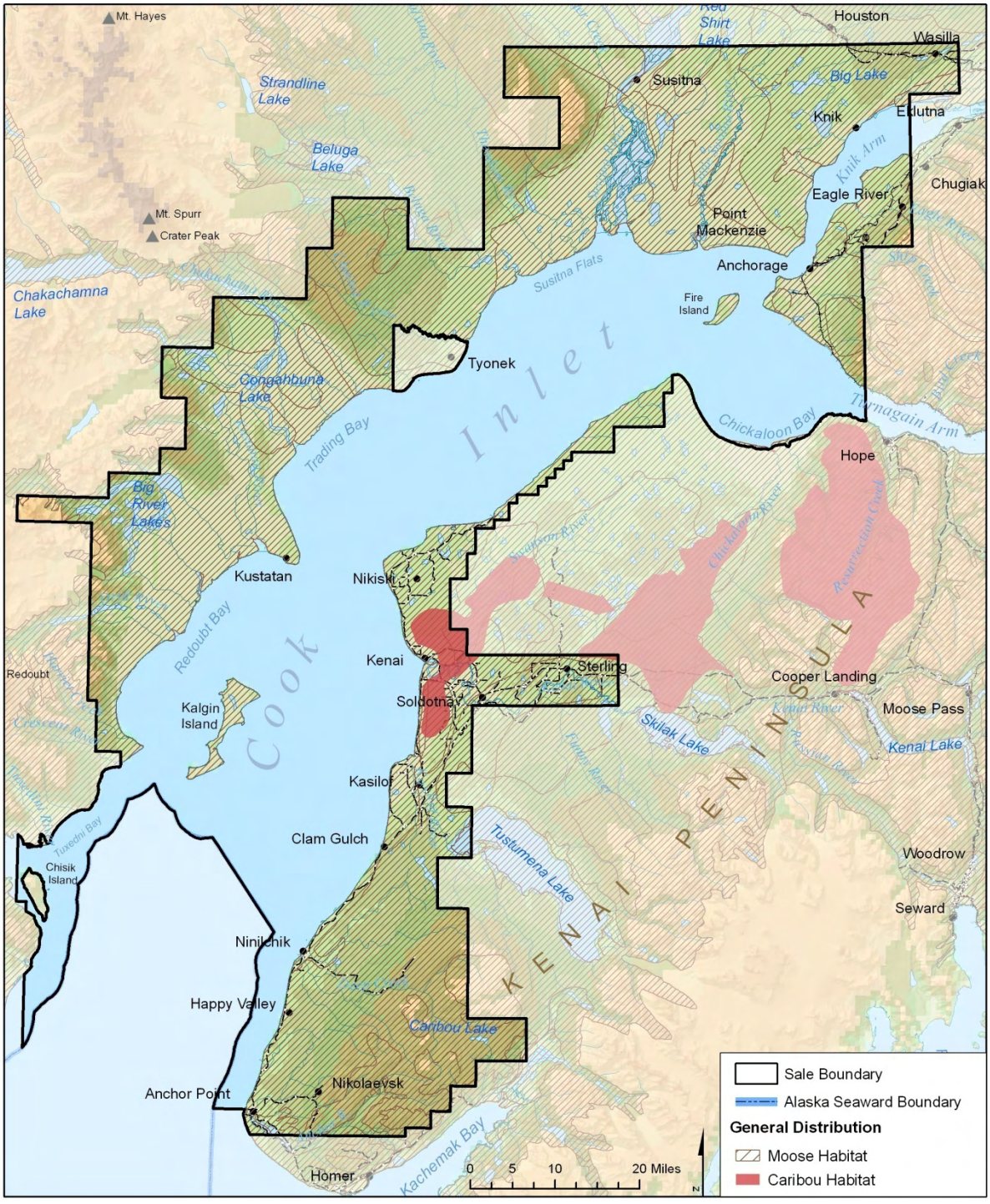


Figure 4.6. Important moose and caribou habitat in the Cook Inlet area.

Roadkill, predation, and habitat loss have been identified as chronic problems for moose populations in unit 15A (northern Kenai Peninsula; ADF&G 2007).

On the west side of Cook Inlet (units 16A and 16B), few wildfires and habitat enhancement projects have resulted in limited increases in moose habitat (Del Frate 2004c, d). In unit 16B (west side of Cook Inlet and Kalgin Island), population levels have been below management objectives, and have been too low to sustain normal harvest levels, and thus general hunting seasons and Federal subsistence cow hunts have been closed until the population increases (ADF&G 2007).

Abundance of moose ranged from about 1,000 animals in unit 16B to over 6,500 animals in unit 14A during regulatory years 1993/1994 through 2003/2004 (Table 4.10, Table 4.11, Table 4.12). Harvest of moose was also highest in unit 14A. Moose mortalities from vehicle and train accidents were significant throughout most of the Cook Inlet area (Table 4.10, Table 4.11, Table 4.12).

Known calving areas on the Kenai Peninsula include regions northeast of Kenai, along the coast between the Kenai and Kasilof rivers, northeast of Homer, and at the head of Kachemak Bay (ADF&G 2007). Moose are year-round residents, although many exhibit seasonal movements related to snow depth and the availability of food. They are found in both lowland and upland shrub communities and lowland areas with ponds during summer and fall. In winter, moose concentrate in areas of relatively shallow snow depth, frequently along river drainages. Wintering areas have been identified along several drainages in Trading and Redoubt; the lower McArthur River, upper Middle River, Noautka Slough, lower Chakachatna River, and Nikolai Creek. On the east side of Cook Inlet wintering areas occur northeast of Kenai, in the Soldotna area, along the coast between the Kasilof River and Ninilchik, along the Anchor River and Fritz Creek, and at the head of Kachemak Bay (ADF&G 2007). Moose also winter and calve along the Skwentna, Yentna, Kahiltna, Susitna, Little Susitna, and Matanuska Rivers (Figure 4.6; ADF&G 1985).

Table 4.10. Estimates of abundance, harvest, and road and train mortalities of moose in the Matanuska-Susitna and Anchorage areas, regulatory years 1993-2003.

Regulatory Year	Unit 14A[a]			Unit 14B[a]			Unit 14C[a]		
	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]
1993–94	5,672	490	184		49	24			
1994–95	6,000	605	299	2,336	55	91			
1995–96	5,250	543	96		80	27			
1996–97	6,000	940	202		121	17			
1997–98	5,500	834	184		101	27			
1998–99	4,729	671	149		109	34	2,100	117	158
1999–00	5,348	415	215	1,687	94	101	1,650	93	161
2000–01	5,552	401	140		82	21		107	165
2001–02	6,679	467	267		94	41	1,965	106	238
2002–03		624	132		94	13		114	154
2003–04	6,564								

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Del Frate 2004a, b; Sinnott 2004.

[a] Unit 14A is the Matanuska Valley; Unit 14B is the western Talkeetna Mountains; Unit 14C is the Anchorage area.
[b] Estimates of abundance.
[c] Road and train mortalities.

Table 4.11. Estimates of abundance, harvest, and road and train mortalities of moose in the Kenai Peninsula area, regulatory years 1993-2003.

Regulatory	Unit 15A[a]			Unit 15B[a]			Unit 15C[a]		
Year	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]
1993–94									
1994–95									
1995–96									
1996–97									
1997–98									
1998–99	3,400	311	138		77	74	2,650	310	76
1999–00		131	81		63	47	2,750	201	59
2000–01	1,704	171	59	958	67	30	2,750	238	58
2001–02	2,000	268	100		70	42	2,981	343	87
2002–03	1,500	181	73		61	33	3,000	292	78
2003–04									

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Selinger 2004a; McDonough 2004a, b.

[a] Unit 15A is the northern Kenai Peninsula; Unit 15B is the Kenai Peninsula; Unit 15C is the southern Kenai Peninsula.
[b] Estimates of abundance.
[c] Road and train mortalities.

Table 4.12. Estimates of abundance, harvest, and road and train mortalities of moose in the west side Susitna River and west side Cook Inlet, regulatory years 1993-2003.

Regulatory	Unit 16A (Westside Susitna)			Unit 16B (Westside of Cook Inlet and Kalgin Is.)		
Year	Abundance	Harvest	Road/Train[a]	Abundance	Harvest	Road/Train[a]
1993–94	3,284	128	9	5,659	220	0
1994–95	3,300	143	4	1,075	280	5
1995–96		166	15	1,156	234	0
1996–97		241	4	2,007	350	1
1997–98	3,636	237	14		376	1
1998–99		205	10		347	0
1999–00		208	16	3,384	396	0
2000–01	2,420	175	20	999	351	0
2001–02		189	15	3,923	199	0
2002–03		190	12		150	0
2003–04				1,023		

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Del Frate 2004c, d.

[a] Road and train mortalities.

The primary herds of **caribou** (*Rangifer tarandus granti*) in the Cook Inlet area are found on the Kenai Peninsula, the result of reintroductions in 1965-1966 and 1985-1986 (Selinger 2005b). Four herds of caribou inhabit the Kenai Peninsula: the Kenai Mountains caribou herd (KMCH), Kenai Lowlands caribou herd (KLCH), Killey River caribou herd (KRCH), and Fox River caribou herd (FRCH; Figure 4.6). A fifth herd, the Twin Lakes herd, is now considered part of the Killey River herd (Selinger 2005b). Herd sizes in 2003-2004 were estimated to be 300 caribou for the KMCH, 135 for the KLCH, 400 for the KRCH, 30 for FRCH.

The KMCH is found in the drainages of the Chikaloon River, Big Indian Creek, and Resurrection Creek. The KLCH uses an area north of the Kenai airport to the Swanson River in the summer; the Kenai National Wildlife Refuge includes important winter habitat for the KLCH, particularly along the Moose River and the Skilak Lake outlet, and south to Brown's Lake (Selinger 2005b). The upper drainages of the Funny River and Killey River are important habitat for the KRCH; and the FRCH uses the area between the upper Fox River and Truuli Creek (Selinger 2005b).

Caribou are found in subalpine habitat that is seldom used by moose, but they may compete with Dall sheep for winter range (Selinger 2005b). Caribou feed on willow leaves, sedges, flowering tundra plants, mushrooms, lichens, dried sedges, and small shrubs such as blueberries (ADF&G 1994a). They may use ridge tops, frozen lakes and bogs, and other open areas for resting to avoid predators such as wolves (ADF&G 1985). They also appear to avoid, or are very cautious, when entering riparian willow and other heavy brush, as these may be areas in which they would be more vulnerable to attacks by wolves and bears (ADF&G 1985). Open, gently-sloping terrain with a wide view is used by caribou during calving, probably to avoid predators. Caribou calve from approximately mid-May through early June (ADF&G 1994a). In general, abundance is limited by predation, including domestic dogs, coyotes, bears, and wolves, rather than habitat (Selinger 2005b).

Wetlands in the vicinity of the Kenai airport and along the coast to the south of the Kenai River provide calving habitat for the KLCH. Caribou stay in the vicinity of the calving grounds all summer. Following the rutting season in October, the herd moves northeast to winter on the Moose River Flats. Caribou remain on the Flats through April or early May, and then return to the Kenai area to calve (ADF&G 2007).

Black bears (*Ursus americanus*) and **brown bears** (*U. arctos*) are found throughout the Cook Inlet area. Black bears range throughout forested habitats of the Cook Inlet area, and may also be found from sea level to alpine areas (ADF&G 1994a). Brown bears are especially prevalent in remote lowland forests and intermountain valleys (Selinger 2005a). The game refuges and critical habitat areas located in the Cook Inlet area provide important habitat for both bear species, including the Susitna Flats State Game Refuge, Goose Bay State Game Refuge, Trading Bay State Game Refuge, Redoubt Bay Critical Habitat Area, Anchor River Critical Habitat Area, and Fox River Critical Habitat Area (ADF&G 2008f). Populations of black bears are estimated to be about 3,000-4,000 bears for the Kenai Peninsula, 530-1,080 bears in the upper Cook Inlet area, and a minimum of 1,825-3,650 bears in the west side of Cook Inlet area (Kavalok 2005a, c, McDonough 2005). An estimated 277 brown bears inhabit the Kenai Peninsula, 185-239 in upper Cook Inlet, and 586-1,156 in the west side of Cook Inlet (Kavalok 2005b, d; Selinger 2005a).

USFWS

Brown bear.

Other than during mating in June and July, black and brown bears are usually solitary, except for sows with cubs (ADF&G 1994a). However, concentrations of brown bears do occur where food is concentrated, such as on salmon spawning streams (ADF&G 1994a). They are most abundant in wooded areas, and along the Cook Inlet shoreline in the vicinity of streams, bogs, and clearings (ADF&G 2007). Black bears eat a wide variety of food, including green vegetation in the spring, winter-killed animals, newborn moose calves, small mammals, salmon, berries, ants, grubs, and other insects (ADF&G 1994a). They may also become habituated to eating garbage (ADF&G 1994a). The distribution and abundance of devil's club appears to be an important factor in the distribution and movement of black bears, and they seem to occur in higher densities along the southern outer coast, probably because of large runs of salmon and lower densities of brown bears (McDonough 2005). Brown bears eat a wide variety of foods, including berries, grasses, sedges, horsetails, cow parsnip, fish, squirrels, and 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 1994a). Brown bears eat most carrion, and will also become habituated to eating garbage.

Black bears hibernate in dens during the winter, which may be located from sea level to alpine areas, and may be in rock cavities, hollow trees, or excavations (ADF&G 1994a). Most brown bears also hibernate during the winter (ADF&G 1994a). Cubs are born in dens in the winter, and bears emerge from their dens in spring, often in May (ADF&G 1994a).

ADF&G

Black bear.

Brown bears of the Kenai Peninsula rely heavily on spawning salmon for food; therefore, access to spawning streams is critical for brown bears (ADF&G 2000a). Upland habitat adjacent to the riparian areas is used for loafing, cover, and other foraging when not feeding on salmon (ADF&G 2007). Large, undeveloped land masses contribute to stable bear populations, brown bears have large home ranges, and they also require habitat linkages such as travel corridors to food sources, and cover for security (ADF&G 2000a; ADF&G 2007).

Most of the Redoubt Bay Critical Habitat Area is intensively used by brown bears from spring through fall. Black bear spring concentration areas have been documented along the shore at the Kustatan River, the upper McArthur River, and the slopes bordering the critical habitat area between Drift River and the South Fork Big River. Both species are concentrated along salmon streams in late summer and fall, particularly the Kustatan River (ADF&G 2007). Known intensive use areas for black bear include the Susitna River at its mouth and an area about the river west of Willow. Black bears are also present in the Anchor River and Fritz Creek Critical Habitat Area during their active period (i.e., May-September), and probably den within the South Fork of the Anchor River and Fritz Creek drainages. Brown bears also inhabit the area, and both species concentrate along the South Fork of the Anchor River in July and August to feed on spawning salmon. Brown bears continue to feed on salmon at the headwaters of the South Fork of the Anchor River through early October (ADF&G 2007). Salmon heads and abundant streamside blueberries are favorite foods for bears.

After emerging from their dens in late April, black and brown bears move into grassy flatlands to graze on sedges, grasses, and other plants (ADF&G 2007). Brown bears are found throughout the coastal wetlands of Redoubt Bay during this time of year, and several black bear spring concentration areas have been documented in Redoubt and Trading bays. Bears also concentrate along salmon streams during the summer and fall. The Kustatan River, Anchor River, and headwaters of the Ninilchik River and Deep Creek support particularly high numbers of bears during salmon spawning periods (ADF&G 2007).

Because of alterations to bear habitat from development activities, and expansion into bear habitat by residents and visitors that led to increases in the number of bears killed in defense of life or property, brown bears of the Kenai Peninsula were designated a species of special concern by ADF&G in 1998 (ADF&G 2000a). As a result, an interagency brown bear study team was formed to coordinate basic research among the various state and federal agencies responsible for brown bears on the Kenai Peninsula, and the Kenai Peninsula Brown Bear Conservation Strategy was developed to identify policies and management actions that will help ensure the future of brown bears and their habitat, and avoid brown bears of the Kenai Peninsula being listed under the federal Endangered Species Act (ADF&G 2008d). A conservation assessment for Kenai Peninsula brown bears was developed in 2001 (IBBST 2001). Reducing non-hunting human-caused mortalities is a high priority for management of the Kenai Peninsula brown bear population (ADF&G 2007).

Several recent studies have added to the body of knowledge concerning Kenai Peninsula brown bears. A study of the genetics of Kenai brown bears found that there was no significant inbreeding of the population, and that there was no evidence of population substructuring (Jackson et al. 2008). Another study examined frequency and distribution of highway crossings by brown bears, finding that highways affected brown bear travel patterns (Graves et al. 2006).

Mountain goats (*Oreamnos americanus*), characterized by relatively short horns, are relatively abundant in Alaska. They usually inhabit rugged terrain, occupying steep and broken mountain areas from sea level to as high as 10,000 feet (ADF&G 1994a). In Southcentral Alaska, they are found primarily in the Chugach and Wrangell mountains, although their range extends into the Talkeetna Mountains, which is considered marginal habitat (Coltrane 2004). Mountain goats are also found throughout the Kenai Mountains, but primarily within the Kenai Fjords National Park, Kenai National Wildlife Refuge, Chugach National Forest, and Kachemak Bay State Park. Populations on the Kenai Peninsula are currently stable at about 3,500-4,500 animals (McDonough 2004c).

USFWS

Mountain goat.

Mountain goats normally summer in high alpine meadows where they graze on grasses, herbs, and low-growing shrubs. In winter, they migrate closer to the treeline in search of browse. Hemlock is an important winter food for mountain goats (ADF&G 1994a). Predators include wolves and bears. Mountain goats mate in November and December. Males may wander considerable distances in search of females. Usually a single kid is born in late May or early June. Kids usually remain with their mothers until the next breeding season. Mountain goats may live 14 to 15 years, though most live fewer than 12 years (ADF&G 1994a).

Wolves (*Canus lupus*) are present throughout the Cook Inlet area. Abundance of wolves varies with prey availability, disease, malnutrition, accidents, and harvest pressure (ADF&G 1994a). Wolves were not found on the Kenai Peninsula during the first half of the 20th century, but recolonized the area beginning in the 1960s. The current population is estimated to be about 200 wolves in 20 packs (Selinger 2003). About 120-150 wolves are estimated to inhabit the Matanuska-Susitna area (Del Frate 2003a), and about 120-140 in 16-19 packs in the west side of Cook Inlet (Del Frate 2003b).

Wolves usually live in packs ranging from 2 to 12 wolves (with an average of 6 or 7), however packs as large as 20 to 30 wolves may occur (ADF&G 1994a). Wolf packs tend to be territorial and stay within a particular range. On the other hand, wolves that depend on migratory caribou may

temporarily abandon their territory and travel long distances for food. Pack territory size ranges from 300 to 1,000 square miles with an average of 600 square miles of habitat. Moose or caribou are the wolf's primary food source, although the summer diet is supplemented by voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish (ADF&G 1994a). Wolves den in dug-out holes in well-drained soils as deep as 10 feet. Breeding occurs in February and March, and litters are born in May or early June (ADF&G 1994a).

Other terrestrial mammals also inhabit the Cook Inlet area. Small furbearers include coyote, beaver, lynx, marmot, marten, mink, muskrat, squirrel, red fox, river otter, weasels, and wolverine. These are found throughout the area depending on habitat quality and prey abundance (Selinger 2004b; Kavalok 2004a, b). Other small game include bats, hares, lemmings, pikas, porcupine, shrews, voles, and mice.

b. Marine Mammals

Beluga whales (*Delphinapterus leucas*) are a medium-sized cetacean related to narwhales, sperm and killer whales, dolphins, and porpoises (ADF&G 1994a). They are found in the Northern Hemisphere throughout arctic and subarctic waters, both coastal and offshore (NMFS 2008a). Their distribution varies by season and region, and is affected by a range of conditions such as temperature, ice cover, tides, and prey availability (NMFS 2008a). Adult beluga males range in size from 11-15 ft and in weight from 1,000-2,000 lbs; females tend to be smaller, usually no more than 12 ft in length (ADF&G 1994a). Female belugas attain sexual maturity between 4 and 5 years old, and males mature slightly later. In Cook Inlet, breeding is believed to occur in late spring and early summer, but mating periods, calving periods, and calving areas are poorly documented (Hobbs et al. 2006). The gestation period is about 14.5 months, and females may produce a calf about every three years (ADF&G 1994a). Belugas can live to be about 40 years old.

NMFS

Beluga whale.

Belugas are predators and consume a wide range of prey, probably influenced by both seasonal prey abundance and preference. Some species found in stomachs of belugas in Cook Inlet during spring, summer and fall include eulachon, salmon, walleye pollock, cod, flatfish, sculpin, crab, and shrimp, some of which may have resulted from secondary ingestion; there are no data on feeding habits of belugas during the winter, November through March (Hobbs et al. 2006).

NMFS currently considers belugas of Cook Inlet to be a discrete population that remains in Cook Inlet year round (Hobbs et al. 2006). However, this conclusion has been challenged as being based on data that are too limited, and on a faulty and subjective application of the definitions and criteria for designating a population as a "Distinct Population Segment" under the Endangered Species Act (Hartig et al. 2007).

Based on aerial surveys and one radio telemetry study of 14 animals, beluga distribution is currently believed to be concentrated in upper Cook Inlet, particularly near river mouths and mudflats, and in shallow, relatively warm, low-salinity water near major river outflows such as the Susitna River, Knik Arm, and Chikaloon Bay, although in the past they were also seen to a lesser extent in Kachemak Bay, Redoubt Bay, and Trading Bay (Moore et al. 2000; Hobbs et al. 2006; Hobbs et al. 2005; Goetz et al. 2007). It is unknown if this reflects a preference for those conditions, or is

indirectly related to prey availability and distribution, and low occurrence of predators (Moore et al. 2000; Goetz et al. 2007). In winter, belugas are more dispersed (Moore et al. 2000). In Knik Arm, movement of belugas and their usage of habitat is greatly influenced by extreme tidal fluctuations that result in changes in water depths of up to 39 ft (Funk et al. 2005). Although distribution of belugas is highly variable, movements through Knik Arm appear to follow corridors along the eastern shoreline (Ireland et al. 2005).

Studies of belugas in Knik Arm in 2004 and 2005 concluded that,

> "The pattern of beluga whale use of Knik Arm might best be described as high during the fall (August through October), reduced and more sporadic in shoulder seasons (April through July and November through early December), and occasional visitation at other times of year (mid-December through March). This description best fits observations made in Knik Arm as well as available data on the relative use of different parts of Cook Inlet by beluga whales" (Markowitz et al. 2005).

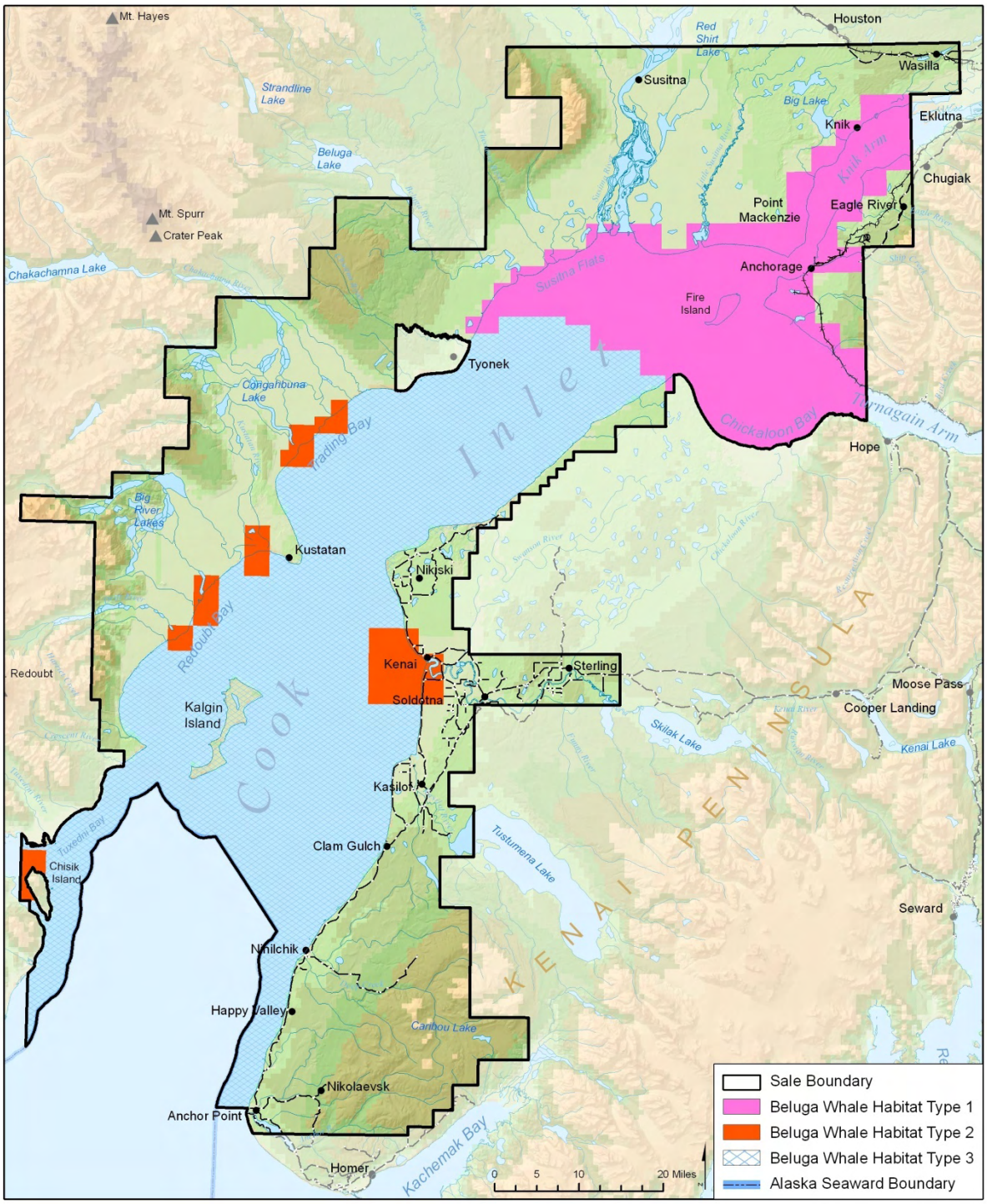
The current distribution of belugas in the core areas of their range, relative to past sitings, may be a result of a smaller population, and in addition, belugas may prefer estuarine waters (Goetz et al. 2007). As the population recovers after cessation of subsistence hunting, beluga distribution will probably expand into portions of habitat that are currently unused (Goetz et al. 2007). Based on information concerning habitat usage provided to DO&G by NMFS, supplements to the 1999 Best Interest Finding for Cook Inlet were issued in 2004 and 2008 adding restrictions to tracts to the mitigation measures (Figure 4.7; DO&G 2004, 2008).

NMFS

Beluga whales.

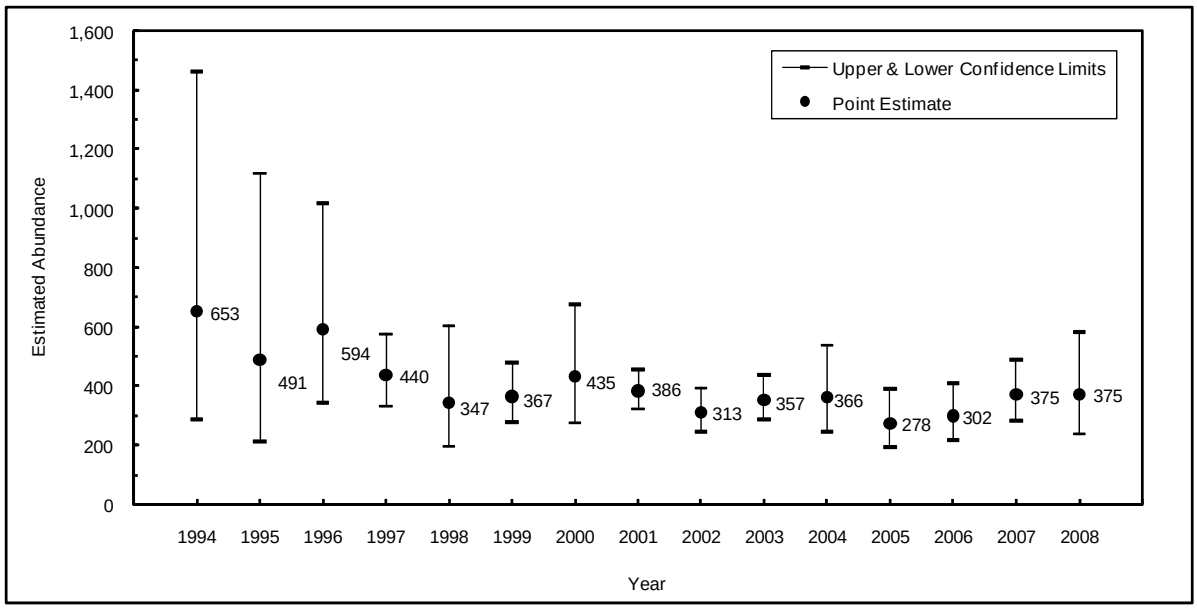
Abundance of belugas in Cook Inlet decreased from 1994-1998, most likely due to Native subsistence hunts (Hobbs et al. 2006). Estimating abundance of Cook Inlet belugas is difficult because of several sources of variability during aerial surveys, including variable surfacing intervals of belugas, varying correction factors to account for missed whales, observer variability, and because high densities of beluga aggregations make them difficult to count (Hobbs et al. 2000a; Hobbs et al. 2000b). Estimating beluga abundance is also difficult because of differences in visibility of older, white belugas which are relatively easy to spot, and younger, blue-gray whales which are difficult to see (Hartig et al. 2007). Abundance estimates with their associated variances are available for 1994-2008 (Figure 4.8; Hobbs et al. 2000a; Hobbs et al. 2006; Hobbs et al. 2008). Estimates for 1994-1998 showed a significantly decreasing trend; there was no significant trend in estimates for 1999-2005 (Angliss and Outlaw 2006). Point estimates of abundance in 2006 (302 animals) and 2007 (375 animals) were higher than for 2005 (278 animals), the lowest point estimate since 1994 (Hobbs et al. 2008). The point estimate for 2008 was 375 beluga whales (NMFS 2008j).

On April 20, 2007, NMFS proposed endangered status for Cook Inlet belugas (72FR 76, 19854). On July 31, 2007, the State of Alaska submitted comments to NMFS objecting to the proposal. The state's objections were based on issues with how abundance estimates were calculated, assumptions underlying abundance estimates and reproductive rates, lack of scientific and commercial data to support a claim of danger of extinction, issues with whether or not the Cook Inlet beluga population is a "Distinct Population Segment", lack of impacts on belugas or their habitat, and the large amount of protected habitat (over 15 million acres) in the Cook Inlet area (Hartig et al. 2007). On April 22, 2008, NMFS extended the date by which a final determination on endangered status would be made



Notes: See Chapter 9, Section A2p-A2r.

Figure 4.7. Location of tracts with restrictions on oil and gas development, based on beluga habitat types defined by NMFS.



Source: Hobbs et al. 2008; NMFS 2008j.

Figure 4.8. Estimated abundance of beluga whales in Cook Inlet, 1994-2008.

to October 20, 2008 (73FR 78, 21578). On October 22, 2008, a final determination to list Cook Inlet beluga whales as endangered was issued, with an effective date of December 22, 2008 (73 FR 205, 62919). A conservation plan for Cook Inlet belugas was also published by NMFS in October 2008 (NMFS 2008b). NMFS critical habitat designations are pending.

Fin whales (*Balaenoptera physalus*) are found off the coast of North America and in the Bering Sea during the summer (Angliss and Outlaw 2008), although little is known of their distribution in, and use of, Cook Inlet. Fin whales migrate to subtropical waters in the winter, where they mate and calve (ACS 2004). Females reach sexual maturity at 6-8 years old, and give birth every 2-3 years (NMFS 2005). They migrate to the Arctic and Antarctic during the summer for feeding. Although they are usually solitary, they may be found in groups of three to seven, and at times, in larger concentrations. As a baleen whale, the diet of fin whales consists mostly of krill and schooling fish (ACS 2004).

The fin whale is listed as endangered under the Endangered Species Act of 1973, and the Northeast Pacific stock is classified as a strategic stock. Reliable estimates of populations size and population trends are lacking (Angliss and Outlaw 2008).

Humpback whales (*Megaptera novaeangliae*) are found throughout the world's oceans (Angliss and Outlaw 2008). They occur in subtropical and tropical waters during the winter. Humpback whales feed on euphasiids and small schooling fish. The Central North Pacific stock migrates between wintering areas in Hawaii or Mexico where they calve, and a summer feeding area in the North Pacific that includes Cook Inlet. The entire North Pacific stock is thought to number about 4,000 (Angliss and Outlaw 2008). Humpback whales reach sexual maturity at 4 to 6 years, and females give birth every two to three years (ADF&G 1994a).

Humpback whales are listed as endangered species under the Endangered Species Act, and the Central North Pacific stock is classified as a strategic stock (Angliss and Outlaw 2008).

Harbor porpoises (*Phocoena phocoena*) are widely distributed and may be locally abundant (NMFS 2008g). Those occurring in Cook Inlet belong to the Gulf of Alaska stock, one of three stocks found in Alaska (Angliss and Outlaw 2008). They are generally found in harbors, bays, and river mouths (MMS 2003). Densities of harbor porpoises in Cook Inlet have been reported at 0.72 animals per square kilometer (MMS 2003, citing to Dahlheim et al. 2000). Based on a 1991 aerial survey, 422 harbor porpoises were estimated to inhabit Cook Inlet (Small and DeMaster 1995). They make inshore-offshore seasonal movements that may be related to prey or ice conditions (NMFS 2008g). Harbor porpoises feed on a wide variety of fish and cephalopods, particularly schooling fish such as herring, mackerel, and pollock (MMS 2003, citing to Leatherwood and Reeves 1987). Harbor porpoises are usually found singly, in pairs, or in groups up to 10 (NMFS 2008g). Little is known of their reproductive behavior, although mating occurs in summer and births occur between May and July (NMFS 2008g).

Harbor seals (*Phoca vitulina richardsi*) are found in marine and estuarine waters of the Cook Inlet area (Figure 4.9), but are also occasionally found seasonally in freshwater rivers and lakes (Angliss and Outlaw 2008; ADF&G 1994a). The most recent estimates put abundance of harbor seals in the Gulf of Alaska, which includes Cook Inlet, at 45,975 animals for 1996-2000, but there are no data available on population trends for Cook Inlet harbor seals (Angliss and Outlaw 2008). Harbor seals in Alaska are currently considered to comprise three stocks, but new genetic information is being analyzed and is expected to result in revisions to the current stock divisions (Angliss and Outlaw 2008). Harbor seals are listed as an Alaska species of special concern (ADF&G 2008b).

USFWS

Harbor seal

Harbor seals are generally non-migratory, but they make local movements related to tides, weather, season, food availability, and reproduction (Angliss and Outlaw 2008). Haul out areas include rocks, reefs, beaches, and drifting glacial ice (Angliss and Outlaw 2008). They use haul outs to rest, give birth, nurse their pups, and for thermal regulation, social interaction, and to avoid predators (ADF&G 1994a; NMFS 2008f). They have a strong tendency to return to the same haul out sites in June and July (Angliss and Outlaw 2008). Harbor seals become sexually mature between 3-7 years old, and their pups are born from May through mid-July (ADF&G 1994a). Common prey includes walleye, pollock, Pacific cod, capelin, eulachon, Pacific herring, salmon, octopus, and squid (ADF&G 1994a).

Three stocks of **northern sea otter** (*Enhydra lutris kenyoni*) occur in Alaska: Southeast, Southcentral, and Southwest stocks. The Southcentral Alaska stock is found in lower Cook Inlet but at generally low densities; they do not occur in upper Cook Inlet (Figure 4.9; Angliss and Outlaw 2008). They are generally found in shallower waters because they forage in subtidal and intertidal habitats (Angliss and Outlaw 2008). Sea otters are generally not migratory, although they may travel long distances if an area becomes overpopulated or food is scarce (Angliss and Outlaw 2008; ADF&G 1994a). Sea otters feed on sea urchins, crabs, clams, mussels, octopus, other marine invertebrates, and fish (ADF&G 1994a). The sea otter body temperature is maintained by air trapped in their fur (ADF&G 1994a).

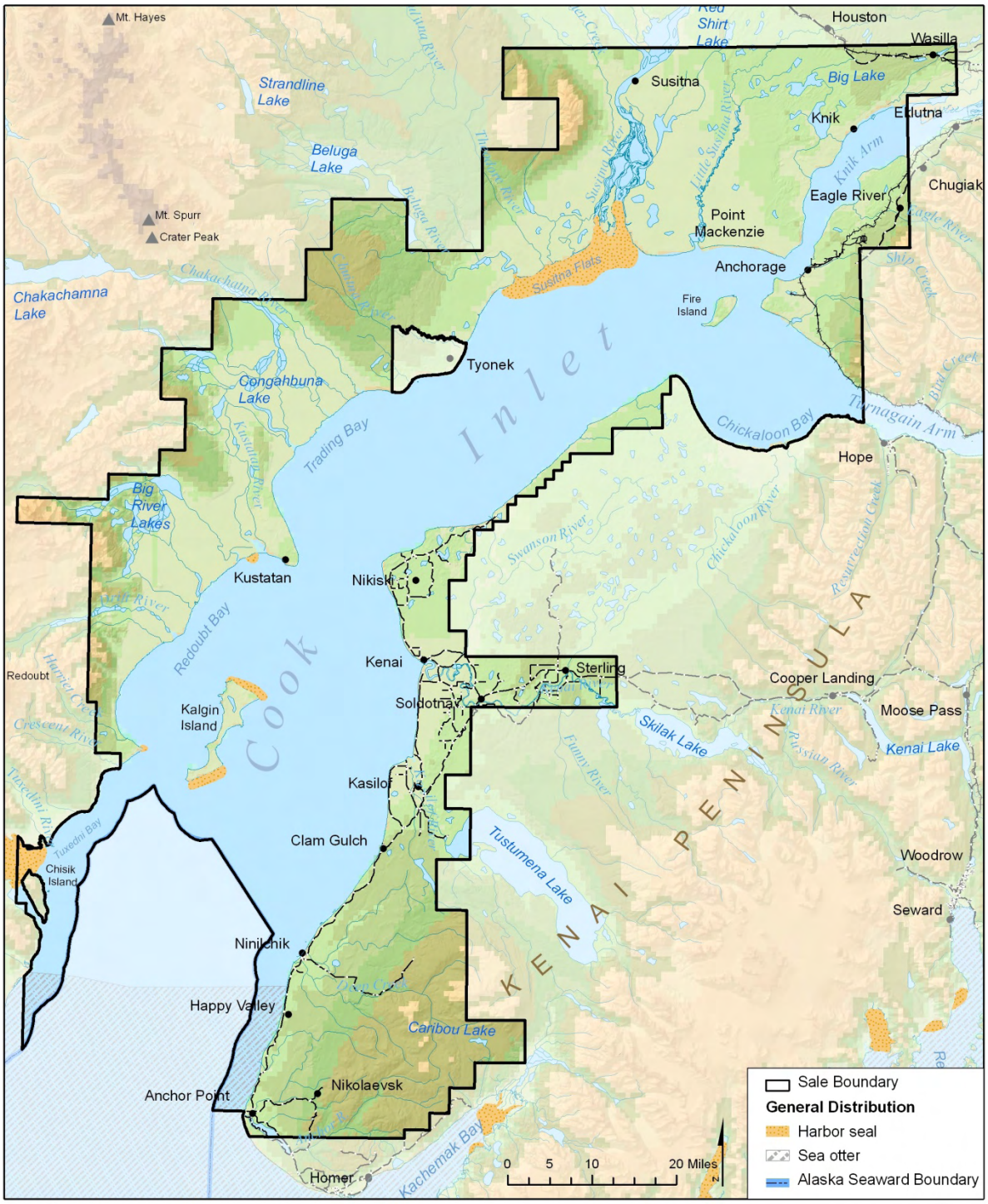


Figure 4.9. Important harbor seal and sea otter habitat.

In 2002, abundance of sea otters in lower Cook Inlet and Kenai Fjords was estimated to be 2,673 animals. The overall trend for the Southcentral stock, which includes Cook Inlet, appears to be stable or slightly increasing, and the population in lower Cook Inlet and Kenai Fjords also appears to be increasing slightly (Angliss and Outlaw 2008). The Southcentral, as well as the Southeast, sea otter stocks are not listed as depleted, threatened or endangered under federal regulations; however, the Southwest stock was listed as threatened under the Endangered Species Act on August 9, 2005 (70 FR 46365 46386).

Steller sea lions (*Eumetopias jubatus*) found in the Cook Inlet area belong to the western stock, one of two stocks of sea lions inhabiting the North Pacific Ocean rim (NMFS 2008l). However, rookeries and haul-outs identified by NMFS are outside the lease sale area (Figure 4.10; NMFS 2008k). Rookeries, used by sea lions for breeding, are usually found on remote island beaches exposed to wind and waves, usually with access that is difficult to predators. Rookeries vary from expanses across low-lying reefs and islands, to narrow strips of beach by steep cliffs; substrates may be sand, gravel, cobble, boulder, or bedrock (NMFS 1992). Haulouts, used by adults during the non-breeding season, include areas used as rookeries during the breeding season, as well as rocks, reefs, beaches, jetties, breakwaters, navigational aids, floating docks, and sea ice (NMFS 1992).

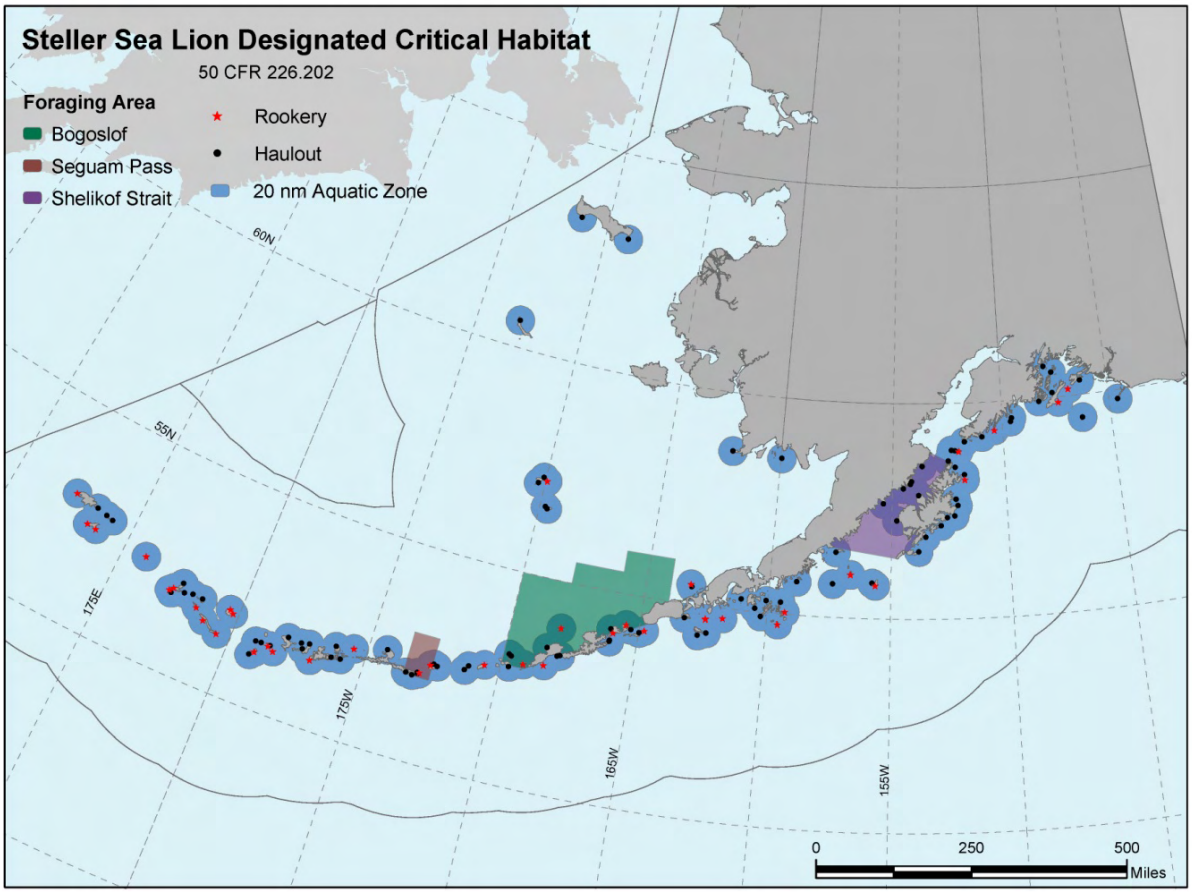
NMFS

Steller sea lions

Steller sea lions can move long distances, and they make seasonal movements from exposed summer areas to protected areas in the winter (ADF&G 1994a). Males that breed in California appear to spend the non-breeding season in Alaska and British Columbia (NMFS 1992). They congregate on rookeries to breed, usually mid-May through mid-July (ADF&G 1994a). Females usually return to the rookery of their birth for breeding (NMFS 1992).

Steller sea lions feed from the intertidal zone to the continental shelf on a wide variety of fish, including pollock, flounder, herring, capelin, Pacific cod, salmon, rockfish, sculpin, and invertebrates such as squid and octopus (ADF&G 1994a).

Steller sea lions were listed as a threatened species under the Endangered Species Act on April 5, 1990 because of a substantial decline in the western stock (NMFS 2008i). Critical habitat was designated by NMFS in 1993, including a 20 nautical mile buffer zone around all major haulouts and rookeries, associated land, air, and aquatic zones, and three large offshore foraging areas (NMFS 2008i). The western stock, reclassified as endangered in 1997, continued to decline during the 1990s, and the total population of the western stock in Alaska is now estimated to be about 45,000 animals (Angliss and Outlaw 2008). From the late 1970s through 1990, the western populations declined by about 70 percent, and by as much as 15 percent annually. It is believed that a combination of several factors contributed to the decline, including changes in the quantity and quality of prey, natural environmental shifts, incidental mortality from commercial fishing, predation, and disease (NMFS 1992; NMFS 2008i). The decline decreased to about 5 percent annually during the 1990s, and recent counts indicate that the decline has stabilized (NMFS 2008i; Angliss and Outlaw 2008).



Source: NMFS 2008k.

Figure 4.10. Federally-designated critical habitat for Steller sea lion.

C. References

ACS (American Cetacean Society)
2004 American Cetacean Society fact sheet: fin whale. http://www.acsonline.org/factpack/finwhl.htm Accessed September 16, 2008.

ADF&G (Alaska Department of Fish and Game)
1985 Alaska habitat management guide, Southcentral Region Volume I: life histories and habitat requirements of fish and wildlife. Division of Habitat.

ADF&G (Alaska Department of Fish and Game)
1988 Susitna Flats State Game Refuge Management Plan. Divisions of Habitat and Game. http://www.wildlife.alaska.gov/refuge/pdfs/susitna.pdf

ADF&G (Alaska Department of Fish and Game)
1989 Anchor River/Fritz Creek Critical Habitat Area management plan. Divisions of Habitat and Wildlife Conservation. http://www.wildlife.alaska.gov/refuge/pdfs/anchor_river.pdf

ADF&G (Alaska Department of Fish and Game)
1991 Anchorage coastal wildlife management plan. Divisions of Habitat and Wildlife Conservation. http://www.wildlife.alaska.gov/refuge/pdfs/anch_coastal.pdf

ADF&G (Alaska Department of Fish and Game)
1993 Kachemak Bay and Fox River Flats Critical Habitat Areas management plan. Divisions of Habitat and Wildlife Conservation. http://www.wildlife.alaska.gov/refuge/pdfs/kachemak_bay.pdf

ADF&G (Alaska Department of Fish and Game)
1994a ADF&G wildlife notebook series (with 1999 and 2003 updates for some species). http://www.adfg.state.ak.us/pubs/notebook/notehome.php

ADF&G (Alaska Department of Fish and Game)
1994b Trading Bay State Game Refuge and Redoubt Bay Critical Habitat Area management plan. Divisions of Habitat and Wildlife Conservation. http://www.wildlife.alaska.gov/refuge/pdfs/tradingbay.pdf

ADF&G (Alaska Department of Fish and Game)
2000a Kenai Peninsula brown bear conservation strategy. Division of Wildlife Conservation, Alaska Department of Fish and Game. http://www.wildlife.alaska.gov/management/planning/planning_pdfs/kbbcs2.pdf

ADF&G (Alaska Department of Fish and Game)
2000b Personal communication from Lance L. Trasky, Regional Supervisor, Division of Habitat, Anchorage to James Hansen, Chief Petroleum Geophysicist, DO&G, February 28, 2000.

ADF&G (Alaska Department of Fish and Game)
2002a Palmer Hay Flats State Game Refuge Revised Management Plan. Division of Wildlife Conservation. http://www.wildlife.alaska.gov/refuge/pdfs/palmer_hf.pdf

ADF&G (Alaska Department of Fish and Game)
2002b Preliminary report to the Alaska Board of Fisheries: Collapsed or recovering shellfish fisheries in the state of Alaska, October 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J02-06, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.1J.2002.06.pdf

ADF&G (Alaska Department of Fish and Game)
2006 Our wealth maintained: A strategy for conserving Alaska's diverse wildlife and fish resources. Alaska Department of Fish and Game, Juneau. http://www.sf.adfg.state.ak.us/statewide/ngplan/files/cover_and_acknowl.pdf

ADF&G (Alaska Department of Fish and Game)
2007 Personal communication from Mark Fink, Habitat Biologist, Division of Sport Fish, Anchorage to Allison Iverson, DO&G, June 6, 2007.

ADF&G (Alaska Department of Fish and Game)
2008a Alaska's non-endangered species. Endangered Species in Alaska. http://www.adfg.state.ak.us/special/esa/non-endangered.php Accessed August 11, 2008.

ADF&G (Alaska Department of Fish and Game)
2008b Alaska species of special concern. http://www.adfg.state.ak.us/special/esa/species_concern.php Accessed August 12, 2008.

ADF&G (Alaska Department of Fish and Game)
2008c Ecosystem description, species of Kachemak Bay: moose. http://www.habitat.adfg.state.ak.us/geninfo/kbrr/coolkbayinfo/kbec_cd/html/ecosys/species/moose.htm Accessed May 19, 2008.

ADF&G (Alaska Department of Fish and Game)
2008d Interagency brown bear study team. http://www.habitat.adfg.state.ak.us/geninfo/kbrr/coolkbayinfo/kbec_cd/html/projsumm/brnbear.htm Accessed May 2, 2008.

ADF&G (Alaska Department of Fish and Game)
2008e Lake stocking policy for Sport Fish Division, revised 04/07/2008. Alaska Department of Fish and Game Division of Sport Fish. http://www.sf.adfg.state.ak.us/Statewide/hatchery/PDFs/StockingPolicy.pdf

ADF&G (Alaska Department of Fish and Game)
2008f Refuges, sanctuaries, and critical habitat areas. Division of Wildlife Conservation. http://www.wildlife.alaska.gov/index.cfm?adfg=refuge.main Accessed March 2008.

ADF&G (Alaska Department of Fish and Game)
2008g Run timing - Anchorage, Whittier, Seward. Anchorage Area Recreational Fishing Series. http://www.sf.adfg.state.ak.us/region2/pdfpubs/anchorage_runtime.pdf Accessed February 1, 2008.

ADF&G (Alaska Department of Fish and Game)
2008h Run timing - Kenai, Soldotna, Homer. Kenai Peninsula Recreational Fishing Series. http://www.sf.adfg.state.ak.us/region2/pdfpubs/kenrun.pdf Accessed February 1, 2008.

ADF&G (Alaska Department of Fish and Game)
2008i Run timing - West Cook Inlet, Palmer, Wasilla, Talkeetna. Northern Cook Inlet Recreational Fishing Series. http://www.sf.adfg.state.ak.us/region2/pdfpubs/valley_runtime.pdf Accessed February 1, 2008.

ADF&G (Alaska Department of Fish and Game)
2008j Sea cucumber fisheries in Alaska. http://www.cf.adfg.state.ak.us/geninfo/shellfsh/seacucumber/seacuchome.php Accessed June 4, 2008.

ADF&G (Alaska Department of Fish and Game)
2008k Susitna sockeye salmon action plan. http://www.boards.adfg.state.ak.us/fishinfo/meetinfo/2007_2008/sus_salmonplan.pdf

ADNR (Alaska Department of Natural Resources)
1980 Chugach State Park master plan. Division of Parks. http://www.dnr.state.ak.us/parks/plans/chugach/chugach_sp_complete.pdf

ADNR (Alaska Department of Natural Resources)
1991 Susitna Basin recreation rivers management plan summary. Division of Mining, Land and Water. http://www.dnr.state.ak.us/mlw/planning/mgtplans/susitna/pdf/Summary_Brochure.pdf

ADNR and ADF&G (Alaska Department of Natural Resources and Alaska Department of Fish and Game)
1986 Matanuska Valley Moose Range management plan. http://www.dnr.state.ak.us/mlw/planning/mgtplans/mat_valley/pdf/Matanuska_Valley_Moose_Range_Management_Plan.pdf

Angliss, R. P. and R. B. Outlaw
2006 Beluga whale (*Delphinapterus leucas*): Cook Inlet stock. NOAA Technical Memorandom, NOAA-TM-AFSC-168. May 15, 2006. http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2006whbg-ci.pdf

Angliss, R. P. and R. B. Outlaw
2008 Alaska marine mammal stock assessments, 2007. NOAA Technical Memorandom, NOAA-TM-AFSC-180. http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2007.pdf

Armstrong, R. H.
1996 Alaska's fish: A guide to selected species. Alaska Northwest Books, Seattle, WA.

Bernard, D. R., J. F. Parker and R. Lafferty
1993 Stock assessment of burbot populations in small and moderate-size lakes. North American Journal of Fisheries Management 13:657-675.

BLM (Bureau of Land Management)
2006 Ring of Fire: Proposed resource management plan and final environmental impact statement. Prepared by: Anchorage Field Office, BLM, U.S. Department of the Interior. July 2006. http://www.blm.gov/ak/st/en/prog/planning/ring_of_fire_propos/ring_of_fire_proposed.html

Burgner, R. L.
1991 Life history of sockeye salmon (*Oncoryhnchus nerka*). Pages 1-117 *in* C. Groot and L. Margolis, editor. Pacific salmon life histories. UBC Press, Vancouver, B.C.

Clark, J. H., A. McGregor, R. D. Mecum, P. Krasnowski and A. M. Carroll
2006 The commercial salmon fishery in Alaska. Alaska Fishery Research Bulletin 12:1-146. http://www.adfg.state.ak.us/pubs/afrb/vol12_n1/clarv12n1.pdf

Coltrane, J.
2004 Unit 13D and 14 mountain goat management report. Pages 146-164 *in* C. Brown, editor. Mountain goat management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 12.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/04goamt.pdf

Conant, B., J. I. Hodges, D. J. Groves and J. G. King
2007 The 2005 census of trumpeter swans on Alaskan nesting habitats. Alaska trumpeter swan status report, 2005, Waterfowl Management, U.S. Fish and Wildlife Service. April 2007. http://alaska.fws.gov/mbsp/mbm/waterfowl/surveys/trswatl.htm

Del Frate, G.
2003a Units 14 wolf management report. Pages 99-108 *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999 - 30 June 2002. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/wol03mt-web-se-sc.pdf

Del Frate, G.
2003b Units 16 wolf management report. Pages 109-117 *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999 - 30 June 2002. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/wol03mt-web-se-sc.pdf

Del Frate, G.
2004a Unit 14A moose management report. Pages 161-173 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

Del Frate, G.
2004b Unit 14B moose management report. Pages 174-182 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

Del Frate, G.
2004c Unit 16A moose management report. Pages 224-232 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

Del Frate, G.
2004d Unit 16B moose management report. Pages 233-245 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

DO&G (Division of Oil and Gas)
2004 Supplement to Cook Inlet areawide oil and gas lease sale best interest finding. Prepared by: Division of Oil and Gas, Department of Natural Resources. February 18, 2004. http://www.dog.dnr.state.ak.us/oil/products/publications/cookinlet/ciaw2004/ci_2004_supplement.pdf

DO&G (Division of Oil and Gas)
2008 Supplement to Cook Inlet areawide oil and gas lease sale best interest finding. Prepared by: Division of Oil and Gas, Department of Natural Resources, Anchorage. February 4, 2008. http://www.dog.dnr.state.ak.us/oil/products/publications/cookinlet/ciaw2008/2008_Supplement_Cook_Inlet_1999_Fina_Finding.pdf

Environmental Laboratory
1987 Corps of Engineers wetlands delineation manual. U.S. Army Engineer Waterways Experiment Station Technical Report Y-87-1 (online edition), Vicksburg, MS. http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf

EPA (Environmental Protection Agency)
2008 Ecoregions of North America. Western Ecology Division. http://www.epa.gov/wed/pages/ecoregions/na_eco.htm#Downloads Accessed May 12, 2008.

Fair, L. F., R. A. Clark and J. J. Hasbrouck
2007 A review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-06, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fms07-06.pdf

Field, C. M. and C. J. Field
1999 Alaska's seashore creatures: a guide to selected marine invertebrates. Alaska Northwest Books, Anchorage, AK.

Funk, D. W., T. M. Markowitz, R. Rodrigues, M. R. Link and M. W. Demarchi
2005 The influence of tide on the habitat use and movements of beluga whales in Knik Arm. Pages 6-1 - 6-27 *in* D. W. Funk, T. M. Markowitz and R. Rodrigues, editor. Baseline studies of beluga whale habitat use in Knik Arm, upper Cook Inlet, Alaska: July 2004 - July 2005. Prepared by LGL Alaska Research Associates in association with HDR Alaska,, Inc. for Knik Arm Bridge and Toll Authority. Anchorage. http://www.knikarmbridge.com/Tech_Reports/Boiler%20QC/Baseline%20Studies%20of%20Beluga%20Whale%20Habitat%20Use%20in%20Knik%20Arm.pdf

Gill, R. E., Jr. and T. L. Tibbitts
1999 Seasonal shorebird use of intertidal habitats in Cook Inlet, Alaska. Biological Resources Division, Alaska Biological Science Center, USGS, OCS Study MMS 99-0012 for Mineral Management Service, Anchorage.

Goetz, K. T., D. J. Rugh, A. J. Read and R. C. Hobbs
2007 Habitat use in a marine ecosystem: beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Marine Ecology Progress Series 330:247-256. http://www.fakr.noaa.gov/protectedresources/whales/beluga/reports/habitatuse012507.pdf

Graves, T. A., S. Farley and C. Servheen
2006 Frequency and distribution of highway crossings by Kenai Peninsula brown bears. Wildlife Society Bulletin 34(3):800-808. http://www.wildlifejournals.org/archive/0091-7648/34/3/pdf/i0091-7648-34-3-800.pdf

Hartig, L., T. Irwin, D. S. Lloyd and E. Notti
2007 State of Alaska comments on ESA beluga listing, and Enclosure with overview and chapters 1-5. From: The Offices of the Commissioners of the Departments of Commerce, Community and Economic Development; Environmental Conservation; Natural Resources; and Fish and Game. To: Kaja Brix, Assistant Regional Administator, National Marine Fisheries Service, Protected Resources Division. July 31, 2007 and August 3, 2007. http://www.gov.state.ak.us/archive.php?id=525&type=1

Hobbs, R. C., K. L. Laidre, D. J. Vos, B. A. Mahoney and M. Eagleton
2005 Movements and area use of belugas, Delphinapterus leucas, in a subarctic Alaskan estuary. Arctic 58(4):331-340.

Hobbs, R. C., D. J. Rugh and D. P. DeMaster
2000a Abundance of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994-2000. Marine Fisheries Review 62(3):37-45.

Hobbs, R. C., K. E. W. Shelden, D. J. Rugh and S. A. Norman
2008 2008 status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). Alaska Fisheries Science Center, NOAA, AFSC Processed Rep. 2008-02, Seattle. http://www.afsc.noaa.gov/Publications/ProcRpt/PR%202008-02.pdf

Hobbs, R. C., K. E. W. Shelden, D. J. Vos, K. T. Goetz and D. J. Rugh
2006 Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). Alaska Fisheries Science Center, NOAA, AFSC Processed Rep. 2006-16, Seattle. http://www.afsc.noaa.gov/Publications/ProcRpt/PR%202006-16.pdf

Hobbs, R. C., J. M. Waite and D. J. Rugh
2000b Beluga, *Delphinapterus leucas*, group sizes in Cook Inlet, Alaska, based on observer counts and aerial video. Marine Fisheries Review 62(3):46-59.

IBBST (Interagency Brown Bear Study Team)
2001 A conservation assessment of the Kenai Peninsula brown bear. November 2001.

Ireland, D. S., S. McKendrick, D. W. Funk, T. M. Markowitz, A. P. Ramos, M. R. Link and M. W. Demarchi
2005 Spatial analysis of beluga whale distribution in Knik Arm. Pages 7-1 - 7-22 *in* D. W. Funk, T. M. Markowitz and R. Rodrigues, editor. Baseline studies of beluga whale habitat use in Knik Arm, upper Cook Inlet, Alaska: July 2004 - July 2005. Prepared by LGL Alaska Research Associates in association with HDR Alaska,, Inc. for Knik Arm Bridge and Toll Authority. Anchorage. http://www.knikarmbridge.com/Tech_Reports/Boiler%20QC/Baseline%20Studies%20of%20Beluga%20Whale%20Habitat%20Use%20in%20Knik%20Arm.pdf

Jackson, J. V., S. L. Talbot and S. Farley
2008 Genetic characterization of Kenai brown bears (*Ursus arctos*): microsatellite and mitochondrial DNA control region variation in brown bears of the Kenai Peninsula, south central Alaska. Canadian Journal of Zoology 86:756-764.

Johnson, J. and M. Daigneault
2008 Catalog of waters important for spawning, rearing, or migration of anadromous fishes - Southcentral Region, effective June 2, 2008. Alaska Department of Fish and Game, Special Publication No. 08-05, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp08-05.pdf

Kavalok, T.
2004a Unit 14 furbearer management report. Pages 170-192 *in* C. Brown, editor. Furbearer management report of survey and inventory activities 1 July 2000 - 30 June 2003. Alaska Department of Fish and Game, Project 7.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/fur04mt.pdf

Kavalok, T.
2004b Unit 16 furbearer management report. Pages 193-212 *in* C. Brown, editor. Furbearer management report of survey and inventory activities 1 July 2000 - 30 June 2003. Alaska Department of Fish and Game, Project 7.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/fur04mt.pdf

Kavalok, T.
2005a Unit 14 black bear management report. Pages 183-194 *in* C. Brown, editor. Black bear management report of survey and inventory activities 1 July 2001 - 30 June 2005. Alaska Department of Fish and Game, Project 17.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05blbweb.pdf

Kavalok, T.
2005b Unit 14 brown bear management report. Pages 148-156 *in* C. Brown, editor. Brown bear management report of survey and inventory activities 1 July 2002 - 30 June 2004. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05brbweb.pdf

Kavalok, T.
2005c Unit 16 black bear management report. Pages 195-208 *in* C. Brown, editor. Black bear management report of survey and inventory activities 1 July 2001 - 30 June 2004. Alaska Department of Fish and Game, Project 17.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05blbweb.pdf

Kavalok, T.
2005d Unit 16 brown bear management report. Pages 157-168 *in* C. Brown, editor. Brown bear management report of survey and inventory activities 1 July 2002 - 30 June 2004. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05brbweb.pdf

King, B. E. and J. A. Breakfield
1998 Coded wire tagging of coho and chinook salmon in the Kenai River and Deep Creek, Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 98-9, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-09.pdf

Larned, W. W. (Minerals Management Service)
2006 Winter distribution and abundance of Steller's eiders (*Polysticta stelleri*) in Cook Inlet, Alaska 2004-2005. OCS Study MMS 2006-066, Alaska Outer Continental Shelf. http://www.mms.gov/alaska/reports/2006rpts/2006_066.pdf

Larson, L. L.
1997 Lower Kenai Peninsula Dolly Varden studies during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 97-2, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-02.pdf

LGL and BioSonics, Inc.
1999 Forage fish assessment in Cook Inlet oil and gas develoment areas, 1997-1998. Minerals Management Service, OCS Study 99-0039, Anchorage. http://www.mms.gov/alaska/reports/1990rpts/99_0039.pdf

Markowitz, T. M., D. W. Funk, D. S. Ireland, R. Rodrigues and M. R. Link
2005 Use of Knik Arm by Cook Inlet beulga whales. Pages 8-1 - 8-19 *in* D. W. Funk, T. M. Markowitz and R. Rodrigues, editor. Baseline studies of beluga whale habitat use in Knik Arm, upper Cook Inlet, Alaska: July 2004 - July 2005. Prepared by LGL Alaska Research Associates in association with HDR Alaska,, Inc. for Knik Arm Bridge and Toll Authority. Anchorage. http://www.knikarmbridge.com/Tech_Reports/Boiler%20QC/Baseline%20Studies%20of%20Beluga%20Whale%20Habitat%20Use%20in%20Knik%20Arm.pdf

McDonough, T.
2004a Unit 15B moose management report. Pages 209-215 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

McDonough, T.
2004b Unit 15C moose management report. Pages 216-223 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

McDonough, T.
2004c Units 7 and 15 mountain goat management report. Pages 106-121 *in* C. Brown, editor. Mountain goat management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 12.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/04goamt.pdf

McDonough, T.
2005 Units 7 & 15 black bear management report. Pages 152-158 *in* C. Brown, editor. Black bear management report of survey and inventory activities 1 July 2001 - 30 June 2005. Alaska Department of Fish and Game, Project 17.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05blbweb.pdf

Meyer, S. C.
2000 Composition and biomass of the recreational rockfish Sebastes harvest in Southcentral Alaska, 1992-1995. Alaska Department of Fish and Game, Fishery Data Series 00-6, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-06.pdf

MMS (Minerals Management Service)
2003 Cook Inlet planning area oil and gas lease sales 191 and 199, final environmental impact statement. OCS EIS/EA MMS 2003-055, Alaska Outer Continental Shelf. http://www.mms.gov/alaska/ref/EIS_EA.htm

Moore, S. E., K. E. W. Shelden, L. K. Litzky, B. A. Mahoney and D. R. Rugh
2000 Beluga, *Delphinapterus leucas*, habitat associations in Cook Inlet, Alaska. Marine Fisheries Review 62(3):60-80. http://spo.nwr.noaa.gov/mfr623/mfr6237.pdf

Morrow, J. E.
1980 The freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage, AK.

NMFS (National Marine Fisheries Service)
1992 Recovery plan for the Stellar sea lion (*Eumetopias jubatus*). Prepared by the Stellar Sea Lion Recovery Team for the National Marine Fisheries Service. Silver Spring, Maryland. http://alaskafisheries.noaa.gov/protectedresources/stellers/recovery/finalrecovery92.pdf

NMFS (National Marine Fisheries Service)
2005 The kids' times: fin whale. Volume II, Issue 3. http://www.nmfs.noaa.gov/pr/pdfs/education/kids_times_whale_fin.pdf Accessed September 16, 2008.

NMFS (National Marine Fisheries Service)
2008a Beluga whale. National Marine Mammal Laboratory: Marine mammal species. http://www.afsc.noaa.gov/nmml/species/species_beluga.php Accessed March 27, 2008.

NMFS (National Marine Fisheries Service)
2008b Conservation plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). National Marine Fisheries Service. Juneau, Alaska. http://alaskafisheries.noaa.gov/protectedresources/whales/beluga/mmpa/final/cp2008.pdf

NMFS (National Marine Fisheries Service)
2008c Essential fish habitat. Office of Habitat Conservation, Habitat Protection Division. http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/index.htm Accessed August 22, 2008.

NMFS (National Marine Fisheries Service)
2008d Essential fish habitat (EFH). Alaska Regional Office. http://www.fakr.noaa.gov/habitat/faq.htm Accessed August 22, 2008.

NMFS (National Marine Fisheries Service)
2008e FBE focal species - walleye pollock. Alaska Fisheries Science Center. http://www.afsc.noaa.gov/race/behavioral/pollock_fbe.htm Accessed May 12, 2008.

NMFS (National Marine Fisheries Service)
2008f Harbor seal (*phoca vitulina*). NOAA Fisheries, Office of Protected Resources. http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/harborseal.htm Accessed May 22, 2008.

NMFS (National Marine Fisheries Service)
2008g Marine mammal species: harbor porpoise. National Marine Mammal Laboratory. http://www.afsc.noaa.gov/nmml/species/species_harporp.php Accessed May 21, 2008.

NMFS (National Marine Fisheries Service)
2008h Pacific cod research. Alaska Fisheries Science Center. http://www.afsc.noaa.gov/species/Pacific_cod.php Accessed May 12, 2008.

NMFS (National Marine Fisheries Service)
2008i Recovery plan for the Stellar sea lion (*Eumetopias jubatus*). Revision. National Marine Fisheries Service. Silver Spring, Maryland. http://alaskafisheries.noaa.gov/protectedresources/stellers/recovery/sslrpfinalrev030408.pdf

NMFS (National Marine Fisheries Service)
2008j Personal communication from Roderick Hobbs, Leader, Beluga and Small Cetacean Projects, Seattle to Saree Timmons, DO&G, December 24, 2008.

NMFS (National Marine Fisheries Service)
2008k Stellar sea lion designated critical habitat. NOAA Fisheries, Alaska Regional Office, Stellar sea lion critical habitat and no-entry zones. http://alaskafisheries.noaa.gov/protectedresources/stellers/criticalhabitat_map.pdf Accessed May 27, 2008.

NMFS (National Marine Fisheries Service)
2008l Stellar sea lions, NMML research - distribution. NOAA Fisheries, Alaska Fisheries Science Center, National Marine Mammal Laboratory. http://www.afsc.noaa.gov/nmml/alaska/sslhome/distrib.php Accessed May 27, 2008.

Otis, E. O. and N. J. Szarzi
2007 A review of escapement goals for salmon stocks in Lower Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-04, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fms07-04.pdf

Pentec Environmental
2005 Marine fish and benthos studies in Knik Arm Anchorage, Alaska. Prepared for Knik Arm Bridge and Toll Authority and HDR Alaska, Inc. 12214-10/12214-12. November 30, 2005. http://www.knikarmbridge.com/Tech_Reports/Boiler%20QC/Marine%20Fish%20and%20Benthos%20Studies.pdf

Piatt, J. F. (U.S. Fish and Wildlife Service)
1994 Monitoring seabird populations in areas of oil and gas development on the Alaskan Continental Shelf: oceanic, shelf and coastal seabird assemblages at the mouth of a tidally-mixed estuary (Cook Inlet, Alaska). Final Report for Minerals Management Service (OCS Study MMS 93-0072), National Biological Service, USGS, Anchorage. http://www.absc.usgs.gov/research/seabird_foragefish/products/index.html

Piatt, J. F. and A. M. A. Harding
2007 Population ecology of seabirds in Cook Inlet. Pages 335-352 *in* R. Spies, editor. Long-term ecological change in the northern Gulf of Alaska. Elsevier, Amsterdam. http://www.absc.usgs.gov/research/seabird_foragefish/products/index.html

Piatt, J. F. and D. G. Roseneau
1997 Cook Inlet seabird and forage fish studies(CISeaFFS). Sisyphus News 1997 (1), Alaska Science Center, Biological Resources Division, USGS, Anchorage. http://www.absc.usgs.gov/research/seabird_foragefish/products/newsletters/sisyphs1.pdf

Robards, M. D., J. F. Piatt, A. B. Kettle and A. A. Abookire
1999 Temporal and geographic variation in fish communities of lower Cook Inlet, Alaska. Fisheries Bulletin 97(4):962-977. http://www.absc.usgs.gov/research/seabird_foragefish/products/publications/Fish_Comm_LCI.pdf

Sandercock, F. K.
1991 Life history of coho salmon (*Oncoryhnchus kisutch*). Pages 395-445 *in* C. Groot and L. Margolis, editor. Pacific salmon life histories. UBC Press, Vancouver, B.C.

Schoch, G. C.
2001 The spatial distribution of bull kelp (*Nereocystis leutkeana*) in the Kachemak Bay Research Reserve. Kachemak Bay Research Reserve, National Estuarine Research Reserve System. http://www.habitat.adfg.state.ak.us/geninfo/kbrr/pdf_files/kelp_report.pdf

Selinger, J.
2003 Units 7 & 15 wolf management report. Pages 58-65 *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999 - 30 June 2002. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/wol03mt-web-se-sc.pdf

Selinger, J.
2004a Unit 15A moose management report. Pages 200-208 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

Selinger, J.
2004b Units 7 and 15 furbearer management report. Pages 90-106 *in* C. Brown, editor. Furbearer management report of survey and inventory activities 1 July 2000 - 30 June 2003. Alaska Department of Fish and Game, Project 7.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/fur04mt.pdf

Selinger, J.
2005a Units 7 & 15 brown bear management report. Pages 63-73 *in* C. Brown, editor. Brown bear management report of survey and inventory activities 1 July 2002 - 30 June 2004. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/05blbweb.pdf

Selinger, J.
2005b Units 7 & 15 caribou management report. Pages 1-19 *in* C. Brown, editor. Caribou management report of survey and inventory activities 1 July 2002 - 30 June 2004. Alaska Department of Fish and Game, Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/ca05_sc_sw_int.pdf

Shields, P.
2007 Upper Cook Inlet commercial fisheries annual management report, 2007. Alaska Department of Fish and Game, Fishery Management Report No. 07-64, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr07-64.pdf

Sinnott, R.
2004 Unit 14C moose management report. Pages 183-199 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001 - 30 June 2003. Alaska Department of Fish and Game, Project 1.0. Juneau. http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/mo04_sc.pdf

Sisinyak, N.
2005 The poor man's lobster of the Tanana Valley burbot. Alaska Fish and Wildlife News. April 2005. http://www.wildlifenews.alaska.gov/index.cfm?adfg=wildlife_news.view_article&articles_id=137&issue_id=25 Accessed February 6, 2008.

Small, R. J. and D. P. DeMaster
1995 Alaska marine mammal stock assessments 1995. NOAA Technical Memorandom, NOAA-TM-AFSC-57. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-57.pdf

Szarzi, N. J., C. M. Kerkvliet, C. E. Stock and M. D. Booz
2007 Recreational fisheries in the Lower Cook Inlet Management Area, 2005-2007, with updates for 2004. Alaska Department of Fish and Game, Fishery Management Report No. 07-55, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr07-55.pdf

Trowbridge, C. E. and K. J. Goldman
2006 2006 review of Cook Inlet Area commercial fisheries for Dungeness crab, shrimp, and miscellaneous shellfish fisheries: A report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Special Publication 06-09, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp06-09.pdf

UAA-ISER (University of Alaska - Institute of Social and Economic Research)
2008 Alaska regional profiles: Southcentral region, descriptive legend of vegetative types. Alaskool. http://www.alaskool.org/resources/regional/sc_reg_pro/contents.htm Accessed May 12, 2008.

URS Corp.
2006 Knik Arm Crossing area shorebird study. Prepared for Knik Arm Bridge and Toll Authority, ADOT, and Federal Highway Administration, Anchorage. http://www.knikarmbridge.com/Tech_Reports/Boiler%20QC/Knik%20Arm%20Crossing%20Area%20Shorebird%20Study.pdf

USACOE (U.S. Army Corps of Engineers)
2007 Regional supplement to the Corps of Engineers wetland delineation manual: Alaska Region (version 2.0). Wetlands Regulatory Assistance Program. ERDC/EL TR-07-24. September 2007. http://www.usace.army.mil/cw/cecwo/reg/erdc-el_tr-07-24.pdf

USFWS (U.S. Fish and Wildlife Service)
2008a Alaska Maritime National Wildlife Refuge: Refuge establishment. http://alaska.fws.gov/nwr/akmar/establishment.htm Accessed March 26, 2008.

USFWS (U.S. Fish and Wildlife Service)
2008b Kenai National Wildlife Refuge: Overview. http://www.fws.gov/refuges/profiles/index.cfm?id=74525 Accessed March 26, 2008.

USFWS (U.S. Fish and Wildlife Service)
2008c Kenai National Wildlife Refuge: Refuge history. http://kenai.fws.gov/history.htm Accessed March 26, 2008.

USFWS (U.S. Fish and Wildlife Service)
2008d Realty and natural resources: Wilderness. http://alaska.fws.gov/nwr/nr/wilderness.htm Accessed March 26, 2008.

USFWS (U.S. Fish and Wildlife Service)
2008e Threatened and endangered species: Steller's eider. http://www.r7.fws.gov/media/StellEider_FactSheet.htm Accessed May 14, 2008.

USGS (U.S. Geological Survey)
2008a Seabirds, forage fish, and marine ecosystems: population trends. http://www.absc.usgs.gov/research/seabird_foragefish/seabirds/index.html Accessed May 16, 2008.

USGS (U.S. Geological Survey)
2008b Seabirds, forage fish, and marine ecosystems: seabird colonies. http://www.absc.usgs.gov/research/seabird_foragefish/seabirds/index.html Accessed May 16, 2008.

USGS (U.S. Geological Survey)
2008c Seabirds, forage fish, and marine ecosystems: seabirds. http://www.absc.usgs.gov/research/seabird_foragefish/seabirds/index.html Accessed May 16, 2008.

Walker, C. and T. Davis
2004 Dead salmon bring life to rivers. Alaska Fish and Wildlife News. December 2004. http://www.wildlifenews.alaska.gov/index.cfm?adfg=wildlife_news.view_article&articles_id=97&issue_id=21 Accessed January 30, 2008.