

December 17, 2019

# COOK INLET AREAWIDE OIL AND GAS LEASE SALE

Supplemental Finding of the Director



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## Introduction

The Department of Natural Resources (DNR), Division of Oil and Gas (DO&G) is augmenting the boundary of the Cook Inlet areawide lease sale area (Sale Area) to include an area previously issued as the Southwest Cook Inlet oil and gas exploration license area (SW Cook Inlet Area) pursuant to AS 38.05.180(d) and (w). Oil and gas exploration and subsequent development within the SW Cook Inlet Area was evaluated and determined to be in the best interest of the state (DNR 2014). An exploration license was issued to Cook Inlet Energy, LLC on June 20, 2014 for a 4-year term with an option to convert to leases after a work commitment was satisfied. Issuance of an exploration license provides that the licensee may convert all or part of the license area to oil and gas leases (AS 38.05.134). The exploration license was relinquished in late 2015 prior to conversion to lease, but exploration activity has continued on adjacent Native corporation lands.

AS 38.05.180(w) specifies that land that is the subject of a written best interest finding (BIF) in the past 10 years can be immediately offered for lease; in addition, AS 38.05.131(a) directs DO&G to apply regular oil and gas statutes to exploration licenses. Oil and gas exploration, development, and production in the Sale Area was evaluated and determined to be in the best interest of the state on November 2, 2018 (DNR 2018). This supplemental finding incorporates the 2014 Southwest Cook Inlet Exploration License BIF into the 2018 Cook Inlet Areawide Oil and Gas Lease Sale BIF by reference through citation and a brief description of its contents (as described in 40 CFR § 1502.21). The supplement follows the chapter structure of the SW Cook Inlet Area and Sale Area BIFs (DNR 2014, 2018) and incorporates new information received in response to a request for agency information and DO&G's annual call for new information. DO&G received responses to the request for agency information from the DNR Division of Mining, Land and Water (DMLW); the Bureau of Ocean Energy Management (BOEM), and the Alaska Department of Fish and Game (ADF&G). DO&G received responses to the annual call for new information from the ADF&G, and the National Park Service (NPS).

## Chapter One: Director's Final Written Finding and Decision

The director of DO&G, with consent of the State of Alaska DNR commissioner, determines whether issuing oil and gas leases serves the state's best interests (AS 38.05.035(e)). This supplement presents the director's written finding for the disposal of interest in state oil and gas through lease sales in the expanded Sale Area. All relevant facts and issues within the scope of review that were known or made known to the director were reviewed. The director limited the scope of the finding to the disposal phase of oil and gas activities and the reasonably foreseeable significant effects of issuing oil and gas leases (AS 38.05.035(e)(1)(A)). Conditions for phasing have been met under AS 38.05.035(e)(1)(C) as outlined in Chapter Two of the SW Cook Inlet Area (DNR 2014, 2-4 to 2-5) and Sale Area (DNR 2018, 2-5 to 2-6) BIFs. The content of best interest findings is specified in AS 38.05.035(e), and topics that must be considered and discussed are found in AS 38.05.035(g).

In cases where the director determines that a supplement to the most recent best interest finding is necessary, the director shall issue the:

- supplement not later than 90 days before the lease sale, and
- notice of the sale not later than 45 days before sale.

The supplement will have the status of a final written best interest finding for purposes of AS 38.05.035(i) and (l).

Substantial new information regarding exploration activities in the vicinity of the SW Cook Inlet Area has become available through public applications, industry press releases, and technical presentations and papers. There is a potential for near-term oil and gas exploration and development activities on the Iniskin Peninsula and in Cook Inlet federal waters. This information is new and substantial and therefore justifies

a supplement to the most recent Sale Area BIF (DNR 2018). Substantial new information concerning the SW Cook Inlet Area and the Sale Area is summarized in chapters Four, Five, Six and Eight herein.

DO&G will offer all available state-owned acreage in the expanded Sale Area at oil and gas lease sales to be held from 2020 to 2028. The gross acreage of the expanded Sale Area is approximately 4 million acres. After weighing the facts and issues known at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director finds the potential benefits of lease sales within the expanded Sale Area outweigh the possible negative effects. The director finds that lease sales within the expanded Sale Area are in the best interests of the State of Alaska. The full director's decisions are found in Chapter One of the BIFs for the SW Cook Inlet Area (DNR 2014, 1-1 to 1-5), and the Sale Area (DNR 2018, 1-1 to 1-3).

## **Chapter Two: Introduction**

The authorities and written finding requirements described in Chapter Two for exploration license areas and for areawide lease sales areas are the same, except that bidding methods are not established, and generally a single written finding is prepared for exploration license areas. The process of developing BIFs includes opportunities for input from a broad range of participants including: the public; state, federal, and local government agencies; Alaska Native organizations; resource user groups; non-government organizations; and any other interested party. Bidding methods and the process for annual calls for new information established for the Sale Area as described in Chapter Two (DNR 2018, 2-6 to 2-10) will apply to the expanded Sale Area lease sales. The full descriptions of authorities, the scope of review, and written finding requirements can be found in Chapter Two of the SW Cook Inlet Area (DNR 2014, 2-1 to 2-5), and the Sale Area (DNR 2018, 2-1 to 2-6) BIFs.

## **Chapter Three: Description of the Cook Inlet Lease Sale Area**

The Sale Area boundary is expanded by about 169,000 acres, on and around the Iniskin Peninsula located about 120 miles south of Tyonek (Figure 1). The SW Cook Inlet Area is located on the west side of Cook Inlet across from Homer, Anchor Point, and Seldovia. The SW Cook Inlet Area extends south as far as Ursus Cove and north as far as Saddle Mountain and is bounded by the Kenai Peninsula Borough boundary to the west and federally-owned Cook Inlet marine waters to the east.

A historical background, and information on surface and subsurface land and mineral ownership, access, and local communities in the SW Cook Inlet Area are found in Chapter Three (DNR 2014, 3-1 to 3-7). The four sections of state-owned land on the Iniskin Peninsula were originally conveyed to the state in the Alaska Statehood Act for the support of public schools. In 1978, the legislature transformed the public school trust from a land-based trust into a monetary trust and the school trust lands were designated general grant lands. Because school trust lands were the subject of two litigation cases, DNR issued Department Order 143 (DO 143; DNR 2014, 3-4), which was intended to preserve the value of school trust lands should the court order reinstatement of a land-based trust. With settlement and dismissal of the school trust litigation cases, DO 143 was rescinded by DNR on September 22, 2017, and school trust lands were redesignated to general grant lands.

DMLW responded to the request for agency information that the expansion would not impact settlement or proposed settlement lands and that they had no objection to the Sale Area boundary expansion. Recent information on the Kenai Peninsula Borough, waters of the Cook Inlet, historical and cultural resources, climate and climate change, and geologic hazards applicable to the expanded Sale Area are described in Chapter Three of the Sale Area BIF (DNR 2018, 3-10 to 3-34).



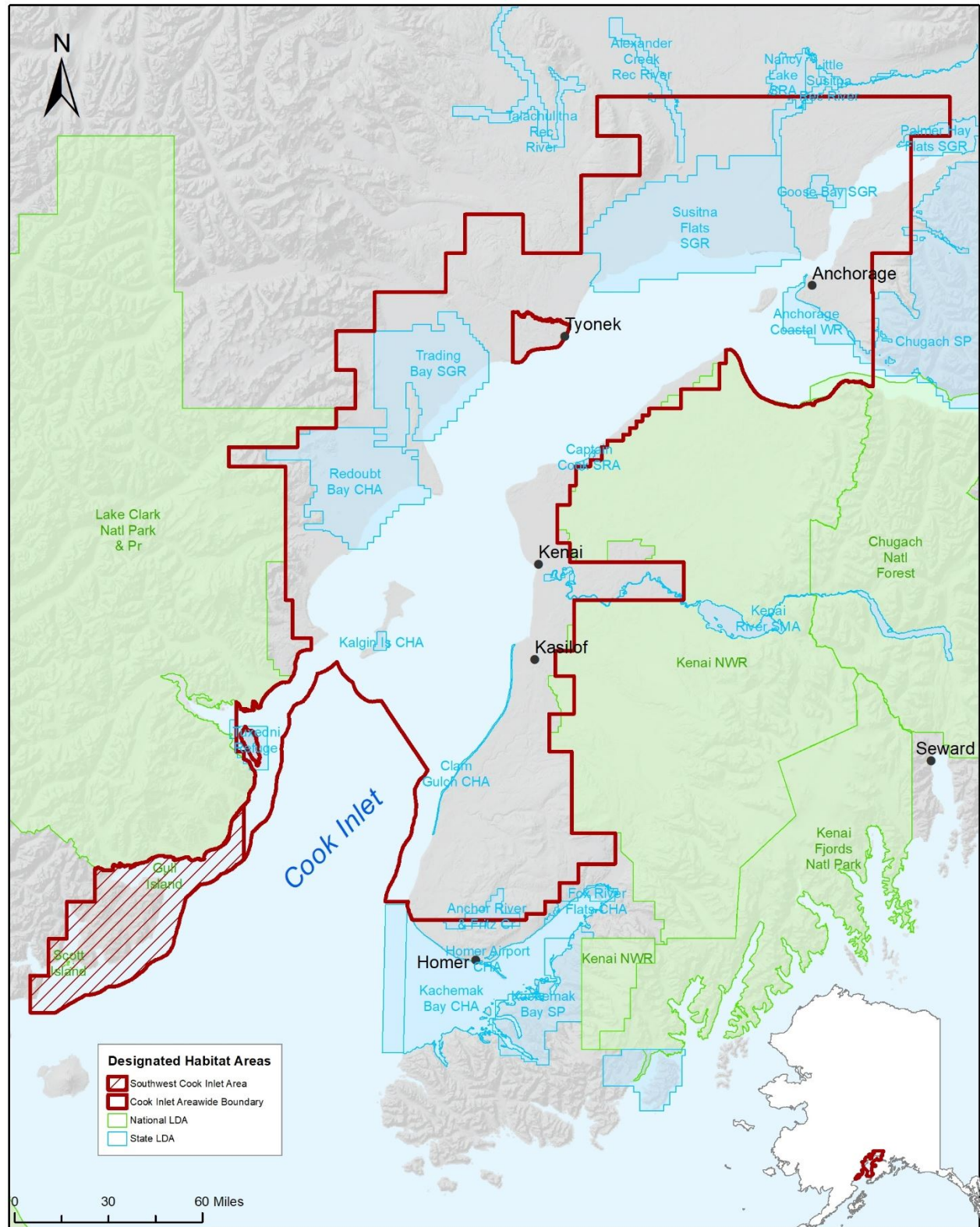


Figure 1.—Designated habitat areas in the expanded Sale Area.

## Chapter Four: Habitat, Fish and Wildlife

### A. Habitats

The Sale Area is primarily within the Cook Inlet Basin ecoregion, while the SW Cook Inlet Area is within the Alaska Range ecoregion (Nowacki et al. 2001). Key habitats of the expanded Sale Area include fresh, marine, and estuarine waters and intertidal and terrestrial habitats that support fish and wildlife populations. Marine habitats in Cook Inlet are described in Chapter Three of the Sale Area BIF (DNR 2018). The NPS provided information on inter and subtidal sampling along rocky shorelines on the west side of lower Cook Inlet. Coastal habitats and the associated plants and animals are controlled by the composition and character of coastal substrates (Harper and Morris 2014). Shorelines north of Anchor Point and Tuxedni Bay are primarily sediment controlled, while shorelines on the lower west side of Cook Inlet, including the SW Cook Inlet Area and Kalgin Island, are primarily bedrock controlled (Table 1; Harper and Morris 2014).

**Table 1.—Shore types in Cook Inlet.**

Category	Description	SW Cook Inlet		Cook Inlet <sup>a</sup>	
		Length (mi)	Length (%)	Length (mi)	Length (%)
Shore Type					
Rock	Cliff, ramp or platform	15.1	8%	21.6	2%
Rock and Sediment	Cliff or ramp with gravel beach	43.2	24%	80.2	9%
Sediment	Gravel, sand, or mud beach, flat, or fan	90.1	50%	439.5	50%
Estuary Dominant	Organics, wetlands, salt marsh	31.1	17%	312.8	36%
Current Dominant	Elongate tidal channels	1.2	1%	3.4	0%
Man Made	Modified or disturbed	0.0	0%	22.6	3%
Total		180.7		880.1	

Source: (Harper and Morris 2014; NOAA Fisheries 2019)

Notes: SW = Southwest, mi = mile.

a Cook Inlet shoreline from Anchor Point around Cook Inlet to the southern edge of the Southwest Cook Inlet exploration license area (includes Knik Arm and Turnagain Arm, excludes Kachemak Bay).

Supratidal biotic communities, or biobands, along Cook Inlet shorelines include the black lichen (*Verrucaria* sp.) splash zone and salt marsh (Table 2). Upper to middle intertidal communities include rockweed (*Fucus distichus*) and blue mussel (*Mytilus trossulus*); lower intertidal communities include soft brown kelps, *Alaria* (*Alaria marginata*), and red algae; and subtidal communities include eelgrass (*Zostera marina*; Table 2). Eelgrass is limited to Iniskin Bay. Wide low-angle rock ramp and platform shore types on Chisik Island, and portions of the Iniskin Peninsula coastline. These relatively unique rocky shore types in western lower Cook Inlet were the focus of field sampling in 2015 (Coletti et al. 2017) that included sample locations in or near Tuxedni, Chinitna, and Iniskin bays. The northern most sites in Tuxedni and Chinitna bays had the lowest numbers of taxa (diversity) compared to sites further south in Kamishak Bay (Coletti et al. 2017).

Table 2.—Shoreline biobands in Cook Inlet.

Category	Description	Length (miles)		Shoreline <sup>a</sup> (%)
		Narrow/ Patchy	Med and Wide/ Continuous	
Biobands				
Splash Zone	Dark stripe of black lichen ( <i>Verrucaria</i> sp.) on rock marking the upper limit of the intertidal	190.5	93.6	32%
Salt Marsh	Sedge or grass in estuaries, marshes, and lagoons, associated with freshwater	78.7	379.9	52%
Upper Intertidal	Combination of rockweed ( <i>Fucus distichus</i> ) and blue mussel ( <i>Mytilus trossulus</i> ) biobands	50.0	5.4	6%
Lower Intertidal	Combination of soft brown kelps, Alaria ( <i>Alaria marginata</i> ), and red algae biobands	86.2	40.8	14%
Eelgrass	Eelgrass ( <i>Zostera marina</i> ), generally in areas with fine sediments	16.2	0.0	2%
Total		421.6	519.7	

Source: (Harper and Morris 2014; NOAA Fisheries 2019)

Notes: Splash zone bioband divided into narrow (<1 meter), medium (1 to 5 meter), and wide (>5 meter) categories; all other biobands are divided into patchy (<50% cover) and continuous (>50% cover).

a Proportion (%) of 880 mile Cook Inlet ShoreZone shoreline identified for biobands (Anchor Point around Cook Inlet to the southern edge of the Southwest Cook Inlet exploration license area [includes Knik Arm and Turnagain Arm, excludes Kachemak Bay]).

The Sale Area includes all or portions of 20 federal, state, and local legislatively-designated habitat areas (Figure 1). The SW Cook Inlet Area adds an additional 100 acres of the Alaska Maritime Wildlife Refuge encompassing small islands and rocky outcrops offshore from the Iniskin Peninsula, including Gull Island and Scott Island which support seabird nesting colonies (USFWS 2017). Portions of the marine waters within the expanded Sale Area are designated as critical habitat under the Endangered Species Act (ESA) for Cook Inlet beluga whales (*Delphinapterus leucas*; 76 FR 20180) and the southwest Alaska distinct population segment (DPS) of northern sea otters (*Enhydra lutris kenyoni*; 74 FR 51988) as shown in Figure 2. In addition, the National Marine Fisheries Service (NMFS) recently proposed to designate Cook Inlet waters south of Kalgin Island as critical habitat for the Mexico DPS of humpback whales (*Megaptera novaeangliae*; Figure 2; 84 FR 54354).

The NMFS defines areas of Essential Fish Habitat (EFH) for federally managed fisheries in Alaska as required by 1996 revisions to the Magnuson-Stevens Act (NOAA Fisheries 2018). EFH is habitat necessary for spawning, breeding, feeding or growth to maturity for fishes managed under federal fishery management plans. Text descriptions and maps are available that identify EFH for each life stage of fish under a federal fisheries management plan (NOAA Fisheries 2018). EFH for fisheries covered by three management plans occur within or near the Sale Area: the Salmon Fisheries Management Plan (NPFMC et al. 2012), the Gulf of Alaska Groundfish Fisheries Management Plan (NPFMC 2018), and the Scallop Fishery Management Plan (NPFMC 2014). Marine and freshwater EFH for Pacific salmon (*Oncorhynchus* sp.) occur in the SW Cook Inlet Area (NPFMC et al. 2012; NMFS 2017), freshwater EFH is regularly updated in ADF&G's Anadromous Waters Catalog (ADF&G 2018). EFH for groundfish occurs within marine waters of the SW Cook Inlet Area, while EFH for weathervane scallops (*Patinopecten caurinus*) is located southeast of the SW Cook Inlet Area, east of Augustine in deep waters of lower Cook Inlet (NPFMC 2014, 2018).



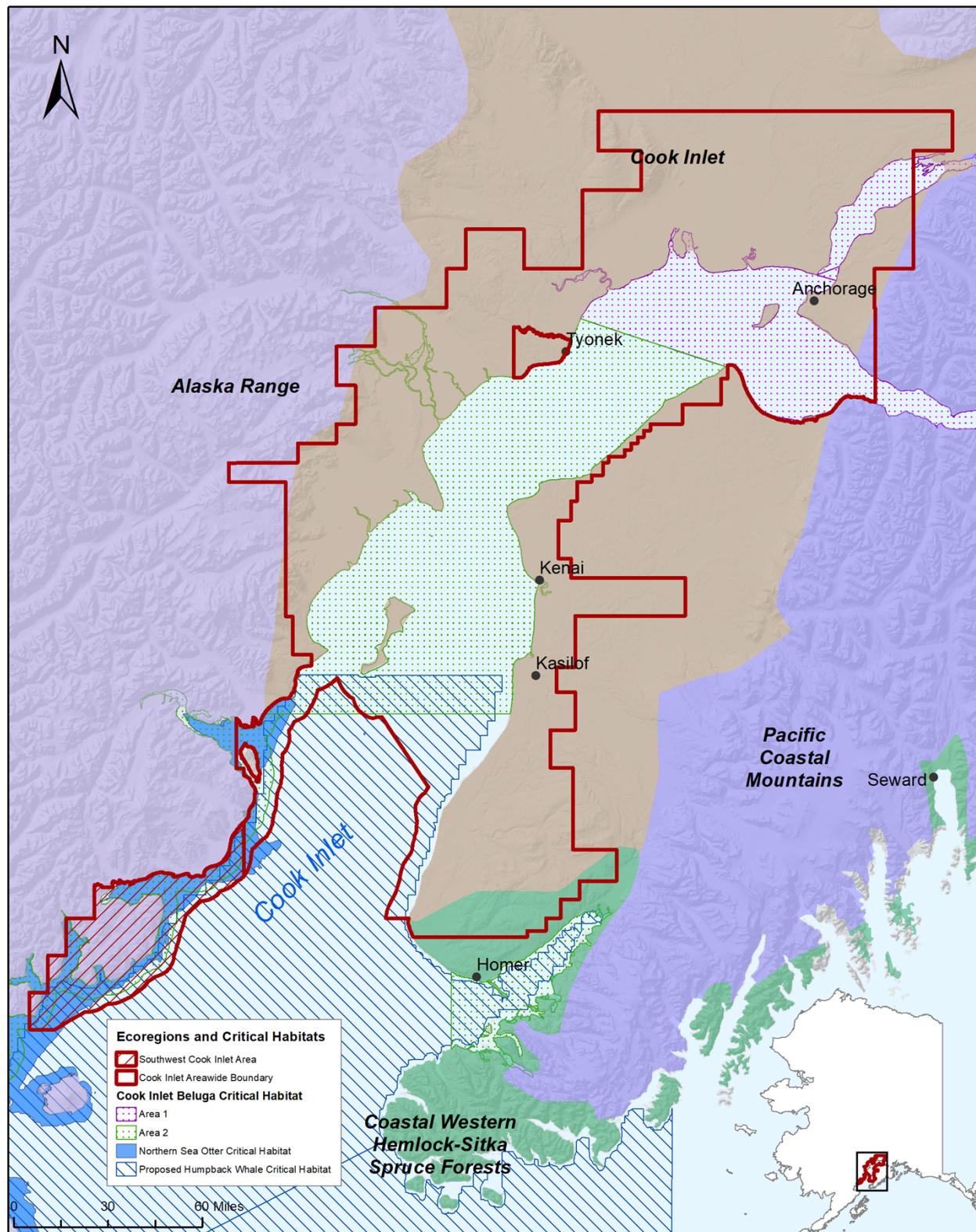


Figure 2.—Ecoregions and critical habitats in the expanded Sale Area.

## B. Fish and Wildlife Populations

The Cook Inlet region is home to a wide diversity of fish and wildlife representing a broad spectrum of life histories and habitat requirements.

### 1. Fish

Freshwater and anadromous fishes, including all five species of Pacific salmon, are found in the area's waters. Many freshwaters provide important spawning, rearing, or migration habitats for anadromous salmon, trout, char, and whitefish. Waters that have been identified as important for anadromous fishes receive special protection under AS 16.05.871. As of June 1, 2019, ADF&G has identified approximately 112 lakes and over 500 stream channels as important anadromous water bodies within the Sale Area. Expansion to include the SW Cook Inlet Area adds nearly 30 important anadromous stream channels (Johnson and Blossom 2019). ADF&G provided updated information for Pacific salmon and marine fisheries in the SW Cook Inlet Area that supplement the descriptions in Chapter Four, Section B.1. Fish and Shellfish in the Sale Area BIF (DNR 2018).

Five species of **Pacific salmon** are found in Cook Inlet: 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.

The SW Cook Inlet Area is within ADF&G's Kamishak Bay District of the Lower Cook Inlet management area and the Central District of the Upper Cook Inlet management area. The Kamishak Bay District includes coastal waters and inland drainages on the western shore of Cook Inlet, south of the latitude of Anchor Point (59° 46.15' North Latitude). The Central District includes waters north of the latitude of Anchor Point. Four hatcheries supply salmon to the Lower Cook Inlet management area. The Trail Lakes Hatchery supplies sockeye and coho salmon, the William Jack Hernandez Hatchery in Anchorage supplies Chinook and coho salmon, and the Tutka Bay Lagoon and Port Graham hatcheries supply pink salmon (Hollowell et al. 2019).

Three areas in or near the SW Cook Inlet Area, Ursus Cove, Cottonwood Creek, and Iniskin Bay, are considered major chum salmon spawning systems (Table 3). No major spawning systems for Chinook, sockeye, coho, or pink salmon occur within the SW Cook Inlet Area.

**Table 3.—Estimated chum salmon escapement (thousands of fish) for major spawning systems in the Kamishak Bay District, of the Lower Cook Inlet management area.**

Spawning System	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	10-year Average
Ursus Cove	6.5	12.9	11.8	10.6	2.8	10.3	5.3	14.8	7.0	22.0	10.4
Cottonwood Creek	11.6	19.4	15.8	4.7	4.1	5.2	7.1	17.0	1.6	6.2	9.3
Iniskin Bay	20.0	30.8	19.3	16.5	3.0	5.9	13.0	7.5	1.1	15.6	13.3

Source: (Hollowell et al. 2019)

**Chinook** (king) salmon are distributed widely throughout Cook Inlet with particularly large runs in the Kenai and Deshka rivers, and in Alexander, Lake, and Prairie creeks (Fair et al. 2007). Chinook salmon are present and rear in Y-Valley Creek near the mouth of Iliamna Bay near the SW Cook Inlet Area, although spawning has not been documented (Johnson and Blossom 2019).

**Sockeye** (red) salmon spawn in a tributary to West Glacier Creek and are present in six streams in or near the SW Cook Inlet Area (Johnson and Blossom 2019). The 2017 sockeye salmon escapement for major spawning systems (outside of the SW Cook Inlet Area) in the Kamishak Bay District was 34,300 fish, which was above the previous 10-year average of 27,000 fish (Hollowell et al. 2019). Of the spawning

systems monitored in Upper Cook Inlet with escapement goals, the closest to the SW Cook Inlet Area is Packers Creek on Kalgin Island (Shields and Frothingham 2018). The nearest hatchery release site is Kirschner Lake, located several miles southwest of the SW Cook Inlet Area, which has been stocked regularly since 1987 (Hollowell et al. 2019). Hatchery returns of sockeye salmon in the Lower Cook Inlet management area were below forecasted levels in 2017. Wild sockeye salmon escapement goals were achieved for Chenik Lake and other systems for this species in Kamishak Bay in that year (Hollowell et al. 2019).

**Coho** (silver) salmon spawn in East Glacier Creek, and the Iniskin River; they rear in Y-Valley Creek and tributaries, and Fitz Creek; and they are present in many creeks in the SW Cook Inlet Area (Johnson and Blossom 2019). While escapement goals have been set for four coho stocks in the Upper Cook Inlet management area (McKinley and Erickson 2019b), no stocks in the Lower Cook Inlet management area have had goals assigned (McKinley and Erickson 2019a).

**Pink** (humpback) salmon spawn in Brown Creek, Bowser Creek, Right Arm Creek, Portage Creek, Y-Valley Creek, Shelter Creek, several unnamed creeks, and the Iniskin River in or near the SW Cook Inlet Area (Johnson and Blossom 2019). There were 132,508 pink salmon counted in Kamishak Bay District index streams in 2017, which was within the sum total for each individual stream's sustainable escapement goal that ranges from 24,800 to 145,400 fish, but was below the previous 10-year average return of 342,300 fish (Hollowell et al. 2019). There are no escapement goals for pink salmon in the Upper Cook Inlet management area (Shields and Frothingham 2018).

**Chum** (dog) salmon spawn in Brown Creek, Bowser Creek, Right Arm Creek, Portage Creek, Wrong Branch Trail Creek, Trail Creek, Fitz Creek, Shelter Creek, Y-Valley Creek, several unnamed creeks, and the Iniskin River in or near the SW Cook Inlet Area (Johnson and Blossom 2019). The 2017 total chum salmon escapement in Kamishak Bay District index streams was 172,546 fish, which was above the sum total of each individual stream's sustainable escapement goal ranges of 61,000 to 126,300 fish, and was above the previous 10-year average of 94,900 fish (Hollowell et al. 2019). The only water within the SW Cook Inlet Area that has a chum salmon escapement goal is Clearwater Creek in Chinitna Bay within the Upper Cook Inlet management area. The Clearwater Creek escapement goal of 3,500 to 8,000 chum salmon was achieved in 2017 based on counts from aerial surveys (Shields and Frothingham 2018).

Marine forage fish, groundfish, and shellfish are prominent fisheries resources in the region. ADF&G's Kamishak Bay bottom trawl survey provides abundance estimates for commercially important groundfish (Byerly and Rheafournier *in prep*). Of the most highly valued commercial groundfish, on average from 1998 to 2012 **Pacific halibut** (*Hippoglossus stenolepis*) had the highest estimated biomass at 10.2 million pounds with an average density of 13,194 pounds per square nautical mile (lbs/nmi<sup>2</sup>), followed by **Pacific cod** (*Gadus macrocephalus*) at 6.8 million pounds with an average density of 8,769 lbs/nmi<sup>2</sup>, **walleye pollock** (*Gadus chalcogramma*) at 6.3 million pounds with an average density of 8,139 lbs/nmi<sup>2</sup>, **sablefish** (*Anoplopoma fimbria*) at 348,000 pounds with an average density of 451 lbs/nmi<sup>2</sup>, and longnose (*Raja rhina*) and big skates (*Raja binoculata*) combined at 7.5 million pounds with an average density of 9,765 lbs/nmi<sup>2</sup> (Byerly and Rheafournier *in prep*). Other commercially harvested flatfish: arrowtooth flounder (*Atheresthes stomias*), butter sole (*Isopsetta isolepis*), flathead sole (*Hippoglossoides elassodon*), rock sole (*Lepidopsetta bilineata*), dover sole (*Microstomus pacificus*), rex sole (*Glyptocephalus zachirus*), English sole (*Parophrys vetulus*), starry flounder (*Platichthys stellatus*), Alaska plaice (*Pleuronectes quadrituberculatus*), and yellowfin sole (*Limanda aspera*) averaged in aggregate an estimated 89.3 million pounds with an average density of 115,670 lbs/nmi<sup>2</sup> in the Kamishak Bay bottom trawl survey (Byerly and Rheafournier *in prep*). Commercially harvested rockfish: dusky rockfish (*Sebastes ciliatus*), Pacific Ocean perch (*Sebastes alutus*), redbanded rockfish (*Sebastes babcocki*), and redstripe rockfish (*Sebastes proriger*), averaged an estimated biomass of 168,000 pounds. Other commercial groundfish captured in the trawl survey include lingcod and spiny dogfish (Byerly and Rheafournier *in prep*).

## 2. Birds

Over 450 species of birds are found in Alaska, many of which occur year-round or seasonally in the Cook Inlet region. Waterfowl, shorebirds, and seabirds concentrate in specific Sale Area habitats (Figure 3). ADF&G provided updated information for trumpeter swans (*Cygnus buccinators*) and Steller's eiders (*Polysticta stelleri*) in the SW Cook Inlet Area that supplement the descriptions in Chapter Four, Section B.2.a. Waterfowl in the Sale Area BIF (DNR 2018).

Aerial surveys of nesting habitats show that **trumpeter swans** have nested on the Iniskin Peninsula area since the early 1990s (Conant et al. 2007), and abundance has likely increased in this area since 2005 based on the increasing statewide trends for trumpeter swans (Groves 2017).

**Steller's eiders** winter primarily in nearshore waters on both sides of the Alaska Peninsula, and in lesser numbers in the eastern Aleutian Islands, the Kodiak Archipelago, and lower Cook Inlet (Martin et al. 2015). Steller's eiders migrate from wintering grounds to breeding grounds in arctic coastal areas of northern Alaska and Russia in spring. Band recovery, telemetry, and genetic data suggest that Alaska-breeding and Russian-Pacific breeding Steller's eider populations intermix during non-breeding seasons in southwest Alaska (USFWS 2019), such that Alaska-breeding and Russian-breeding populations are indistinguishable. The Alaska-breeding population, which consists of western and northern subpopulations (USFWS 2019), of Steller's eiders was listed as threatened in 1997 because of an apparent reduction in breeding range (62 FR 31748). The western subpopulation is considered functionally extirpated (USFWS 2019). Because the proportion of the northern subpopulation that breeds varies annually, the abundance and trends for the northern subpopulation cannot be determined; although an average of 300 Steller's eiders were present in northern Alaska from 2007 to 2017; with an average of 200 Steller's eiders in the Utqiagvik area where nesting is concentrated (USFWS 2019). Spring migration staging counts of mixed Alaska- and Russian-breeding populations along the Alaska Peninsula average 81,000 eiders with a long-term decline of 2.4 percent per year (1992-2012), although this trend may be biased by more optimally-timed counts in early survey years (Larned 2012). Fall aerial surveys indicated that the only important molting habitat in Cook Inlet are the shoals and reefs near the Douglas River in Kamishak Bay south of the SW Cook Inlet Area (Larned 2005). An average of about 125 Steller's eiders used habitats in and around Iniskin Bay in the SW Cook Inlet Area during winter 2004 and 2005 (Larned 2006). Molting Steller's eiders are present in lower Cook Inlet in late August, and many remain through the winter, departing for breeding grounds in April (Larned 2006).

## 3. Mammals

Big game mammals in the Cook Inlet region include moose (*Alces americanus*), caribou (*Rangifer tarandus*), black bear (*Ursus americanus*), brown bear (*Ursus arctos*), Dall sheep (*Ovis dalli*), and mountain goat (*Oreamnos americanus*). Other terrestrial mammals include furbearers, such as wolves (*Canis lupus*), lynx (*Lynx canadensis*), marten (*Martes americana*), otters (*Lontra canadensis*), beaver (*Castor canadensis*), mink (*Neovison vison*), wolverine (*Gulo gulo*), and other small game.

Marine mammals in the Sale Area include Cook Inlet beluga, fin (*Balaenoptera physalus*), and humpback whales (*Megaptera novaeangliae*); harbor porpoise (*Phocoena phocoena*) and harbor seals (*Phoca vitulina*), northern sea otters, and Steller sea lions (*Eumetopias jubatus*). The NPS submitted a report for 2017 USFWS aerial surveys documenting the distribution and abundance of northern sea otters (*Enhydra lutris kenyoni*) in lower Cook Inlet (Garlich-Miller et al. 2018). Of the three stocks of northern sea otters in Alaska, the southwest and southcentral stocks occur in the Sale Area in lower Cook Inlet (Muto et al. 2018; Garlich-Miller et al. 2018). Sea otters on the west side of lower Cook Inlet belong to the southwest stock, and those on the east side belong to the southcentral stock (Garlich-Miller et al. 2018). The most recent population estimate for lower Cook Inlet is nearly 20,000 sea otters (19,889 animals  $\pm$  3,764 standard error [SE]), with the highest density for the southcentral stock in Kachemak Bay, and the highest density for the southwestern stock in Kamishak Bay during the May survey (Garlich-Miller et al. 2018).



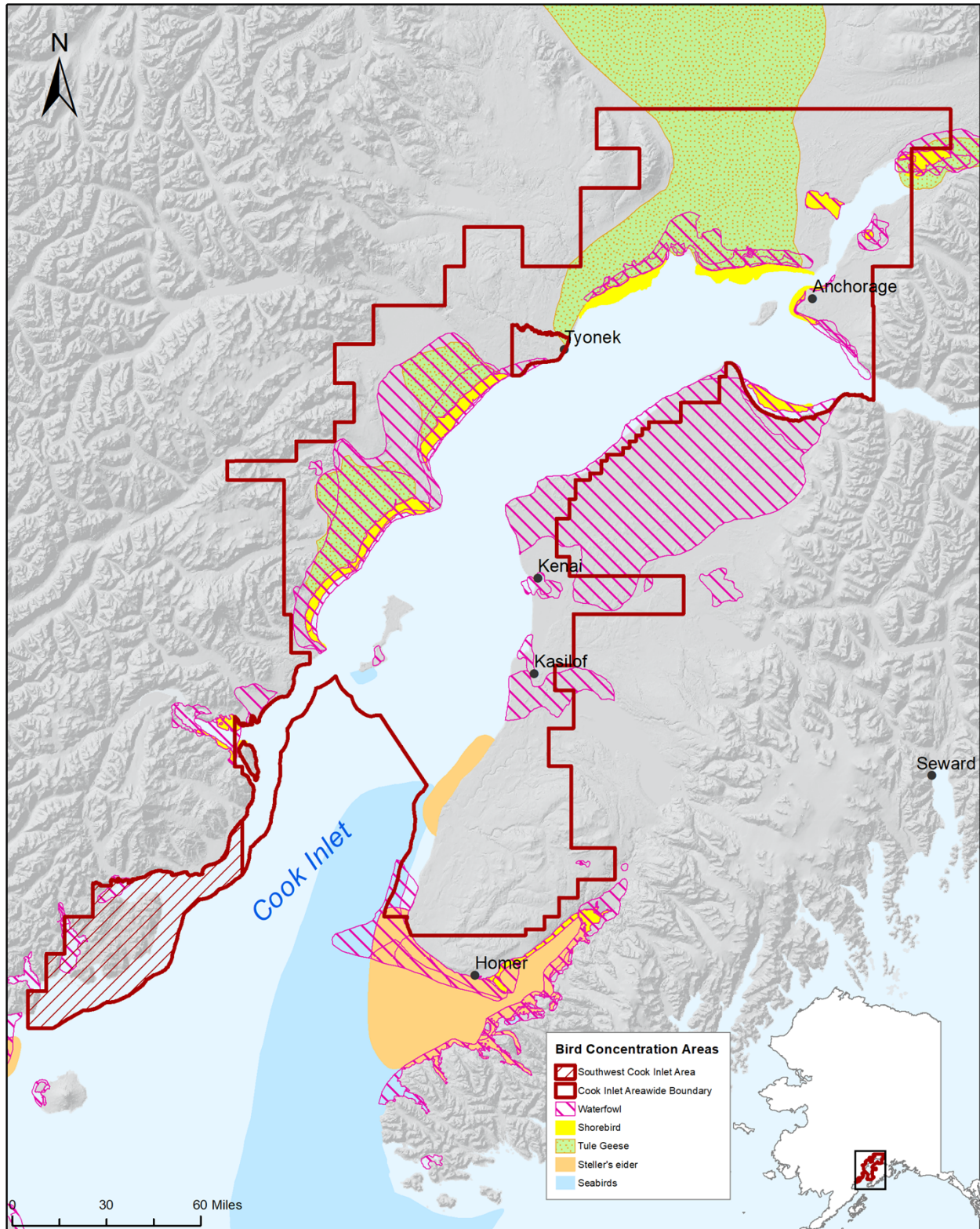


Figure 3.—Important bird habitat in the expanded Cook Inlet areawide lease sale area.



The overall abundance trend for southcentral stock appears to be increasing (Muto et al. 2019). The southwest DPS or stock was listed as threatened under the ESA in 2005 (70 FR 46366). Comparison of population estimates from 2002 and 2017 for western lower Cook Inlet indicate that survey confidence intervals were wide, but the population appeared to increase at an average annual growth rate of about 3 percent. Western lower Cook Inlet sea otters do not appear to have declined since the early 2000s as have other sub-regions of the southwest stock, although there has been little range expansion beyond Kamishak Bay (Garlich-Miller et al. 2018). Sea otters are not considered migratory, although they commonly move tens of miles and seasonal shifts in distribution are likely. Previous winter surveys have noted concentrations of sea otters in Iliamna and Iniskin bays (Garlich-Miller et al. 2018).

Harbor seals (mean = 78 animals) and harbor porpoises (mean = 74) were more abundant on the west side of lower Cook Inlet than on the east side (means of 1 and 0 animals, respectively); as were Steller sea lions. A few humpback and killer whales were sighted on both east and west sides of lower Cook Inlet. Minke whales (*Balaenoptera acutorostrata*) occurred in Kachemak Bay and on the east side of lower Cook Inlet during May 2017 surveys (Garlich-Miller et al. 2018).

Federal-listed ESA threatened or endangered animals that occur in the expanded Sale Area include: Alaska breeding population Steller's eiders, Cook Inlet beluga whales, southwest DPS of northern sea otters, western DPS Steller sea lions, fin whales, and the western North Pacific and Mexico DPS humpback whales.

Information on habitats, fish, and wildlife in the SW Cook Inlet Area are found in Chapter Four (DNR 2014, 4-1 to 4-21). Recent information on fish and wildlife population status for the Cook Inlet region is provided in Chapter Four of the Sale Area BIF (DNR 2018, 4-1 to 4-46).

## **Chapter Five: Current and Projected Uses in the Lease Sale Area**

ADF&G provided updated information for SW Cook Inlet Area commercial and sport fisheries and subsistence fish and wildlife uses which is summarized below to supplement the Sale Area BIF (DNR 2018). Information provided by ADF&G on Cook Inlet scallop, crab, and other shellfish fisheries is covered by the descriptions of these fisheries in Chapter Five of the Sale Area BIF (DNR 2018).

### **A. Habitat and Recreation Areas**

State and federal wildlife refuges, critical habitat areas, recreation areas, and parks exist within or near the Sale Area. These areas have significant scenic and recreational value, provide important habitat for fish and wildlife, and are used extensively for recreation, fishing, hunting, and trapping. Most of the uplands within the Sale Area on the west side of Cook Inlet, including the uplands in the SW Cook Inlet Area on the Iniskin Peninsula, are outside of the designated nonsubsistence use area. All other uplands and submerged lands in the Sale Area and the SW Cook Inlet Area are located within the Anchorage-Matsu-Kenai nonsubsistence use area. Uplands in the SW Cook Inlet Area are predominately private lands owned by regional village corporations.

### **B. Fish and Wildlife Uses and Value**

Fisheries in the region support commercial, subsistence, personal use, and sport harvest. Wildlife populations support hunting and trapping by local and nonlocal resident and non-resident hunters.

#### **1. Commercial Fisheries**

All five species of **Pacific salmon** are harvested commercially in Cook Inlet; the most significant commercial fishery in the Sale Area. ADF&G divides Cook Inlet into two commercial fisheries management areas: Upper Cook Inlet waters north of Anchor Point, and Lower Cook Inlet south of

Anchor Point to Cape Douglas and the Barren Islands. The SW Cook Inlet Area is in both Upper and Lower Cook Inlet management areas (Shields and Frothingham 2018; Hollowell et al. 2019). Sockeye salmon are the most important economically, followed by coho, Chinook, chum, and pink (Shields and Frothingham 2018). Commercial harvest and ex-vessel value of salmon in upper Cook Inlet are dominated by sockeye salmon. In 2017, a total of 2.6 million salmon were harvested in Upper Cook Inlet, of which 1.8 million were sockeye; total ex-vessel value was about \$23.8 million for all salmon, and about \$19.7 million for sockeye (Shields and Frothingham 2018). In 2017, a total of 2.5 million salmon were harvested in Lower Cook Inlet, of which 2.0 million were pinks; total ex-vessel value was about \$5.7 million for all salmon, with about \$2.1 million for pink salmon and \$2.4 million for sockeye salmon (Hollowell et al. 2019). Additional information on management and value of commercial salmon fisheries in Cook Inlet is provided in Chapter Five of the Sale Area BIF (DNR 2018, 5-2 to 5-6).

Commercial fisheries for Pacific halibut, groundfish, Pacific herring (*Clupea pallasii*), and razor clams (*Siliqua patula*) occur in Lower Cook Inlet and Kamishak Bay. From 2006 to 2017, commercial harvest of **Pacific halibut** within statistical area 261 – Cook Inlet in the International Pacific Halibut Commission’s (IPHC) regulatory Area 3A – Gulf of Alaska, steadily decreased from 984,622 to 321,637 pounds of halibut (IPHC 2019). Halibut harvest in Cook Inlet (261) represents a small proportion (4 percent) of the Gulf of Alaska (Area 3A) harvest (IPHC 2019). In 2018, halibut harvest in Area 3A (7.2 million pounds with 2.3 million pounds off loaded in Homer) was 45 percent of the total Alaska commercial harvest valued at \$110 million; with the Cook Inlet catch valued at \$38 million (NOAA Fisheries 2018; ADF&G 2019f). The average halibut harvest in state waters of Cook Inlet from 2009 to 2018 was 138,890 pounds, with 35 percent of the total Cook Inlet District harvest from state waters (ADF&G 2019c). In 2018, 131,761 pounds of halibut was harvested in state waters of Cook Inlet with a value of \$534,802; representing 36 percent of the total Cook Inlet harvest in state and federal waters (ADF&G 2019c).

The **Pacific cod** fishery is the largest commercial groundfish fishery in the Cook Inlet Area (all waters between latitude of Cape Douglas and the longitude of Cape Fairfield) with about half of the total harvest occurring in the Cook Inlet District (waters of Cook Inlet north of a line from Cape Douglas to Point Adam). For combined federal and state waters of the Cook Inlet District over the recent 20 years, annual Pacific cod harvest has averaged about 2.7 million pounds with a high of about 4.4 million pounds, with about 40 percent of the harvest occurring in the federal waters between Kamishak and Kachemak Bays (Rumble et al. 2019). The exvessel value of the fishery in the Cook Inlet District in 2017 was just under \$1 million with 37 vessels harvesting 1.6 million pounds of Pacific cod. Other commercially important groundfish harvested in the Cook Inlet District, with average 2009 to 2018 harvests, include: lingcod (*Ophiodon elongatus*) 21,042 pounds, rockfish 79,176 pounds, sablefish 46,982 pounds, walleye pollock, spiny dogfish (*Squalus acanthias*), and skates (ADF&G 2019b). The commercial sac roe seine fishery for Pacific herring in Kamishak Bay has been closed since 2000 to allow the stock to rebuild from historically low abundance (Hollowell et al. 2019).

## 2. Recreational Fisheries

Personal use fishing, an important source of food for many Alaskans, is prevalent in the Sale Area. Sport fishing is a major economic driver for Sale Area residents, supporting commercial guides and associated businesses with an estimated annual statewide impact of more than \$1 billion (Southwick Associates 2013; NMFS 2018). Recreational fishing in Alaska generated 4,865 jobs, \$539.4 million in sales, \$195.1 million in income, and \$315.5 million in value-added impacts; with expenditures for fishing trips and durable equipment totaling over \$412 million in 2016 (NMFS 2018). Anglers fished about 863,648 days in 2016, which was an 18 percent decrease in days fished from 2007, and an 11 percent decrease in days fished from 2015 (NMFS 2018). The SW Cook Inlet Area is beyond areas where sport fishing is typically concentrated on the Kenai Peninsula and closer to population centers (ADF&G 2019a). Salmon and Dolly Varden (*Salvelinus malma*) provide sport fishing opportunities from June through October in western

Cook Inlet freshwaters, with the primary sport fishing window during July and August (ADF&G 2019d). Notable fishing restrictions within the SW Cook Inlet Area include: closure to salmon fishing for all flowing waters of West Cook Inlet from October 1 to December 31, with additional restriction at the head of Chinitna Bay; and year-round closure to all fishing in the Clearwater Creek drainage, including Roscoe Creek, within ½ mile upstream from the confluence with the Chinitna River (ADF&G 2019e). An estimated 7,967 angler-days were fished in West Cook Inlet drainages in 2017, a 33 percent reduction in angler-days over the past 10 years which averaged 11,939 angler-days per year (ADF&G 2019a).

### **3. Subsistence**

The fish, wildlife, and plant resources of the Cook Inlet area have been used for subsistence by area residents for centuries. Subsistence resources include salmon and nonsalmon fish, large and small land mammals, marine mammals and invertebrates, migratory waterfowl and upland game birds, and wild plants and berries (Jones et al. 2015; Jones and Kostick 2016; SRBA 2011). Communities using the SW Cook Inlet Area for subsistence include: Nikiski (bird eggs, shellfish) and Seldovia (shellfish) in Chinitna Bay accessing bird eggs by boat and shellfish by airplane (AOOS 2019); Port Alsworth (marine invertebrates, furbearers, small mammals), Iliamna (marine invertebrates, nonsalmon fish), and Pedro Bay (marine invertebrates, nonsalmon fish) with marine invertebrates and fish taken in Chinitna, Oil, Iniskin, and Iliamna bays, and furbearers and small mammals taken on the Iniskin Peninsula (SRBA 2011). The communities of Nanwalek and Port Graham, located on the east side of Cook Inlet, also rely on salmon and other resources from lower Cook Inlet (Davis and Dublin 2019).

### **C. Other Uses**

The visitor industry is one of Alaska's major economic drivers and, overall, the Southcentral region receives the highest economic impact from visitors. Estimated overall total visitor spending in the state in October 2014 to September 2015 was \$1.94 billion, excluding travel cost to and from Alaska. Forestry, mining, renewable energy, and agricultural uses are also present in the Sale Area. Cook Inlet is crossed by vessels and submarine fiber-optic cables. Vessel traffic is dominated by scheduled, weekly port calls by freight cargo ships to Anchorage and ferries to Homer (Eley 2012). Three submarine fiber-optic cables cross the Sale Area: General Communication Incorporation's Kodiak Kenai Fiber Link and TERRA SW cables, and Alaska Communications' Alaska-Oregon Network cable (TeleGeography 2019).

Information on current and projected uses of the SW Cook Inlet Area are found in Chapter Five (DNR 2014, 5-1 to 5-17). Recent and comprehensive information on fish and wildlife and other Cook Inlet uses that encompass the expanded Sale Area are described in Chapter Five of the Sale Area BIF (DNR 2018, 5-1 to 5-42).

## **Chapter Six: Petroleum Potential, Operations and Transportation Methods in the Sale Area**

Cook Inlet has experienced oil and gas exploration and development over the past 60 years. Commercial oil and gas production comes from two main petroleum systems: 1) biogenic natural gas, sourced from Tertiary coals and reservoirs in sandstones of the middle and upper Kenai Group (upper Tyonek, Beluga, and Sterling formations), and 2) thermogenic oil with minor associated gas, sourced from the middle Jurassic Tuxedni Group and reservoirs in sandstones of the lower and middle Kenai Group (West Foreland, Hemlock, and lower Tyonek formations). These Tertiary reservoirs are absent in the SW Cook Inlet Area. The greatest prospectivity in the SW Cook Inlet Area is Jurassic-sourced thermogenic oil and gas in Jurassic sandstones of the Tuxedni Group, Chinitna Group, and the Naknek Formation (DNR 2014). Volcanic breccia in the uppermost Talkeetna Formation is another possible reservoir (Buthman 2018). Potential unconventional targets include low-porosity, low-permeability oil saturated sandstones within the Tuxedni Group that may be commercially viable using modern drilling technology such as lateral horizontal wells and hydraulic fracturing (Buthman 2018).

Exploratory drilling began on the Iniskin Peninsula in the early 1900s with six wells drilled between 1902 and 1905 near oil seeps at Oil Bay and Dry Bay; two of these wells had strong oil and gas shows. Between 1903 and 1934, reports from geologic field studies conducted by US Geological Survey geologists described a potential structural trap now known as the Fitz Creek anticline (Moffit 1922, 1923, 1927; Detterman and Hartsock 1966). Three subsequent wells were drilled near the Fitz Creek oil seep between 1939 and 1958 with strong shows, but non-commercial flow rates. More recently, in 2013, Cook Inlet Regional Corporation (CIRI) issued an oil and gas exploration license covering their lands on the Iniskin Peninsula and the first 2-dimensional (2D) seismic acquisition began. Aerial gravimetric and magnetic surveys were completed for lower Cook Inlet and the Iniskin Peninsula in 2018 (Cashman 2019).

Natural oil seeps, oil stained rocks in outcrops within the Tuxedni Group and the Chinitna Formation, and small quantities of oil and gas recovered in wells on the Iniskin Peninsula provide evidence of hydrocarbon generation and migration in the SW Cook Inlet Area (Wartes and Herriott 2014, 2015; Herriott and Wartes 2017). The predominant conventional trap at Iniskin is the southwest-plunging Fitz Creek anticline that is obvious in surface geology and topography, magnetic surveys, and recent 2D seismic. Uncertainties exist around whether faulting may have resulted in leakage of trapped hydrocarbons from the anticlinal structural trap. A recent evaluation based on 2D seismic concluded that exploration wells drilled to date missed the crest of a deeper anticlinal structural trap (Buthman 2018). Uncertainties also exist around whether the Jurassic volcanic-rich and plutonic-rich sandstones have sufficient primary porosity and permeability to provide economically viable reservoirs (Helmold et al. 2013). However, outcrop studies within the Jurassic strata at Iniskin document multiple pervasive fracture sets, which can provide permeability in low primary porosity and primary permeability reservoirs (Rosenthal et al. 2018).

Oil and gas exploration, development, and production phases include activities such as seismic surveys; construction of roads, well pads, and facilities; exploration, delineation, production, and disposal well drilling; and installation of processing facilities, camps, storage facilities, pipelines and transport terminals. Oil and gas produced in the Sale Area is often transported by pipelines, but trucking and marine tanker transportation also occur. The most likely method of transportation of oil and gas from the SW Cook Inlet Area is by pipeline.

Currently no oil and gas facilities exist in the SW Cook Inlet Area. Oil and gas infrastructure is well-developed in upper Cook Inlet. Oil and gas are produced from leases in 25 active federal, state, Native or joint administered unit areas in the Cook Inlet region (Figure 4). Existing Cook Inlet oil production is processed at the Trading Bay production facility on the west side of Cook Inlet and the Kenai Refinery located at Nikiski on the east side of Cook Inlet. All current Cook Inlet produced oil is transported to the Kenai Refinery. Cook Inlet Natural Gas Storage Alaska enables storage of natural gas when supply exceeds demand. Natural gas produced from the Kenai Gas Field and the Beluga River Field is transported by pipeline to Anchorage, Girdwood, Wasilla, and Palmer for domestic consumption. The advantages and disadvantages of likely oil and gas transportation methods are discussed in Chapter Six of the Sale Area BIF (DNR 2018, 6-19 to 6-21).

On June 21, 2017 BOEM offered 20 percent of the Cook Inlet Outer Continental Shelf (OCS) Planning Area in Lease Sale 244 (BOEM 2019). Lease Sale 244 covered 1.09 million acres contiguous with the Sale Area and SW Cook Inlet Area (Figure 4). BOEM geoscientists and engineers estimated that Tertiary oil and gas plays would attract bids because of the proven commercial petroleum production in the northern Cook Inlet Basin (BOEM 2016a). Fourteen blocks received over \$3 million in bids. Geophysical surveys are scheduled for lower Cook Inlet in 2019 (BOEM 2018; NOAA Fisheries 2019), with two to four exploratory wells anticipated in lower Cook Inlet federal waters pending geophysical survey results (Cashman 2019). BOEM has scheduled Lease Sale 258 for Cook Inlet in 2021 (BOEM 2016b). At market values of \$60 per barrel of oil and \$3.20 per thousand cubic feet of gas, BOEM estimates undiscovered

economically recoverable oil and gas resources of 0.94 billion barrels of oil and 0.40 trillion cubic feet of gas for leased and unleased lands in the Cook Inlet OCS Planning Area (BOEM 2017).

Oil spills and gas releases are concerns with pipelines, wells, platforms, and facilities in the Sale Area. There is a comprehensive network of agencies, local governments, non-governmental organizations, and other entities prepared for a spill or release event. Information on exploration history, petroleum potential, oil and gas activities and phases, likely methods and risks of oil and gas transportation, and spill risk, prevention, and response specific to the SW Cook Inlet Area are found in Chapter Six (DNR 2014, 6-1 to 6-19). Recent and comprehensive information on petroleum potential, oil and gas exploration, development, and production; oil and gas transportation methods; spill history and risk; and a comprehensive discussion of oil spill response capabilities including cleanup and remediation techniques applicable to the SW Cook Inlet Area are described in Chapter Six of the Sale Area BIF (DNR 2018, 6-1 to 6-45).

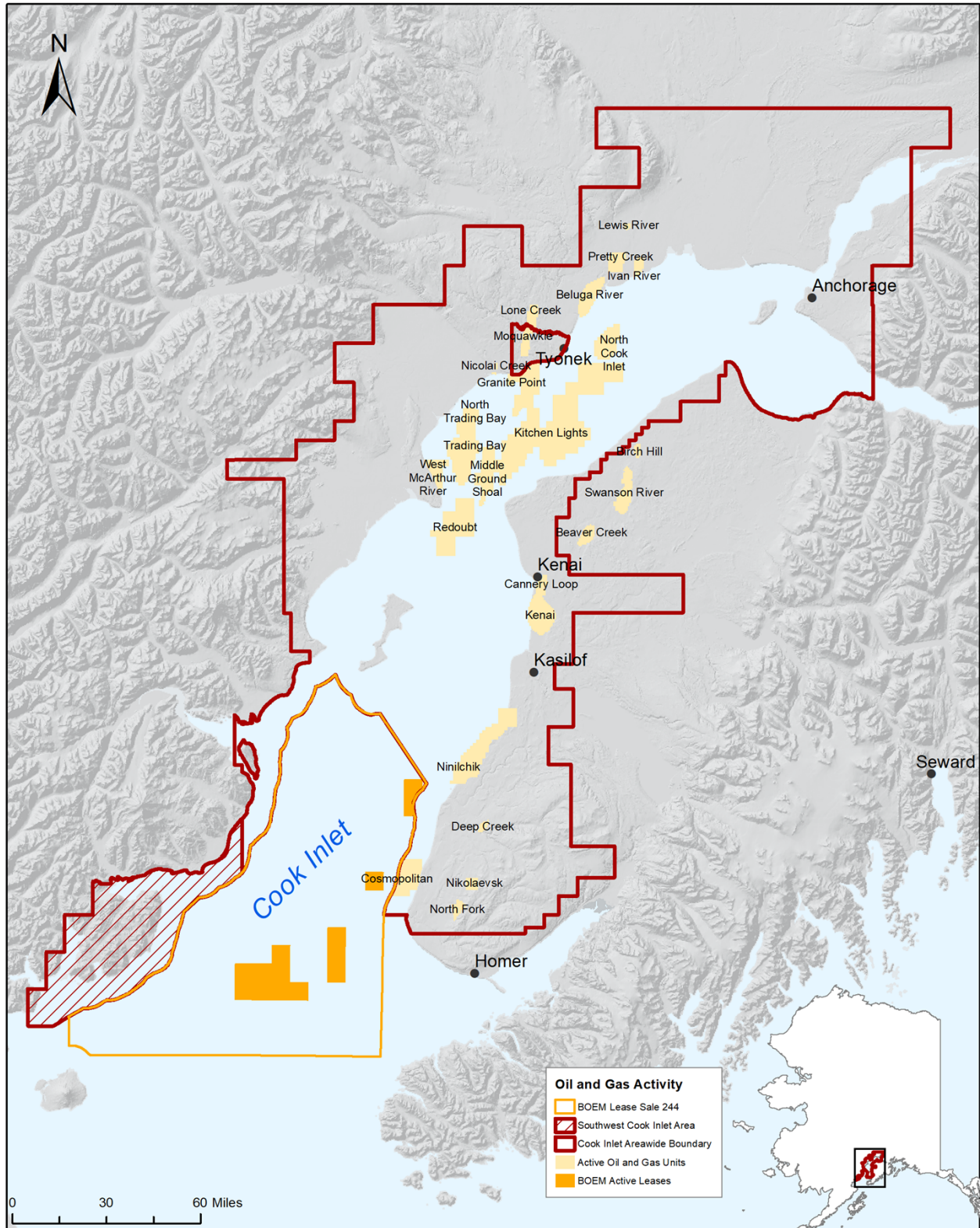


Figure 4.—Oil and gas activity in the Cook Inlet region.

## **Chapter Seven: Governmental Powers to Regulate Oil and Gas**

All oil and gas activities are subject to numerous federal, state, and local laws and regulations. Government agencies have broad authority to regulate and condition activities related to oil and gas. Lessees are responsible for knowing and complying with all applicable federal, state, and local laws, regulations, policies, ordinances, and the provisions of the lease. Agencies include the Alaska Departments of Natural Resources, Environmental Conservation, Labor and Workforce Development, and Fish and Game; the Alaska Oil and Gas Conservation Commission; the US Environmental Protection Agency; the US Army Corp of Engineers; the Pipeline and Hazardous Materials Safety Administration; the US Fish and Wildlife Service (USFWS); the National Marine Fisheries Service (NMFS); the US Coast Guard; and local municipalities and boroughs.

The primary government agencies with their authorities to prohibit, regulate, and condition oil and gas activities applicable to the SW Cook Inlet Area are discussed in Chapter Seven of the Sale Area BIF (DNR 2018, 7-1 to 7-17).

## **Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity**

Over 50 years of oil and gas activities in the Sale Area have had a range of effects on the environment, fish and wildlife, subsistence uses, cultural resources, and other uses. As effects are understood, measures are taken to prevent and mitigate substantial negative impacts from pollution and habitat degradation, and disturbances to fish and wildlife, subsistence users, commercial and sport fisheries, and communities. Oil and gas activities include seismic and geotechnical surveys, construction and operation of support facilities, exploration and development drilling, construction of drilling and production pads or platforms, access roads, and pipelines. Potential cumulative effects of these activities include physical disturbances, human activity, or contamination that could alter air and water quality; terrestrial, marine, estuarine, riverine and wetland habitats; landscape connectivity through habitat fragmentation; behavior and habitat use of fish, birds, and mammals. Information provided by ADF&G on reasonably foreseeable effects of oil and gas activities on increased predation risks and oil spill impacts on birds and marine mammals are covered in Chapter Eight of the Sale Area BIF (DNR 2018). New information was identified by BOEM on impact assessments of proposed oil and gas activities in middle and lower Cook Inlet, including activity on the Iniskin Peninsula, that are summarized here.

Cumulative effects of oil and gas activities on terrestrial habitats and wildlife are primarily related to habitat loss from construction of roads, pads, and facilities and habitat alteration from indirect effects resulting from construction and use of these facilities such as altered drainage patterns, fugitive dust, and changes in vegetation cover.

Oil and gas activities that introduce seismic pulses, infrastructure, aircraft and vessel traffic, and discharges into coastal and nearshore waters could have cumulative effects on fish and wildlife populations. A primary concern for oil and gas activities in marine waters is the potential effect that noise from these activities could have on marine fish and mammals.

A discussion of fish hearing and the potential effects of seismic surveys are discussed in Chapter Eight in the Sale Area BIF (DNR 2018, 8-19). ADF&G commented that the discussion failed to adequately address potential impacts of seismic surveys on fish eggs and larvae and salmon migration which are addressed herein. Most energy from seismic airguns range from 10 to 120 Hertz (Hz) with sound pressures as high as 255 decibels [dB] reference level in water [re] 1 micropascal [ $\mu$ Pa] or well above the levels known to cause injury to fish (Limpinsel et al. 2017; Halvorsen et al. 2012). Received sound pressure levels depend on the distance of the fish from the source. Loud sounds may cause fish to change



behavior moving away from the source, display alarm response, change schooling patterns, change swimming speed and location in the water column, and interrupt feeding and reproduction (Limpinsel et al. 2017). In addition, disruptions in fish behavior can contribute to secondary effects including increased stress; displacement to lower value feeding or spawning areas; increased vulnerability to predators; masking of biologically important sounds; and changes in migratory patterns (Popper and Hastings 2009; Popper and Hawkins 2019; NOAA 2016). Behavioral studies specific to seismic operations have shown that both pelagic and demersal fishes changed horizontal and vertical distributions during and after airgun operations, but they returned to their original distributions within hours or days after seismic operations ended (Popper and Hawkins 2019). It is likely that migrating salmon would respond similarly, avoiding ensonified areas during migration, but returning when activity ceased. A review of studies on the effects of low-frequency sound on fishes identified evidence for physical trauma and other negative effects, but found conflicting evidence for changes in catch rates and abundance (Carroll et al. 2017). Standard ramp up procedures for seismic surveys allow mobile fish to escape the ensonified area and avoid physical damage (NOAA 2016). Fish eggs, fish larvae, and zooplankton would not be able to escape and would be exposed to lethal sound levels within 2 to 10 feet, and injurious sound levels within about 16 feet from the sound source (NOAA 2016); although decreased zooplankton abundance and increased mortality may occur out as far as 0.75 miles (McCauley et al. 2017).

Seismic surveys require permits with mitigation measures and would likely be timed to avoid salmon spawning migration periods when commercial, subsistence, and personal use salmon fisheries are active in Cook Inlet waters. The total area exposed to sound pressures that could injure or kill fish during seismic surveys would be relatively small and the activity would be short term over periods of days or weeks. Because most mobile fish may avoid injury by avoiding ensonified areas and would be expected to return to habitats within hours to days after the survey, significant cumulative effects on fish from seismic surveys are not expected. ADF&G has developed blasting criteria in or near fresh water fish-bearing water bodies (Timothy 2013). The location of known fish bearing waters and information on blasting criteria can be obtained from ADF&G's Habitat Section.

In summer 2019, the NMFS (84 FR 37442) and the USFWS (Services; 84 FR 37716) published regulations on the take of marine mammals throughout Cook Inlet incidental to oil and gas activities. The Services evaluated the potential impact of incidental take of ESA and non-ESA protected marine mammals that could result from proposed oil and gas exploration, development, production, and transportation activities over a 5-year period. The assessments included calculation of incidental take due to potential exposure of marine mammals to sounds identified as causing auditory injury (Level A harassment) or disruption of behavioral patterns (Level B harassment). The Services also evaluated the potential for spills, acoustic, and habitat effects on prey animals that included marine and anadromous fishes. With implementation of required monitoring and mitigation measures, the Services concluded that the total marine mammal take from authorized oil and gas activities would have negligible impacts on affected marine mammal species or stocks (84 FR 37442 ; 84 FR 37716).

Oil and gas activities may affect subsistence wildlife resources through avoidance or displacement of animals from historical ranges or through disruption of subsistence fishing or hunting activities. The primary cumulative impact from construction of support facilities for onshore oil and gas development, besides impacts to habitats and distribution and abundance of fish and wildlife populations, is related to changes in access for subsistence uses. The Services evaluated the potential for specific oil and gas activities in Cook Inlet to impact subsistence use of marine mammals and determined that the authorized incidental take of marine mammals, with implementation of measures to prevent disruption of subsistence uses, would not result in an unmitigable adverse impact on the availability for taking of marine mammals for subsistence uses (84 FR 37442 ; 84 FR 37716).

Oil and gas development could also result in increased access to recreation, hunting, and fishing areas due to construction of new roads, which could increase competition between user groups. Increased access



could benefit recreational and visitor use by increasing the area available for those uses. Other potential benefits from oil and gas development to local communities include a potential increase in wage earning opportunities to supplement subsistence activities. Consultation and coordination with subsistence stakeholders along with seasonal avoidance of subsistence use areas by oil and gas-related vessel and aircraft traffic are standard mitigation measures required by marine mammal incidental take authorizations (84 FR 37442 ; 84 FR 37716). Mitigation measures included in the Sale Area BIF (DNR 2018, 9-1 to 9-8) and those developed through permitting in future phases, along with laws and regulations imposed by state and federal agencies, are expected to minimize and mitigate potential effects on fish, wildlife, and their uses.

Oil and gas activities may also have fiscal and other effects on nearby communities. Positive potential effects are job creation, substantial local and state revenues, and the potential for local use of oil and gas to lower energy costs. If local and Alaska residents and contractors are hired for work in the Sale Area the multiplier effect may benefit local and state economies.

Information on reasonably foreseeable cumulative effects from oil and gas activities for the SW Cook Inlet Area are found in Chapter Eight (DNR 2014, 8-1 to 8-28). Updated and comprehensive information on the reasonably foreseeable effects of oil and gas activities on air and water quality and availability; terrestrial and coastal, freshwater and marine habitats and respective fish and wildlife populations; fish and wildlife uses; historical and cultural resources; fiscal effects on the state, municipalities, and communities; and effects on municipalities and communities related to employment, natural gas needs, access, recreation and tourism that encompass the expanded Sale Area are described in Chapter Eight of the Sale Area BIF (DNR 2018, 8-1 to 8-56).

## **Chapter Nine: Mitigation Measures**

Mitigation measures address protection of state lands; air and water quality; habitat for fish and wildlife; local subsistence, and nonlocal and nonresident harvest activities; access; prehistoric, historic, and archeological sites; management of fuels, hazardous substances, and wastes; potential spills of hazardous substances; and siting of oil and gas facilities and operations. Mitigation measures that apply to the expanded Sale Area are listed in Chapter Nine of the Sale Area BIF (DNR 2018, 9-1 to 9-8).

## **Summary of Comments and Responses**

DO&G issued calls for public comments on the SW Cook Inlet exploration license on May 30, 2013 and June 2 and 13, 2013. Comments and responses for the SW Cook Inlet exploration license are summarized in Appendix A (DNR 2014, Appendix A). DO&G issued a request for agency information for preparation of the 2018 Cook Inlet Areawide BIF on September 1, 2016, with a request for public comments on the preliminary BIF on January 31, 2018. Comments and responses for the 2018 Sale Area BIF are summarized in Appendix A (DNR 2018, A-1 to A-5).

DO&G issued a request for agency information for the SW Cook Inlet Area to 55 federal, state, and local agency personnel on June 10, 2019. DO&G received responses from DMLW; ADF&G; and BOEM. DMLW responded that the boundary expansion would not impact settlement or proposed settlement lands and they had no objection to the boundary expansion for the Sale Area. ADF&G provided updated information on Pacific salmon and marine fisheries; trumpeter swans and Steller's eiders; SW Cook Inlet Area commercial and sport fisheries and subsistence fish and wildlife uses; and seismic effects on fish eggs, fish larvae, and salmon migration which were incorporated into this supplement. Information provided by ADF&G on Cook Inlet scallop, crab, and other shellfish fisheries; reasonably foreseeable effects of oil and gas activities on increased predation risks, and oil spill impacts on birds and marine mammals were covered in the Sale Area BIF (DNR 2018). BOEM identified information sources for lease sales, active leases, proposed oil and gas exploration activities, and impact assessments for oil and

gas activities in middle and lower Cook Inlet, including activity on the Iniskin Peninsula. Information from sources identified by BOEM was incorporated into this supplement.

DO&G issued a public call for new information for the Cook Inlet and Alaska Peninsula areawide oil and gas lease sales on September 10, 2019. The call for new information noted DO&G's intention to include the SW Cook Inlet Area in the Cook Inlet areawide lease sales. DO&G received responses to the annual call for new information from ADF&G, and NPS. ADF&G recommended including new research on anthropogenic noise and Cook Inlet beluga whales and that cumulative impacts of noise be considered in the permitting process for Cook Inlet activities, in areas of oil and gas production and areas with intense shipping activities. NPS submitted new research by USFWS on sea otter surveys in lower Cook Inlet, and by BOEM on nearshore invertebrate communities and habitats in lower Cook Inlet. This new information was incorporated into the supplement.

## Disposal Decision

After considering the facts, issues, applicable laws and regulations, mitigation measures, and other regulatory protections; the director finds that the potential benefits outweigh the possible negative effects such that inclusion of the SW Cook Inlet Area in the annual Cook Inlet areawide oil and gas lease sales will best serve the interests of the State of Alaska.

The state is sufficiently empowered through constitutional, statutory, and regulatory regimes, terms of the lease sale, lease, contract, and plans of operations to ensure lessees conduct their activities safely and in a manner that protects the environment and maintains opportunities for existing and anticipated uses.

Supplemental findings have the status of a final best interest finding for the purpose of a request for reconsideration (AS 38.05.035(e)(6)(F)(iii)). To be eligible to file a request for reconsideration a person who is aggrieved by the final written finding must have meaningfully participated in the public participation process through submission of written comments during the public comment period. A person may appeal a final written finding to the superior court, only if eligible and requested reconsideration within 30 days from the date of the reconsideration decision.



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Tom Stokes

Director, Division of Oil and Gas

I concur with the director that the inclusion of the Southwest Cook Inlet Area into the annual Cook Inlet areawide oil and gas lease sales is in the state's best interest.



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Commissioner, Department of Natural Resources

## References

- 62 FR 31748. 1997. Endangered and threatened wildlife and plants; threatened status for the Alaska breeding population of the Steller's eider, Final rule. Department of the Interior, Fish and Wildlife Service. pp. 31748-31757.
- 70 FR 46366. 2005. Endangered and threatened wildlife and plants; determination of threatened status for the southwest Alaska distinct population segment of the northern sea otter (*Enhydra lutris kenyoni*), Final rule. Department of the Interior, Fish and Wildlife Service. pp. 46366-46386.
- 74 FR 51988. 2009. Endangered and threatened wildlife and plants; designation of critical habitat for the southwest Alaska distinct population segment of the northern sea otter, Final rule. Department of the Interior, Fish and Wildlife Service. pp. 51988-52012.
- 76 FR 20180. 2011. Endangered and threatened species: Designation of critical habitat for Cook Inlet beluga whale, Final rule. National Marine Fisheries Service National Oceanic and Atmospheric Administration. pp. 20180-20214.
- 84 FR 37442. 2019. Takes of marine mammals incidental to specified activities; taking marine mammals incidental to oil and gas activities in Cook Inlet, Alaska, Final rule; issuance of Letters of Authorization (LOA). Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. pp. 12330-12377.
- 84 FR 37716. 2019. Marine mammals; incidental take during specified activities: Cook Inlet, Alaska, Final rule. Department of Interior, Fish and Wildlife Service. pp. 37716-37750.
- 84 FR 54354. 2019. Endangered and threatened wildlife and plants: Proposed rule to designate critical habitat for the Central America, Mexico, and western North Pacific distinct population segments of humpback whales, Proposed rule. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. pp. 54354-54391.
- ADF&G (Alaska Department of Fish and Game). 2018. State of Alaska anadromous waters catalog. <https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home> (Accessed May 14, 2018).
- ADF&G (Alaska Department of Fish and Game). 2019a. Alaska Sport Fishing Survey. Regional summary estimates: Southcentral (N) West Cook Inlet drainages. <http://www.adfg.alaska.gov/sf/sportfishingsurvey/> (Accessed August 21, 2019).
- ADF&G (Alaska Department of Fish and Game). 2019b. Commercial groundfish fisheries, Cook Inlet management area. <https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareacookinlet.groundfish> (Accessed August 20, 2019).
- ADF&G (Alaska Department of Fish and Game). 2019c. Cook Inlet District halibut harvest (whole pounds). Prepared by Elisa Russ. Anchorage, Alaska. <https://elandings.alaska.gov/> (Accessed November 15, 2019).
- ADF&G (Alaska Department of Fish and Game). 2019d. Sport fish run timing: West-side Susitna drainage / western Cook Inlet sport fish availability in fresh water. <https://www.adfg.alaska.gov/index.cfm?adfg=fishingSportFishingInforuntiming.main> (Accessed August 21, 2019).
- ADF&G (Alaska Department of Fish and Game). 2019e. Sport fishing regulations. Southcentral Alaska 2019 regulations: West Cook Inlet. [https://www.adfg.alaska.gov/static/regulations/fishregulations/PDFs/southcentral/2019sc\\_sfregs\\_west\\_cook\\_inlet.pdf](https://www.adfg.alaska.gov/static/regulations/fishregulations/PDFs/southcentral/2019sc_sfregs_west_cook_inlet.pdf) (Accessed August 21, 2019).

- ADF&G (Alaska Department of Fish and Game). 2019f. Statewide halibut wholesale value and pounds processed. [https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar\\_halibutproduction](https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar_halibutproduction) (Accessed September 4, 2019).
- AOOS (Alaska Ocean Observing System). 2019. Wild resource harvest and use by Cook Inlet communities. Cook Inlet Response Tool. <https://portal.aos.org/old/#module-metadata/567cafb7-5126-431a-9c8e-7f63648d433b/c4f626d4-d7ef-47bf-85d0-4ff8b9599e49> (Accessed August 14, 2019).
- BOEM (Bureau of Ocean Energy Management). 2016a. Cook Inlet Planning Area Oil and Gas Lease Sale 244 In the Cook Inlet, Alaska. Final Environmental Impact Statement. Alaska OCS Region, OCS EIS/EA BOEM 2016-069. <https://www.boem.gov/Sale-244/> (Accessed March 29, 2018).
- BOEM (Bureau of Ocean Energy Management). 2016b. Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022: Final Programmatic Environmental Impact Statement. US Department of the Interior, OCS EIS/EA, BOEM 2016-060. <https://www.boem.gov/Five-Year-Program-2017-2022/> (Accessed February 8, 2018).
- BOEM (Bureau of Ocean Energy Management). 2017. Assessment of undiscovered oil and gas resources of the Nation's Outer Continental Shelf, 2016a. BOEM Fact Sheet RED-2017-12. <https://www.boem.gov/2016-National-Assessment-Fact-Sheet/> (Accessed August 8, 2019).
- BOEM (Bureau of Ocean Energy Management, Alaska OCS Region). 2018. Alaska Region Geological and Geophysical Survey 19-01: Hilcorp Alaska LLC. Permit Number 19-01. <https://www.boem.gov/Alaska-Region-GandG-Survey-19-01/> (Accessed May 21, 2019).
- BOEM (Bureau of Ocean Energy Management). 2019. Cook Inlet Oil and Gas Lease Sale 244. Alaska OCS Region. <https://www.boem.gov/ak244/> (Accessed September 4, 2019).
- Buthman, D. B. 2018. Iniskin Peninsula conventional and unconventional exploration targets, Jurassic Tuxedni Group, lower Cook Inlet onshore, Alaska. AAPG Pacific Section Annual Meeting, Innovating the Future: Discovery to Recovery May 21-24, 2017, Anchorage, Alaska.
- Byerly, M. and W. Rheafournier. *in prep*. Groundfish population trends from the Cook Inlet bottom trawl surveys, 1991 to 2018. Alaska Department of Fish and Game, Fishery Data Series No. ###-##.
- Anchorage, Alaska.
- Carroll, A. G., R. Przeslawski, A. Duncanb, M. Gunning, and B. Bruce. 2017. A critical review of the potential impacts of marine seismic surveys on fish and invertebrates. Marine Pollution Bulletin 114(2017): 9-24.
- Cashman, K. 2019. Explorers magazine preview: Hilcorp aims to drill in lower Cook Inlet. Despite delay in 3-D seismic survey to late August, lower CI, Iniskin Peninsula and Trading Bay exploration programs on track. Petroleum News, April 14, 2019.
- Coletti, H., K. Iken, T. Jones, B. Konar, M. Lindeberg, S. Saupe, and S. Venator. 2017. Evaluation of nearshore communities and habitats in lower Cook Inlet, Alaska. US Department of the Interior, Bureau of Ocean Energy Management, OCS Study BOEM 2017-045. Anchorage, Alaska.
- Conant, B., J. I. Hodges, D. J. Groves, and J. G. King. 2007. Alaska trumpeter swan status report 2005. Waterfowl Management, US Fish and Wildlife Service, Juneau. [http://www.fws.gov/alaska/mbps/mbm/waterfowl/surveys/pdf/TRSW\\_Status\\_2005\\_Text.pdf](http://www.fws.gov/alaska/mbps/mbm/waterfowl/surveys/pdf/TRSW_Status_2005_Text.pdf) (Accessed July 28, 2015).
- Davis, B. and R. Dublin. 2019. Alaska Sustainable Salmon Fund, May 2019 completion report: Port Graham and Nanwalek subsistence fishery harvest monitoring. Alaska Department of Fish and Game, Division of Subsistence, Project No. 44207. Anchorage, Alaska. <https://s3-us-west->

- [1.amazonaws.com/akssfapm/APM\\_Uploads/2015/44207/.pdf/CR\\_5\\_2019.pdf](http://1.amazonaws.com/akssfapm/APM_Uploads/2015/44207/.pdf/CR_5_2019.pdf) (Accessed November 25, 2019).
- Detterman, R. L. and J. K. Hartsock. 1966. Geology of the Iniskin-Tuxedni Region, Alaska. US Geological Society, US Geological Survey Professional Paper 512. US Government Printing Office, Washington.
- DNR (Alaska Department of Natural Resources). 2014. Southwest Cook Inlet oil and gas exploration license: Written finding of the director. June 20, 2014.  
[http://dog.dnr.alaska.gov/Library/Document/BAD6426493E1420DA200906E504FDE69/6-20-2014\\_Southwest\\_Cook\\_Inlet\\_Oil\\_and\\_Gas\\_Exploration\\_License\\_Written\\_Finding\\_of\\_the\\_Director\\_\(BIF\)](http://dog.dnr.alaska.gov/Library/Document/BAD6426493E1420DA200906E504FDE69/6-20-2014_Southwest_Cook_Inlet_Oil_and_Gas_Exploration_License_Written_Finding_of_the_Director_(BIF)) (Accessed April 22, 2019).
- DNR (Alaska Department of Natural Resources). 2018. Cook Inlet areawide oil and gas lease sale: Written finding of the director. November 2, 2018.  
[http://dog.dnr.alaska.gov/Documents/Leasing/BIF/Cook\\_Inlet/20181102\\_Final\\_CI\\_BIF.pdf](http://dog.dnr.alaska.gov/Documents/Leasing/BIF/Cook_Inlet/20181102_Final_CI_BIF.pdf) (Accessed April 22, 2019).
- Eley, W. D. 2012. Cook Inlet vessel traffic study: report to Cook Inlet Risk assessment advisory panel. Edited by Nuka Research and Planning Group, LLC. Cape International, Inc., Juneau, Alaska.  
<http://www.cookinletriskassessment.com/documents/120206CIVTSvFINAL.pdf> (Accessed February 18, 2014).
- Fair, Lowell F., Robert A. Clark, and James J. Hasbrouck. 2007. Review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, No. 07-06. Anchorage.  
<http://www.sf.adfg.state.ak.us/FedAidPDFs/fms07-06.pdf> (Accessed June 27, 2018).
- Garlich-Miller, J. L., G. G. Esslinger, and B. P. Weitzman. 2018. Aerial surveys of sea otters (*Enhydra lutris*) in Lower Cook Inlet, Alaska May, 2017. US Fish and Wildlife Service, Marine Mammals Management, USFWS Technical Report MMM 2018-01. Anchorage, Alaska.  
[https://www.fws.gov/r7/fisheries/mmm/seaotters/pdf/2017\\_Cook\\_Inlet\\_Sea\\_Otter\\_Survey\\_Final\\_Report.pdf](https://www.fws.gov/r7/fisheries/mmm/seaotters/pdf/2017_Cook_Inlet_Sea_Otter_Survey_Final_Report.pdf) (Accessed October 15, 2019).
- Groves, D. J. 2017. The 2015 North American trumpeter swan survey: A cooperative North American survey. US Fish and Wildlife Service, Division of Migratory Bird Management, March 2017. Juneau, Alaska. [https://www.fws.gov/migratorybirds/pdf/surveys-and-data/NATrumpeterSwanSurvey\\_2015.pdf](https://www.fws.gov/migratorybirds/pdf/surveys-and-data/NATrumpeterSwanSurvey_2015.pdf) (Accessed May 17, 2018).
- Halvorsen, M. B., B. M. Casper, C. M. Woodley, T. J. Carlson, and A. N. Popper. 2012. Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. PLoS ONE 7(6): e38968. <https://doi.org/10.1371/journal.pone.0038968> (Accessed April 25, 2018).
- Harper, J. R. and M. C. Morris. 2014. Alaska ShoreZone coastal habitat mapping protocol. Bureau of Ocean Energy Management.  
<https://alaskafisheries.noaa.gov/sites/default/files/chmprotocol0114.pdf> (Accessed September 7, 2018).
- Helmold, K. P., D. L. LePain, M. D. Wilson, and C. S. Peterson. 2013. Petrology and reservoir potential of Tertiary and Mesozoic sandstones, Cook Inlet, Alaska: A preliminary analysis of outcrop samples collected during 2007-2010 field seasons. Alaska Division of Geological and Geophysical Surveys, Preliminary Interpretive Report 2013-5.  
<http://dggs.alaska.gov/pubs/id/25035> (Accessed October 30, 2019).
- Herriott, T. M. and M. A. Wartes. 2017. Discovery of a 35-meter-thick, oil-stained sandstone interval in outcrop of the Tonnie Siltstone Member, Chinitna Formation, lower Cook Inlet, south-central



- Alaska. Alaska Division of Geological and Geophysical Surveys, Preliminary Interpretive Report 2017-5. <http://dggs.alaska.gov/pubs/id/29837> (Accessed October 30, 2019).
- Hollowell, G., E. O. Otis, and E. Ford. 2019. 2017 Lower Cook Inlet area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 19-08. Anchorage, Alaska. <https://www.adfg.alaska.gov/FedAidPDFs/FMR19-08.pdf> (Accessed August 12, 2019).
- IPHC (International Pacific Halibut Commission). 2019. IPHC Secretariat data: Commercial fisheries. <https://iphc.int/data/iphc-secretariat-data> (Accessed August 15, 2019).
- Johnson, J. and B. Blossom. 2019. Catalog of waters important for spawning, rearing or migration of anadromous fishes - Southcentral Region, effective June 1, 2019. Alaska Department of Fish and Game, Special Publication No. 19-03. Anchorage, Alaska. [https://www.adfg.alaska.gov/static-sf/AWC/PDFs/2019scn\\_CATALOG.pdf](https://www.adfg.alaska.gov/static-sf/AWC/PDFs/2019scn_CATALOG.pdf) (Accessed August 12, 2019).
- Jones, B., D. Holen, and D. S. Koster. 2015. The harvest and use of wild resources in Tyonek, Alaska, 2013. 132 p. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 404. Anchorage, Alaska. <http://www.adfg.alaska.gov/sf/publications/> (Accessed April 26, 2018).
- Jones, B. and M. L. Kostick. 2016. The harvest and use of wild resources in Nikiski, Seldovia, Nanwalek, and Port Graham, Alaska 2014. 517 p. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 420. Anchorage, Alaska. <http://www.adfg.alaska.gov/sf/publications/> (Accessed April 26, 2018).
- Larned, W. W. 2005. Aerial survey of Lower Cook Inlet to locate molting flocks of Steller's eiders and mergansers, 14 September 2005. US Fish and Wildlife Service, Trip Report. Soldotna, Alaska.
- Larned, W. W. 2006. Winter distribution and abundance of Steller's eiders (*Polysticta stelleri*) in Cook Inlet, Alaska 2004-2005. Minerals Management Service, OCS Study MMS 2006-066. [https://www.fws.gov/alaska/mbmp/mbm/waterfowl/surveys/pdf/cistei\\_report.pdf](https://www.fws.gov/alaska/mbmp/mbm/waterfowl/surveys/pdf/cistei_report.pdf) (Accessed May 4, 2018).
- Larned, W. W. 2012. Steller's eider spring migration surveys Southwest Alaska 2012. US Fish and Wildlife Service, Division of Migratory Bird Management, Anchorage, Alaska.
- Limpinsel, D. E., M. P. Eagleton, and J. L. Hanson. 2017. Impacts to essential fish habitat from non-fishing activities in Alaska. EFH 5 year review: 2010 through 2015. US Department of Commerce, National Oceanic and Atmospheric Administration National Marine Fisheries Service, NOAA Technical Memorandum NMFS-F/AKR-14. <https://alaskafisheries.noaa.gov/habitat/efh> (Accessed April 30, 2018).
- Martin, P. D., D. C. Douglas, T. Obritschkewitsch, and S. Torrance. 2015. Distribution and movements of Alaska-breeding Steller's eiders in the non-breeding period. The Condor 117: 341-353.
- McCauley, R. D., R. D. Day, K. M. Swadling, Q. P. Fitzgibbon, R. A. Watson, and J. M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology and Evolution 1(June 22, 2017): 0195. <https://www.nature.com/articles/s41559-017-0195>. (Accessed September 19, 2019).
- McKinley, T. and J. W. Erickson. 2019a. Lower Cook Inlet escapement goal memorandum. Alaska Department of Fish and Game, March 26, 2019. Anchorage, Alaska. [http://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2019-2020/ws/2019\\_LCI\\_EG\\_memo.pdf](http://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2019-2020/ws/2019_LCI_EG_memo.pdf) (Accessed August 13, 2019).
- McKinley, T. and J. W. Erickson. 2019b. Upper Cook Inlet escapement goal memorandum. Alaska Department of Fish and Game, March 26, 2019. Anchorage, Alaska.

- [http://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2019-2020/ws/2019\\_UCI\\_EG\\_memo.pdf](http://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2019-2020/ws/2019_UCI_EG_memo.pdf) (Accessed August 13, 2019).
- Moffit, F. H. 1922. Geology of the vicinity of Tuxedni Bay, Cook Inlet Pages 141-147 Mineral resources of Alaska, report on progress of investigations in 1920, US Geological Survey Bulletin 722.
- Moffit, F. H. 1923. The Iniskin Bay district Pages 117-132 Mineral resources of Alaska, report on progress of investigations in 1921, US Geological Survey Bulletin 739.
- Moffit, F. H. 1927. The Iniskin-Chinitna Peninsula and the Snug Harbor district, Alaska. 71 p., 5 sheets p US Geological Survey Bulletin 789. <http://dggs.alaska.gov/pubs/id/3440> (Accessed May 6, 2019).
- Muto, M. M., V. T. Helker, R. P. Angliss, B. A. Allen, P. L. Boveng, J. M. Breiwick, M. F. Cameron, P. J. Clapham, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2018. Alaska marine mammal stock assessments, 2017. June 2018. US Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-378. <https://repository.library.noaa.gov/view/noaa/18114> (Accessed November 14, 2018).
- Muto, M. M., V. T. Helker, R. P. Angliss, P. L. Boveng, J. M. Breiwick, M. F. Cameron, P. J. Clapham, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2019. Alaska marine mammal stock assessments, 2018. June 2019. US Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-393. <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-393.pdf> (Accessed October 15, 2019).
- NMFS (National Marine Fisheries Service). 2017. Appendix A. Essential fish habitat (EFH) and habitat areas of particular concern (HAPC). Fishery management plan for the salmon fisheries in the EEZ off Alaska. NOAA-NMFS-2017-0087-0019. <https://www.regulations.gov/docketBrowser?rpp=50&po=0&dct=SR&D=NOAA-NMFS-2017-0087> (Accessed October 1, 2018).
- NMFS (National Marine Fisheries Service). 2018. Fisheries economics of the United States, 2016. US Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-187a. <https://www.fisheries.noaa.gov/content/fisheries-economics-united-states-2016> (Accessed August 20, 2019).
- NOAA (National Oceanic and Atmospheric Administration). 2016. Effects of oil and gas activities in the Arctic Ocean final environmental impact statement. National Marine Fisheries Service, Office of Protected Resources. <http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm> (Accessed April 30, 2018).
- NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2018. Individual Fishing Quota (IFQ) Halibut/Sablefish allocations and landings, 2018. Last Modified December 31, 2018. <https://www.fisheries.noaa.gov/alaska/commercial-fishing/fisheries-catch-and-landings-reports#ifq-halibut/sablefish> (Accessed August 15, 2019).
- NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2019. Incidental take authorization: Hilcorp Alaska LLC oil and gas activities in Cook Inlet, Alaska. Last Modified May 2, 2019. <https://www.fisheries.noaa.gov/action/incidental-take-authorization-hilcorp-alaska-llc-oil-and-gas-activities-cook-inlet-alaska> (Accessed May 21, 2019).

- NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2018. Essential fish habitat. Alaska Regional Office. <https://alaskafisheries.noaa.gov/habitat/efh> (Accessed May 30, 2018).
- NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2019. Alaska ShoreZone geodatabase. Alaska Regional Office. <https://alaskafisheries.noaa.gov/mapping/szflex/szapps.htm#> (Accessed October 23, 2019).
- Nowacki, G. J., P. Spencer, M. Fleming, T. Brock, and T. Jorgenson. 2001. Unified ecoregions of Alaska: 2001. US Geological Survey, Open-File Report 02-297. <https://agdc.usgs.gov/data/usgs/erosafo/ecoreg/index.html> (Accessed February 25, 2015).
- NPFMC (North Pacific Fishery Management Council). 2014. Fishery management plan for the scallop fishery off Alaska. Anchorage, Alaska. <https://www.npfmc.org/wp-content/PDFdocuments/fmp/Scallop/ScallopFMP2014.pdf> (Accessed August 20, 2019).
- NPFMC (North Pacific Fishery Management Council). 2018. Fishery management plan for groundfish of the Gulf of Alaska. Anchorage, Alaska. <https://www.npfmc.org/wp-content/PDFdocuments/fmp/GOA/GOAfmf.pdf> (Accessed August 20, 2019).
- NPFMC, NMFS, and ADF&G (North Pacific Fishery Management Council, National Marine Fisheries Service, Alaska Region and Alaska Department of Fish and Game). 2012. Fishery management plan for the salmon fisheries in the EEZ off Alaska. Anchorage, Alaska. <https://www.npfmc.org/wp-content/PDFdocuments/fmp/Salmon/SalmonFMP114.pdf> (Accessed October 1, 2018).
- Popper, A. N. and M. C. Hastings. 2009. The effects of human-generated sound on fish. *Integrative Zoology* 4: 43-52.
- Popper, A. N. and A. D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. *Journal of Fish Biology* 94: 692-713. <https://doi.org/10.1111/jfb.13948>. (Accessed September 16, 2019).
- Rosenthal, J. L., P. M. Betka, R. J. Gillis, and E. S. Nadin. 2018. Fracture intensity of the Mesozoic sedimentary forearc strata of lower Cook Inlet, Alaska. Alaska Division of Geological and Geophysical Surveys, Report of Investigation 2018-4. <http://dggs.alaska.gov/pubs/id/30063> (Accessed October 30, 2019).
- Rumble, J., E. Russ, and C. Russ. 2019. Cook Inlet Area groundfish management report, 2016-2018. Alaska Department of Fish and Game, Fishery Management Report No. 19-##. Anchorage, Alaska.
- Shields, P. and A. Frothingham. 2018. Upper Cook Inlet commercial fisheries annual management report, 2017. Alaska Department of Fish and Game, Fishery Management Report No. 18-10. Anchorage, AK. <http://www.adfg.alaska.gov/FedAidPDFs/FMR18-10.pdf> (Accessed September 20, 2018).
- Southwick Associates. 2013. Sportfishing in America: An economic force for conservation. Edited by Southwick Associates. Produced for the American Sportfishing Association (ASA) under a US Fish and Wildlife Service (USFWS) Sport Fish Restoration grant (F12AP00137, VA M-26-R) awarded by the Association of Fish and Wildlife Agencies (AFWA), Alexandria, Virginia. [http://asafishing.org/uploads/2011\\_ASASportfishing\\_in\\_America\\_Report\\_January\\_2013.pdf](http://asafishing.org/uploads/2011_ASASportfishing_in_America_Report_January_2013.pdf) (Accessed April 5, 2017).
- SRBA (Stephen R. Braund and Associates). 2011. Subsistence uses and traditional knowledge: Bristol Bay drainages. Chapter 23.[In] The Pebble Partnership. Pebble project environmental baseline document 2004 through 2008. <https://pebbleresearch.com/download/> (Accessed August 14, 2019).



- TeleGeography. 2019. Submarine cable map. PriMetrica, Inc. <https://www.submarinecablemap.com/> (Accessed April 29, 2019).
- Timothy, J. 2013. Alaska blasting standard for the proper protection of fish. Alaska Department of Fish and Game, Technical Report No. 13-03. Douglas, Alaska. [https://www.adfg.alaska.gov/static/home/library/pdfs/habitat/13\\_03.pdf](https://www.adfg.alaska.gov/static/home/library/pdfs/habitat/13_03.pdf) (Accessed September 16, 2019).
- USFWS (US Fish and Wildlife Service). 2017. Alaska Maritime National Wildlife Refuge: Refuge establishment. [https://www.fws.gov/refuge/alaska\\_maritime/establishment.html](https://www.fws.gov/refuge/alaska_maritime/establishment.html) (Accessed September 25, 2017).
- USFWS (US Fish and Wildlife Service). 2019. Status assessment of the Alaska-breeding population of Steller's eiders. Version 1. Fairbanks Fish and Wildlife Field Office. Fairbanks, Alaska. <https://ecos.fws.gov/ServCat/DownloadFile/163633> (Accessed August 13, 2019).
- Wartes, M. A. and T. M. Herriott. 2014. A new occurrence of oil-stained rocks within a small fault zone involving the Middle Jurassic Cynthia Falls Formation, Tuxedni Group, northern Iniskin Peninsula Pages 23-27. [In] R. J. Gillis, editor. Alaska Division of Geological and Geophysical Surveys, Preliminary Interpretive Report 2014-2.
- Wartes, M. A. and T. M. Herriott. 2015. Oil-stained sandstone in the Middle Jurassic lower Paveloff Siltstone member of the Chinitna Formation: Exploring the potential role of facies variations in controlling diagenesis and reservoir quality in western Cook Inlet, Alaska. Alaska Division of Geological and Geophysical Surveys, Preliminary Interpretive Report 2015-7. <http://dggs.alaska.gov/pubs/id/29533> (Accessed October 30, 2019).