Draft

Fish and Wildlife Coordination Act Report

for

Alaska Deep-Draft Arctic Port System Project

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Acronyms and Abbreviations

ACP	Arctic Coastal Plain
ADF&G	Alaska Department of Fish and Game
ADOT&PF	Alaska Department of Transportation and Public Facilities
AKNHP	Alaska Natural Heritage Program
AMBCC	Alaska Migratory Bird Co-Management Council
ASWG	Alaska Shorebird Working Group
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
BLM	Bureau of Land Management
CAR	Coordination Act Report
CFR	Code of Federal Regulations
CWA	Clean Water Act
ECOS	Environmental Conservation Online System
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FAO	Food and Agriculture Organization of the United Nations
ft	feet
FWCA	Fish and Wildlife Coordination Act
h	height
ha	hectare
IPM	Integrated Pest Management
IUCN	International Union for the Conservation of Nature
kg	kilogram
km	kilometer
LORAN	Long Range Navigation
m	meters
MBTA	Migratory Bird Treaty Act
mi	miles
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OCSEAP	Outer Continental Shelf Environmental Assessment Program
SCS	Soil Conservation Service
sq	square
TERA	Troy Ecological Research Associates
UME	Unusual Mortality Event
U.S.	United States

USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
v	vertical
WHSRN	Western Hemisphere Shorebird Reserve Network
yr	year

1. Scope and Authority

This report constitutes a draft of the U. S. Fish and Wildlife Service (USFWS) Fish and Wildlife Coordination Act Report (CAR) of the U. S. Army Corps of Engineers-Alaska District (USACE) and Alaska Department of Transportation and Public Facilities (ADOT&PF) joint proposal to develop an Alaska Deep-Draft Arctic Port System Project (Project) on the Seward Peninsula of Alaska (USACE 2013). Project and study updates are available at http://www.poa.usace.army.mil/Library/ReportsandStudies/AlaskaRegionalPortsStudy.aspx.

This report provides planning information and recommendations specific to fish and wildlife resources that occur in the vicinity of the Project. It discusses the presence of specific fish and wildlife resources that could be affected by construction of the port system; identifies fish and wildlife issues that should be addressed; identifies potential adverse impacts to fish and wildlife resources; and provides recommendations on measures for mitigating those impacts.

In response to a negotiated scope of work, the USFWS is providing this draft report for the Project to the USACE. It is prepared under the authority of and in accordance with the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 661-667e), the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.), National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 et seq.), Federal Water Pollution Control Act ("Clean Water Act") (CWA), as amended, (33 U.S.C. 1251 et seq.), the Migratory Bird Treaty Act of 1918 (MBTA), as amended, (16 U.S.C. 703 et seq.), the Bald and Golden Eagle Act (BGEPA) (16 U.S.C. 668-668c), and the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361-1407). This report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the FWCA.

The final CAR will describe the USACE section 7 consultation process with the USFWS for listed and candidate species that may be affected by the Project. If formal consultation occurs, the USFWS will provide a Biological Opinion that may include a list of non-discretionary terms and conditions considered apart and separate from recommendations contained in this report.

The USFWS gratefully acknowledges the assistance and expertise of the following people with the preparation of this report: Mike Salyer, Chris Johnson, Robert Henszey, William Morris, Megan Boldenow, Charleen Veach, and Debora Nigro.

2. Purpose and Description of Project

The purpose of the Project is to provide navigation improvements to support multiple maritime missions in the Arctic, such as search and rescue, oil and gas industry, security, cargo, resource export, tourism and oil spill and emergency response.

The tentatively selected Project plan (USACE 2013) involves developing a system of improved or new port facilities in deep water about 10.7 m (35-ft deep) on the Seward Peninsula to address the need for improved maritime infrastructure in Arctic Alaska. Locations of the proposed port facilities take advantage of existing deep water features and infrastructure that provides access to transportation (roads and airports), staging areas, and other essential upland services. The portion of the southern Seward Peninsula under consideration for this Project is shown in Figure 2.1, and is in the vicinities of Nome, Port Clarence, Teller and Brevig Mission.

Figure 2.1. Area map showing the city of Nome, Port Clarence/Point Spencer, the villages of Teller and Brevig Mission, and mining locations. Source: Alaska District Corps of Engineers Geomatics Section.

Nome is a small city of 3,759 people (2012 estimate) built on Norton Sound in the Bering Sea on the south cost of the Seward Peninsula. With its airport, hospital, schools, stores, and a limited road network out of the city including a gravel road to the village of Teller. Nome is the supply, service and transportation center of the Bering Strait region. Port Clarence is a natural bay located about 112 km (70 mi) northwest of Nome on the Bering Sea. There is currently a U.S. Coast Guard (USCG) Long Range Navigation (LORAN) station on the western side of Port Clarence, also known as Point Spencer. The Native Villages of Teller (population about 240 people) and Brevig Mission (population about 406 people) are located about 120 and 145 km (75 and 90 mi), respectively, northwest of Nome on the eastern side of Port Clarence.

Project Alternatives

In additional to a No Action Plan, the Project is evaluating a Nome Alternative, a Point Spencer Alternative, a Cape Riley Alternative, and Combination Plans. Preliminary descriptions of the alternatives are presented below and evaluated in this draft report.

No Action Alternative:
No improvements or development of maritime infrastructure would occur.

Nome Alternative and Site Designs:
The Nome Alternative (Figure 2.2) would extend the existing causeway 655 m (2,150 ft), demolish the existing spur breakwater, construct a 183-m (600-ft) long concrete caisson dock, dredge an outer entrance channel and maneuvering area to -10.7 m (-35 ft) MLLW (mean lower low water), and expand dredging in the inner maneuvering area between the existing causeway and main breakwater to -6.7-m (-22-ft) MLLW. Dredged material would consist of sand, gravel, cobbles, and glacial till material. The dredged material would be disposed of in an existing offshore disposal area located approximately 1.6 km (1 mi) east of the project in depths of -4.6 m to -10.7 m (-15 ft to -35 ft). Two new modified diaphragm sheet pile docks adjacent to the existing docks would be constructed. Fuel, water, and power lines would be extended from the City Dock to the new caisson dock at the head of the causeway extension. Twenty-two ton armor stone would be placed on the seaside side slope, and 8-ton armor stone would be placed on the harbor-side side slope of the causeway extension. Armor stone would be placed using "selective" placement methods during construction. The design wave for the Nome alternative is 5.8 m (19 ft) with a period of 24 seconds from the southwest direction. Progressively smaller waves from the south and southeast directions also impact the site. Operations and maintenance will be required for the causeway extension and the dredged channel and maneuvering areas. The sediment load from the Snake River is minimal; however maintenance dredging will be required due to sediment deposition from longshore transport along the coastline.

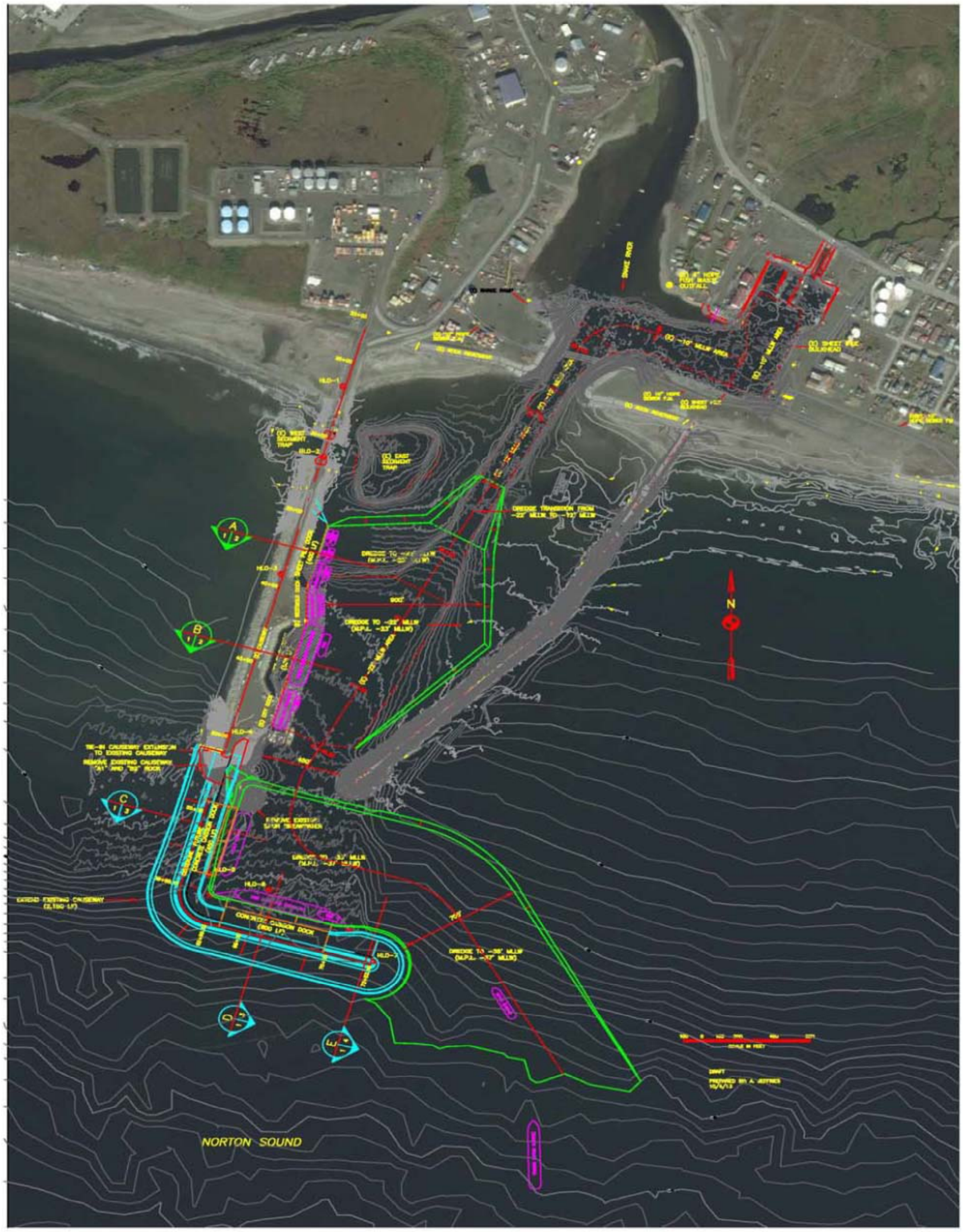

Figure 2.2. Preliminary Nome Harbor layout. Source: USACE (2013).

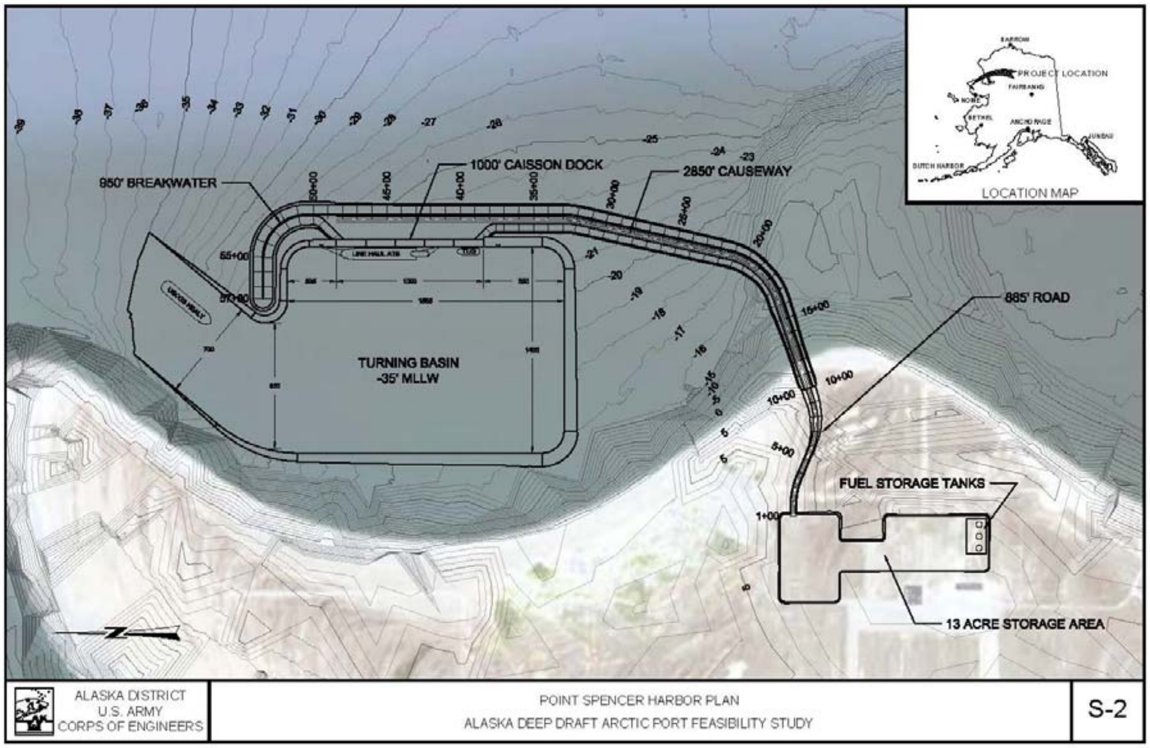

Figure 2.3. Preliminary Point Spencer layout. Source USACE (2013).

Port Spencer Alternative and Site Design:

The Port Spencer Alternative (Figure 2.3) assumes the line haul barge and USCG vessels can be accommodated. It includes a 309-m (1,000-ft) caisson dock, a 1463-m (4,800-ft) causeway and breakwater protecting a 427-m x 575-m (1,400-ft x 1,885-ft) turning basin. The turning basin and entrance channel will be dredged to -10.7 m (-35 ft) MLLW to accommodate vessels up to 184 m (605 ft) in length drafting up to 8.8 m (29 ft). The site experiences 2.1-m (7-ft) waves and a storm surge of +2.3-m (+7.7-ft) MLLW at a two percent probability of annual exceedance. Armor stone for the breakwater and causeway has a median weight of 3,600 pounds and the causeway and breakwater armor is placed up to +4.9 m (+16 ft) MLLW to prevent overtopping. Upland facilities include fuel tanks and a laydown area of 13-acres (based on what is needed at Nome) and are connected to the causeway by a 270-m (885-ft) long road. Construction of this project is estimated to require approximately 300,000 cubic yards of quarried rock, 650,000 cubic yards of aggregates and fill material, and 2.1 million cubic yards of dredging. There are no existing fuel tanks at the site, and insufficient storage at the retired LORAN site. It is assumed that Bering Straits Native Corporation and the USCG will maintain the runway. A road to the Nome/Teller Hwy is not needed for this site to be functional so no road plans are included here.

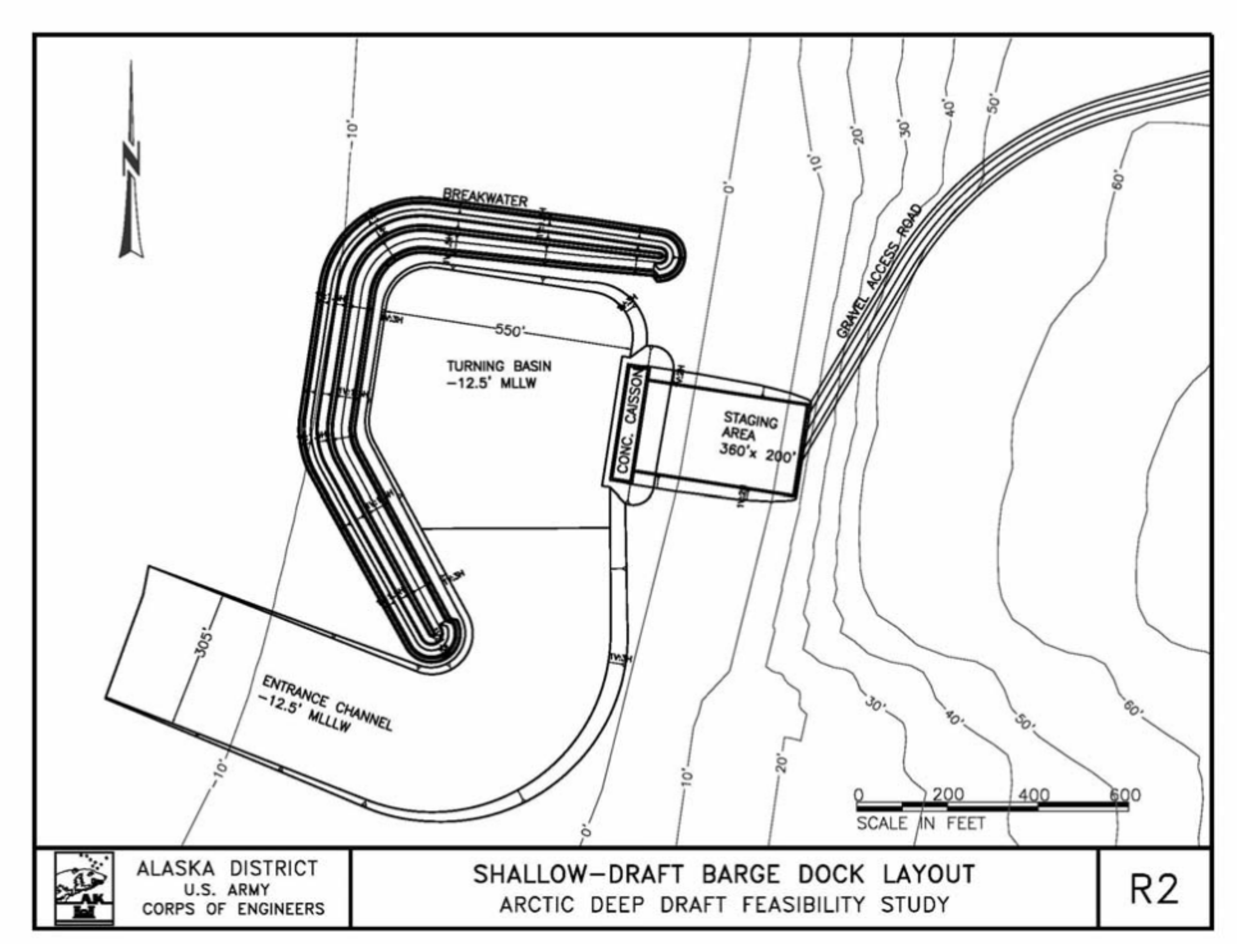

Figure 2.4. Preliminary Cape Riley layout. Source: USACE (2013).

<u>Cape Riley Alternative and Site Description:</u>

The Cape Riley Alternative was designed as a shallow-draft mineral extraction dock for use by lightering barges (Figure 2.4). The design vessel is a 46-m x 15-m (150-ft x 50-ft) barge with a 1.5-m (5-ft) draft, pushed by a 20-m (65-ft) tug. The alternative's features include a caisson dock with an attached staging area, dredged entrance channel and turning basin, rubble-mound breakwater for wave protection, and a gravel access road. The 76-m x 12-m (250-ft x 40-ft) concrete caisson dock will have a gravel surface with finished elevation of +3.7-m (+12-ft) MLLW. The attached 61-m x 110-m (200-ft x 360-ft) fill staging area will also have a gravel surface that slopes back to the backshore with a 4% slope. The 1v:2h side slopes of the staging area will have 0.46 m (1.5 ft) of placed slope protection to provide stable slopes. The 152-m (550-ft) turning basin will have a depth of -3.8-m (-12.5-ft) MLLW. The entrance channel will be 93 m (305 ft) wide and 404 m (1,325 ft) long. The channel depth will be same as the turning basin at -3.8-m (-12.5-ft) MLLW. The site experiences 2.6-m (8.5-ft) waves and 2.36-m (7.75-ft) storm surge during the 50-year wave condition. The 480 m (1,575 ft) long, rubble-mound breakwater will provide protection for the dock and basin area from the 50-yr wave condition. Breakwater armor stone will weigh between 6,000 and 12,000 pounds. The maximum height of the breakwater will be +5.5-m (+18-ft) MLLW to prevent wave overtopping. The maximum wave height within the basin area will be limited to 0.61 m (2 ft) during a 50-year wave event. The 8.9 km (5.5 mi) gravel access road will connect the dock to the Nome-Teller highway. The access road will have a width of 9.1 m (30 ft) to accommodate two traffic lanes for both on-highway and light, off-highway vehicles. No other upland facilities are planned. Construction of this project is estimated to require approximately 116,000 cubic yards of quarried rock, 285,000 cubic yards of fill and aggregates, and 159,000 cubic yards of dredging.

3. Description of Existing Conditions

3.1. **Marine Areas Surrounding the Southern Seward Peninsula**

Three distinct areas of marine waters surround the southern portion of the Seward Peninsula, Norton Sound, the Chirikov Basin, and the Bering Strait (Smith 2011). The physical attributes of these marine areas are described here because of their influence on the biological environment and distributions of fish and wildlife. The entire area is very important for migratory species that use the Chukchi and Beaufort Seas, and their associated coasts and upland areas, during the summer breeding season. Many species of birds and marine mammals pass through the Chirikov Basin and Bering Strait twice a year during migration, following the ice edge and leads through the area, which typically becomes relatively ice-free in early June. Key physical and biological features offshore northwestern Alaska have been summarized by Smith (2010) in *Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas*. Maps from that atlas depicting bathymetry, major ocean circulation, annual sea ice dynamics, typical sea surface temperatures, and productivity are shown in Figures 3.1.1 to 3.1.6.

<u>Norton Sound</u>

Norton Sound lies between the Seward Peninsula on the north and the Yukon River Delta to the south. Many small Native communities dot the coast of Norton Sound. Nome, the largest Bering Sea community of about 3,500 people is located on the Seward Peninsula portion of the Norton Sound coast. The water of Norton Sound is very shallow, averaging 15 m deep, with some depths reaching 25 m. The Alaska Coastal Current passes through the sound; this low salinity, low-nutrient current is fed by freshwater from the Yukon and Kuskokwim Rivers. Ice break up in Norton Sound begins in April and it is generally ice free from May to November. The seafloor substrate is mostly mud, gravelly mud, and muddy sand. The water is relatively warm, 7-8.5° C during the ice-free period. The eastern waters of Norton Sound are considered the most productive area of the northern Bering Sea, and the waters are very important fish, bird, and marine mammal habitat.

<u>Chirikov Basin</u>

The Chirikov Basin covers both U.S. and Russian waters and is a relatively shallow basin from about 25 to 50 m deep. It is located in the northern Bering Sea immediately south of the Bering Strait, north of St. Lawrence Island, and west of Norton Sound. Three major ocean currents converge in the Chirikov Basin before flowing north through the Bering Strait. Salty, nutrient-rich Anadyr Water flows along the Russian coast on the west edge of the basin. Low-salinity, nutrient-poor Alaska Coastal Current, heavily influenced by freshwater from the Yukon and Kuskokwim Rivers, flows along the east side of the basin along the Alaska coast. The main current moving through the center of the Chirikov Basin is Bering Shelf Water, which is relatively nutrient rich, although lower salinity and lower nutrient than Anadyr Water. Pack ice covers this area approximately six months each year, from December to April and ice floes are present during adjacent months. The Chirikov Basin seafloor is primarily muddy sand mixed with gravel. Sea surface temperatures range from 3-6° C during the ice-free period, increasing across the basin from west to east. Portions of the Chirikov Basin are considered primary productivity hotspots for both zooplankton (such as copepods) and benthic biomass which are critical food resources for bird and mammal species that inhabit or migrate through the area.

Bering Strait

The Bering Strait is located at the narrowest point between the continents of Asia and North America and is only about 90 km wide. It serves as the only marine corridor connecting the Pacific and Arctic Oceans, seasonally funneling both migrating birds and marine mammals between the oceans as well as marine vessel activity. The Strait is on the relatively shallow continental shelf and is about 60 m at its deepest, rising to sea level in the center of the Strait where the Diomede Islands emerge. Three major ocean currents meet in the Strait: the relatively nutrient rich Bering Sea water flowing north into the Chukchi Sea; the salty, nutrient-rich Anadyr Water; and the lower-salinity, nutrient-poor Alaska Coastal Water current that is heavily influenced by the Yukon and Kuskokwim rivers.

Pack ice covers this area about six months a year, from December to May, and ice floes are present during adjacent months. The Bering Sea floor is made up of mixed mud and gravel, and sand. Sea surface temperatures are stratified into three distinct north-south columns reflecting the three ocean currents with temperatures increasing across the Strait from west to east, averaging 4-6° C during the ice free period.

The Bering Strait has both high primary productivity and benthic biomass making it an important foraging hotspot for wildlife. Even seabirds and seaducks that breed on Alaska's North Slope generally migrate through the Bering Strait, rather than over the Alaskan landmass.

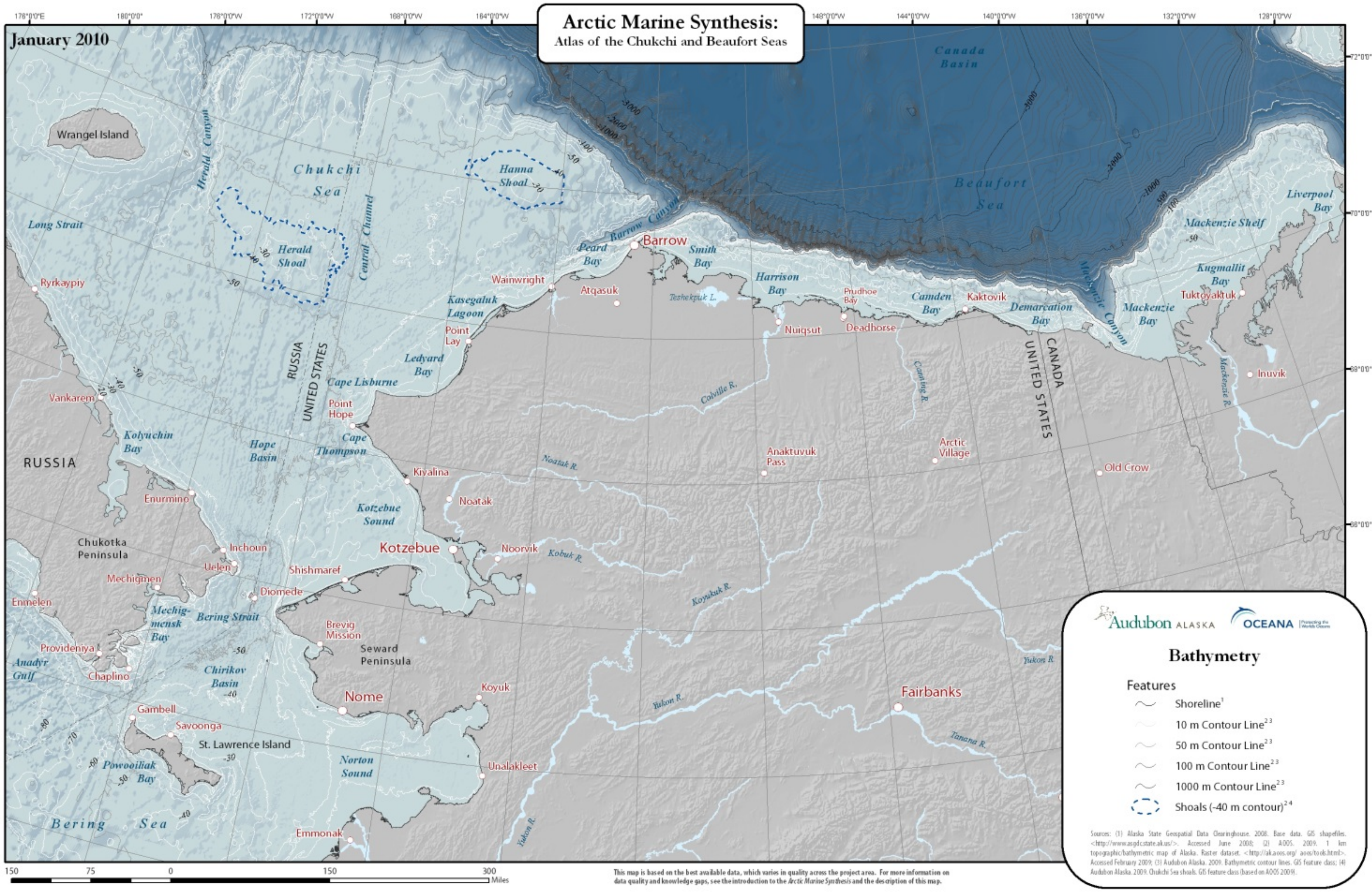

Figure 3.1.1. Bathymetry offshore northwestern Alaska (Smith 2010).

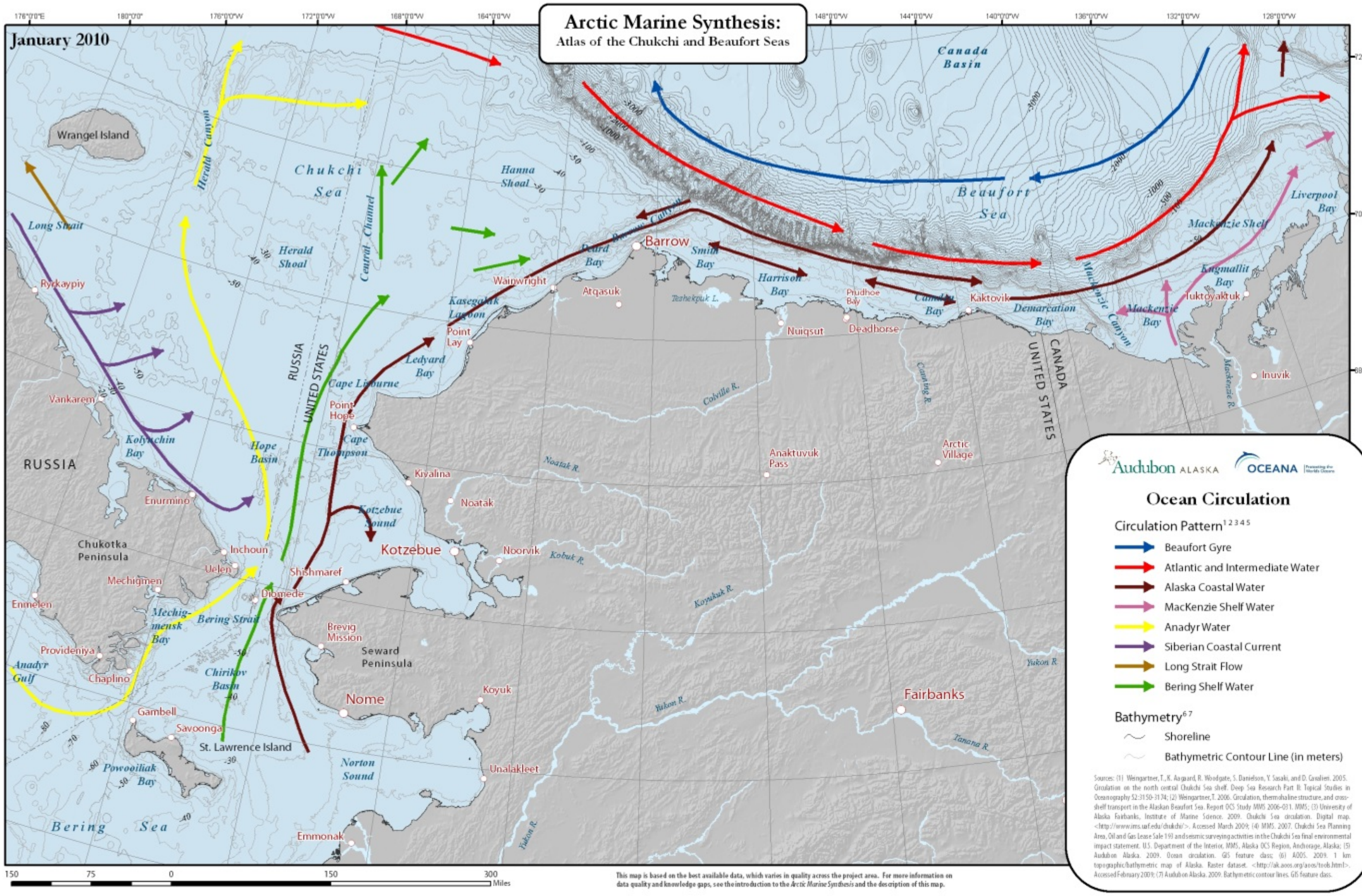

Figure 3.1.2. Ocean circulation offshore northwestern Alaska (Smith 2010).

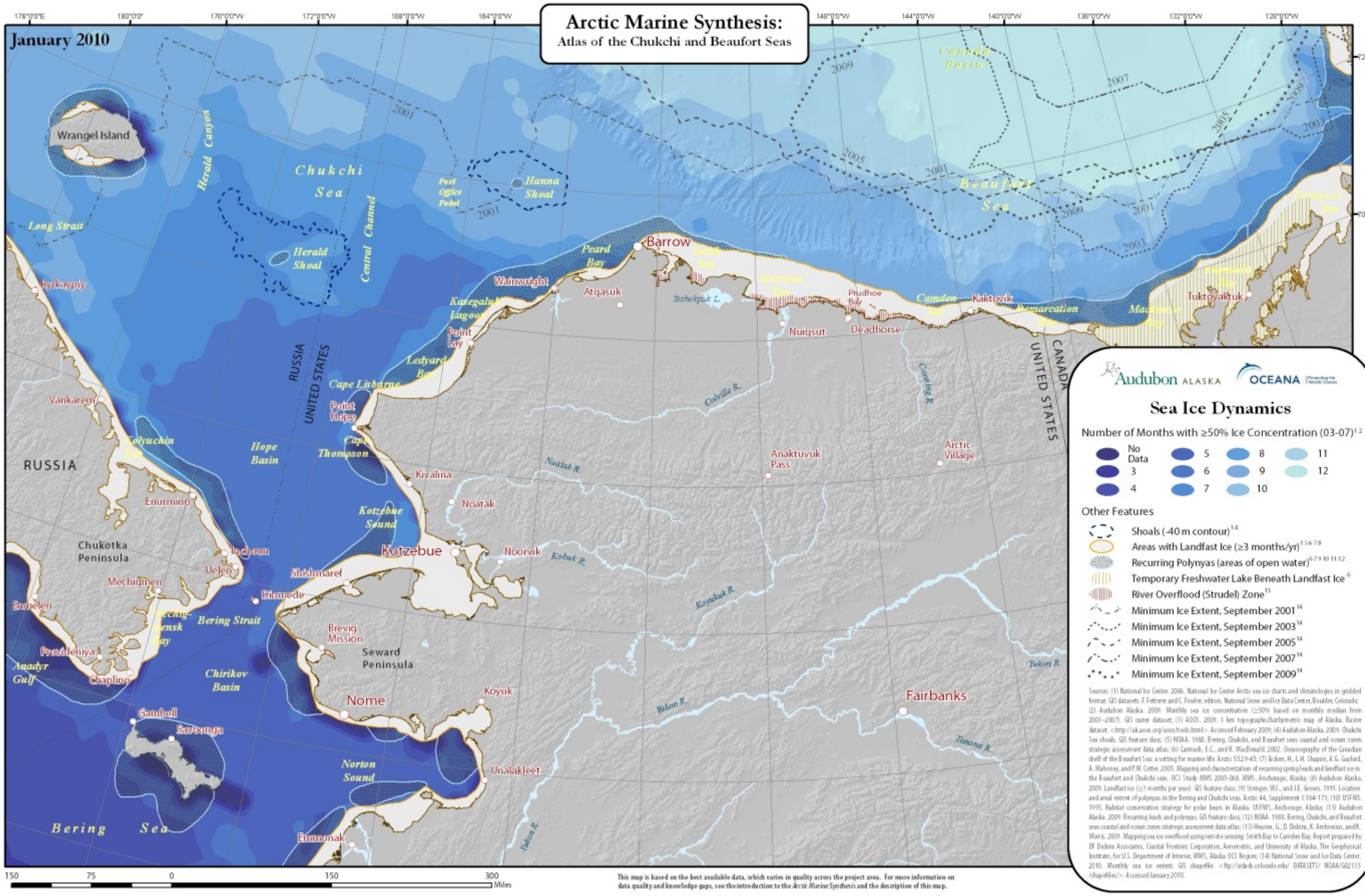

Figure 3.1.3. Sea ice dynamics offshore northwestern Alaska (2010).

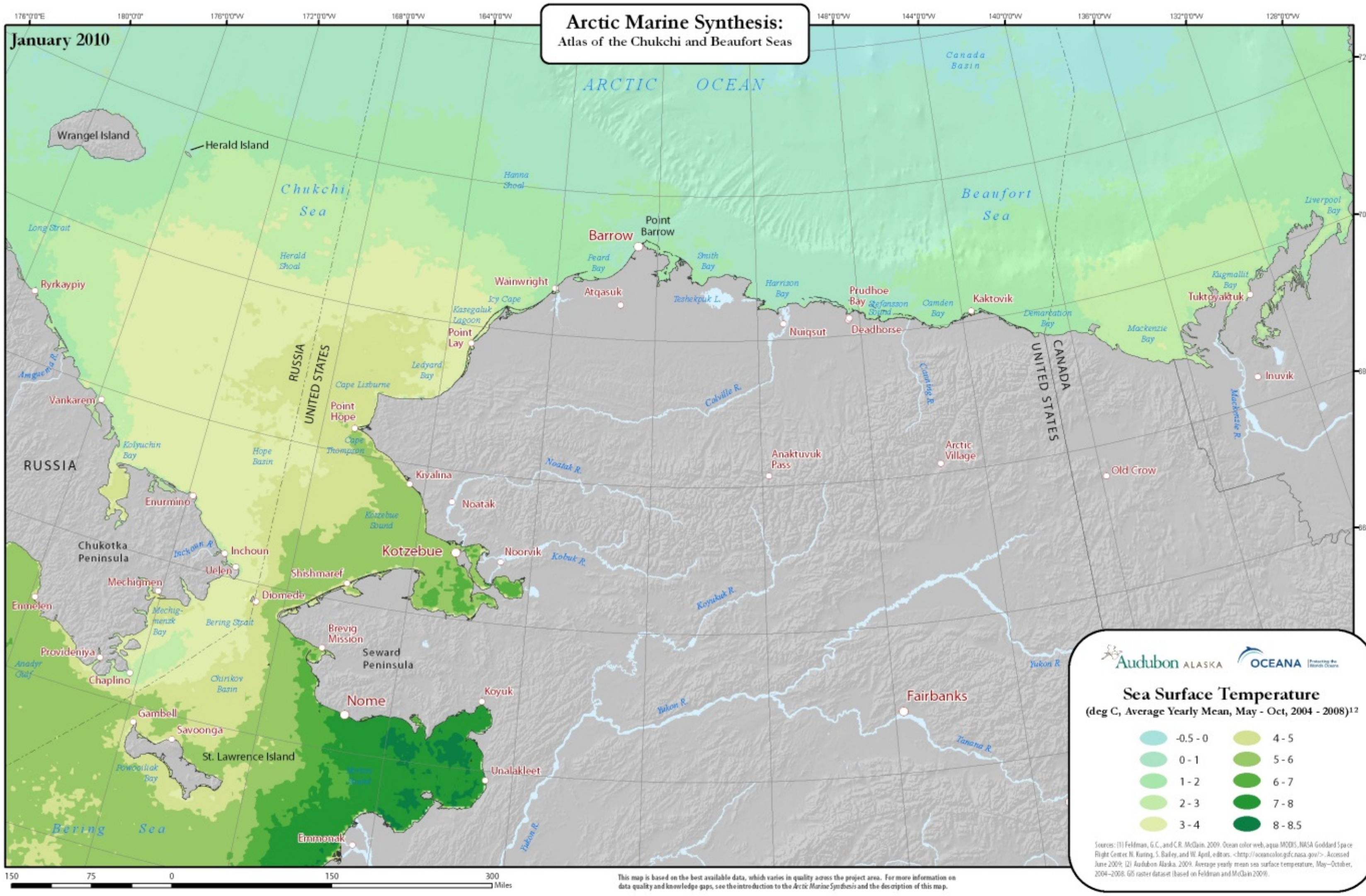

Figure 3.1.4. Sea surface temperatures offshore northwestern Alaska (Smith 2010).

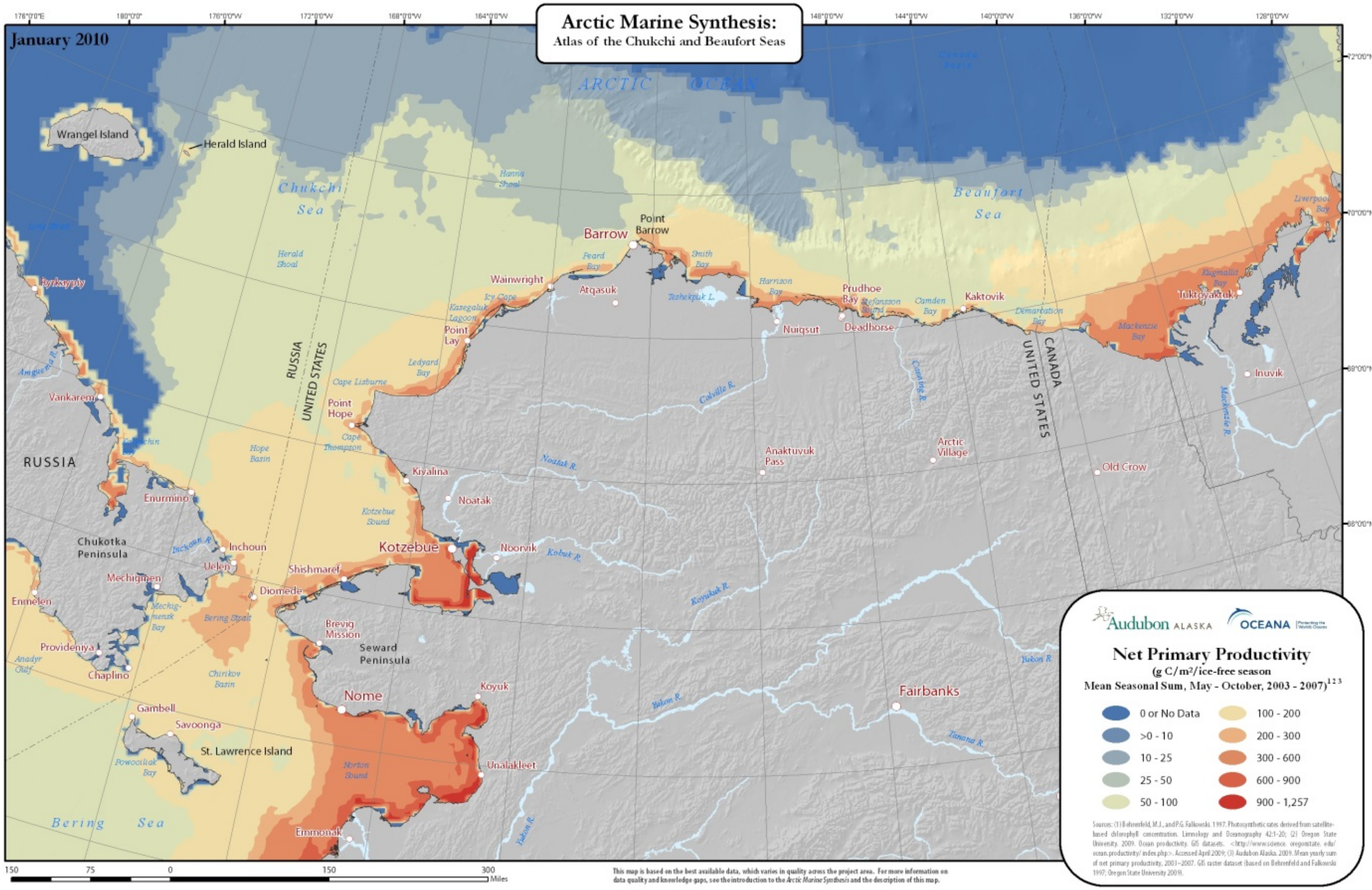

Figure 3.1.5. Net primary productivity offshore northwestern Alaska (Smith 2010).

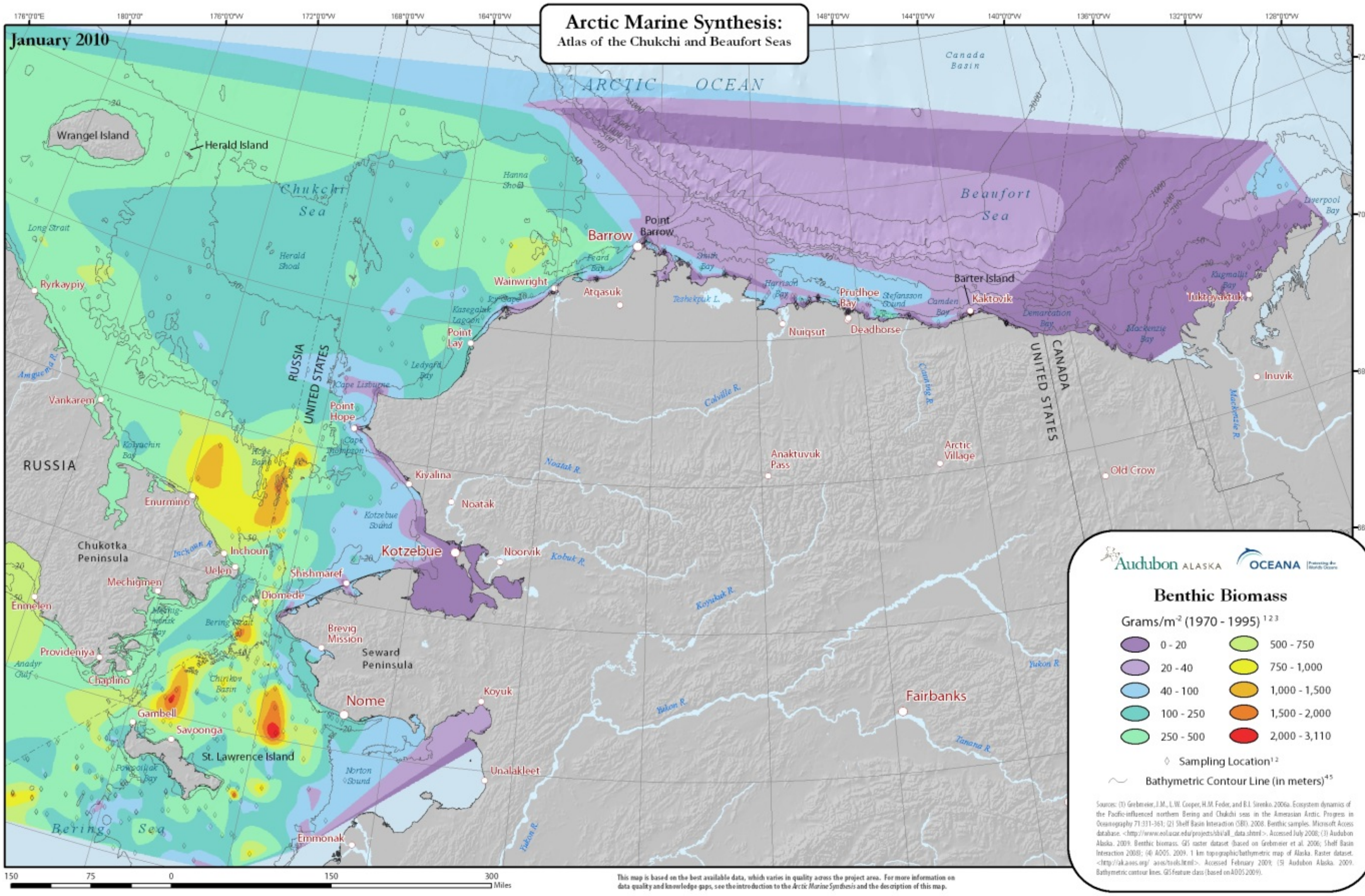

Figure 3.1.6. Benthic biomass productivity offshore northwestern Alaska (Smith 2010).

3.2 Vegetation and Wetlands

Vegetation

The Alaska State Office of the USDA Natural Resources Conservation Service (formally Soil Conservation Service) mapped the vegetation of the Seward Peninsula using color infrared aerial imagery from the early 1980s (Swanson et al. 1985). Although these data were primarily intended for developing range management plans for reindeer, the ecological site descriptions (more appropriately range site descriptions, Michelle Schuman, NRCS, Wasilla, AK, March 2014) in a companion document (SCS 1984) provide a wealth of additional information, including a brief description of soil properties and potential use by a number of mammal and migratory bird species. The spatial data for these range sites and the general vegetation types are available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ak/technical/?cid=nrcs142p2_035997. Although the area was mapped over 30 years ago, and the mapping scale is fairly coarse by today's standards (minimum mapping unit was 160 acres, accurate to about 100 m), these data still provide a good general description of the vegetation on the Seward Peninsula. Burned areas are obviously dated, and developments like mines and villages were not distinguished from the adjacent vegetation in this mapping effort. For a more detailed, but still reconnaissance level mapping effort of wetlands, see the next section on wetlands.

General vegetation types near Nome Harbor and Port Clarence are shown in Figures 3.2.1 and 3.2.2. Range sites and the general vegetation types within an 8 km (5 mi) radius of the intersection of the mouth of Nome Harbor and the coastline are summarized in Table 3.2.1, which also summarizes vegetation within an 8 km (5 mi) radius of the Port Clarence shoreline. Summarizing vegetation within a specific area allows for additional analyses and comparisons. The percentage for each vegetation type in Table 3.2.1 does not include water bodies, because only the largest bodies of water were mapped (i.e., ≥160 acres) and their inclusion/omission would affect the percentages of actual vegetation on the landscape.

Nome and Port Clarence are northwest of the tree line. The nearest concentration of trees is about 85 km to the east of Nome near Council. About half (49%) of the general vegetation near Nome Harbor is Herbaceous (Mat) (Figures 3.2.1 and Table 3.2.1). This vegetation is primarily coastal tundra dominated by a mosaic of sedges, prostrate shrubs, and lichen. Other notable general vegetation types near Nome Harbor are about equally abundant: Herbaceous (17%), Low Shrub/Herbaceous (17%), and Low & High Shrub (16%). For Port Clarence, the most abundant (46%) general vegetation type is Herbaceous (Figures 3.2.2 and Table 3.2.1). This vegetation is primarily sedge wet meadows and other sedge-dominated range sites, beach dunes, and tidal marshes. About a quarter (28%) of the general vegetation near Port Clarence is Low Shrub/Herbaceous. This is primarily a mosaic of low shrubs and tussock tundra.

Range sites within the immediate vicinity of Nome Harbor and the best available aerial imagery base layer (http://www.gina.alaska.edu/) are shown in Figure 3.2.3. At the scale these range sites were mapped, none of the developments around Nome were mapped separately. Like the area within an 8 km (5 mi) radius of Nome, the Lichen-Sedge (Coastal Tundra) – Sedge (Drainageway) Complex is the most abundant range site near Nome Harbor. The Lichen-Sedge part of the complex occurs on alluvial fans and toe slopes on coastal plains (Swanson et al. 1985). Lichens (~26%) and moss/clubmosses (~69%) are nonvascular plants that dominate the plant biomass on this site. The most common vascular plants on this site include water sedge (*Carex aquatilis*), cottongrasses (*Eriophorum* spp.), northern labrador tea (*Ledum decumbens*), dwarf arctic birch (*Betula nana*), and salmonberry (*Rubus chamaemorus*). The Sedge (Drainageway) part of the complex occurs on upland drainageways and within shallow lake systems. The most common vascular plants on this site include water sedge, white cottongrass (*Eriophorum scheuchzeri*), dwarf arctic birch, and Alaska bog willow (*Salix fuscescens*). The Low Shrub (Floodplain) site occurs along river floodplains and lowlands, particularly on rich alluvial deposits, and is dominated by willows 0.9 to 1.5 m (3 to 5 ft) tall (SCS 1984, Swanson et al. 1985). Diamondleaf willow (*Salix planifolia*) and feltleaf willow (*Salix alaxensis*), along with other shrubs such as dwarf arctic birch, resin birch (*Betula glandulosa*), and bog blueberry (*Vaccinium uliginosum*) dominate the vegetation on this site. SCS (1984) considers the Low Shrub (Floodplain) site unique and valuable wildlife habitat, providing nesting habitat for several bird species and small-mammal prey for raptors. The Sedge (Wet Meadow) site occurs along coastal plains immediately inland of beach dunes and on nearly level areas in the uplands. Water sedge, Bigelow sedge (*Carex bigelowii*), Alaska bog willow, and white cottongrass comprise the most common plants on this site.

Range sites within the immediate vicinity of Point Spencer and the NOAA Nautical Chart base layer (http://gina.alaska.edu/services) are shown in Figure 3.2.4. The resolution of the best available aerial imagery base layer for Point Spencer is too low to be useful like in Figure 3.2.3. The general vegetation on Point Spencer is all herbaceous, although the most abundant range site, Dunes (Beach), can be 25 to 50 percent bare ground (Swanson et al. 1985). This site occurs on narrow sandy beaches and gravelly beach ridges along the coast. Dunegrass (*Leymus mollis*), sea peavine (*Lathyrus maritimus*), and large-flower spear grass (*Poa eminens*) are the most common plants. In contrast, the other two range sites on Pont Spencer are well vegetated. The Marsh (Tidal) site occurs on tidal flats vegetated by salt-tolerant plant species such as creeping alkaligrass (*Puccinellia phryganodes*) Ramens sedge (*Carex ramenskii*), dunegrass, and water sedge. The Sedge (Wet Meadow) site occurs along coastal plains immediately inland of beach dunes. The vegetation composition for this site was described previously with the vegetation within the immediate vicinity of Nome Harbor.

Range sites within the immediate vicinity south of Cape Riley and the NOAA Nautical Chart base layer (http://gina.alaska.edu/services) are shown in Figure 3.2.5. Low Shrub/Herbaceous sites dominate this area, with two range sites or a complex of these two range sites representing this general vegetation type. The Low-Shrub-Water Sedge or Low Shrub-Cottongrass (Tussock Tundra) site is most common. This is actually two somewhat similar sites that vary in landscape position and plant species dominance. The water sedge site occurs in combination with other wet sites on broad depressions and coastal plains, with the dominant vegetation consisting of Bigelow sedge, water sedge, northern labrador tea, and dwarf arctic birch. The cottongrass site occurs on foot slopes, rolling hills, and broad depressions, with dominant vegetation consisting of tussock cottongrass (*Eriophorum vaginatum*), Bigelow sedge, northern labrador tea, and lingonberry (*Vaccinium vitisidaea*). The other Low Shrub/Herbaceous site is the Shrub Meadow (Mountain) site. This site occurs on mountainsides and ridges with low shrubs visually dominating the site, including bog blueberry, dwarf arctic birch, willows (*Salix* spp.) and entire-leaf mountain-avens (*Dryas integrifolia*), but Bigelow sedge is the most abundant plant species by weight. The drainage ways and floodplain are dominated by tall shrubs. The Tall Shrub (Drainageway) site occurs along upland drainages and streams where moisture collects forming a dense cover of shrubs dominating the overstory and consisting mainly of diamondleaf willow (*Salix planifolia*). The understory includes Bigelow sedge, bluejoint (*Calamagrostis canadensis*) and various forbs. Tall Shrub (Floodplain) sites occur along river floodplains and lowlands where soils are deep, moisture is readily available, and growing season conditions are favorable for producing tall shrubs. Dense stands of tall green alders (*Alnus crispa*) and willows dominate the overstory, while the understory is composed of scattered bluejoint and field horsetail (*Equisetum arvense*). SCS (1984) considers these tall shrub sites along streams and drainages to be high value for wildlife, particularly if they are dominated by willows. Sites dominated by alders, however, support fewer kinds of wildlife because they tend to have poorly developed understories and fewer wildlife species prefer alder forage. Dryas Limestone Slope sites occur on limestone hillsides, mountainsides and moraine terraces where 12 to 25 percent of the ground may be exposed rock. Mountain-avens (*Dryas* spp.), spike sedge (*Carex nardina*), various forbs, and lichens are the most common vegetation on this site. This site is also usually the last site to be covered with snow in the fall and the first site to be exposed in the spring. The two range sites comprising the lone general Herbaceous vegetation type complex, Sedge (Wet Meadow) and Shrub Meadow (Mountain), were described previously for the range sites within the immediate vicinity of Nome Harbor and in this paragraph respectively.

Wetlands

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (Cowardin et al. 1979). They provide a variety of beneficial functions, including storing floodwater to reduce flood peaks, recharging groundwater aquifers, filtering pollutants, providing habitat for wildlife, and supporting unique plant communities that contribute to the conservation of biological diversity (National Research Council 1995). For regulatory purposes under the Clean Water Act, the term wetlands is defined as "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 (Environmental Laboratory 1987)."

The National Wetlands Inventory (http://www.fws.gov/wetlands/index.html) is a useful tool for producing reconnaissance level information on the location, type and size of wetlands and deepwater habitats. Maps are prepared from analysis of high-altitude imagery based on vegetation, visible hydrology, and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. In addition, wetlands or other mapped feature may have changed since the date of the imagery and/or field work. Some wetland types relevant to Nome Harbor and Port Clarence (e.g., seagrasses or submerged aquatic vegetation found in intertidal and subtidal zones of estuaries and nearshore coastal waters) are not well mapped because they are difficult to distinguish from water in aerial imagery. As long as these limitations are considered, the National Wetlands Inventory (NWI) is still an invaluable reconnaissance tool.

The NWI is based on the Cowardin et al. (1979) wetland and deepwater classification system, and uses a series of letter and number codes to identify the habitat type (e.g., PEM1A represents a palustrine, emergent, persistently vegetated, temporarily flooded wetland). All five of the system level habitat types are found in the Nome Harbor and Port Clarence areas: marine (M), estuarine (E), riverine (R), lacustrine (L), and palustrine (P). Beyond the system level, the codes become more detailed and specialized for each habitat type. The complete habitat codes are presented below, summarized by major habitat type, but only the complete codes for habitat types of special interest (e.g., higher-value fish and wildlife habitat or degraded habitat) will be fully described. For additional description of these codes see Cowardin et al. (1979), and the online wetland code interpreter at http://www.fws.gov/wetlands/data/wetland-codes.html.

Major wetland and deepwater habitat types near Nome Harbor and Port Clarence are shown in Figures 3.2.6 and 3.2.7. Wetlands within an 8 km (5 mi) radius of the intersection of the mouth of Nome Harbor and the coastline are summarized in Table 3.2.2, which also summarizes wetlands within an 8 km (5 mi) radius of the Port Clarence shoreline. Summarizing wetlands within a specific area allows for additional analyses and comparisons. The percentage for each wetland type in Table 3.2.2 does not include the deepwater estuarine and marine habitats (codes E1 and M1), because these subtidal areas are continuously submerged, their aerial extent can be extensive (e.g., open ocean), and they are technically not wetlands. These deepwater habitats, however, still provide important fish and wildlife habitat. Although lacustrine (i.e., lakes, code L) and riverine (i.e., rivers, code R) are also not technically wetlands, they are typically closely associated with wetlands in the Nome Harbor and Port Clarence areas, so they are included in the percentage of "non-deepwater" wetlands for this analysis.

Roughly a third (31.6%) of the area near Nome Harbor, and a quarter (22.9%) of the area near Port Clarence is uplands (Table 3.2.2). By far the most common major wetland type for both areas is freshwater emergent wetlands (60.4% for Nome Harbor, 68.0% for Port Clarence). Estuarine and marine are the least common major wetland type in the Nome Harbor area (0.8%); more than five times less than the Port Clarence area (4.4%). Freshwater ponds are the least common major wetland type in the Port Clarence area (0.4%); about three times less than the Nome area (1.3%). As mentioned above, lakes and rivers are not technically wetlands, but their areal coverage is not very extensive. Still, they provide important habitat for fish and wildlife.

Wetlands within the immediate vicinity of Nome Harbor and the best available aerial imagery base layer (http://www.gina.alaska.edu/) are shown in Figure 3.2.8. Nome has expanded since the wetlands were mapped (e.g., the northeastern part of town), so there are now less wetlands than when the area was mapped. Most of the disturbed wetlands created by excavation (identified by an "x" at the end of the wetland code) are in the Nome area (Table 3.2.2). Of the 144.4 acres of estuarine wetlands (code E2) within a five-mile radius of Nome Harbor, 77.3 acres are associated with the Nome Harbor, but about 24.5 of these acres have been lost to expansion of the Nome Airport since the wetlands were mapped (Figure 3.2.8). Most of the other estuarine and marine wetlands in the Nome area are associated with the mouth of the nearby Nome River to the east (67.1 acres, see also Figure 3.2.6). Before the Nome Harbor was developed, the lower Snake River likely had a more extensive estuary similar to the lower Nome River. Estuaries are considered higher-value wetlands by the USFWS because they provide some of the most productive fish and wildlife habitat. Freshwater shrub wetlands (e.g., willows) associated with rivers like the Snake and Nome Rivers (Figure 3.2.6), are also considered by the USFWS to be higher-value wetlands. Past rerouting of the lower Snake River to accommodate expansion of the Nome Airport may have greatly reduced the amount of higher-value shrub wetlands in the lower Snake River (Figure 3.2.8), since the lower Nome River has shrub wetlands until they meet the estuarine wetlands (Figure 3.2.6).

Wetlands within the immediate vicinity of Point Spencer and the NOAA Nautical Chart base layer (http://gina.alaska.edu/services) are shown in Figure 3.2.9. The resolution of the best available aerial imagery base layer for Point Spencer is too low to be useful like in Figure 3.2.8. Higher-value estuarine and marine wetlands (codes E2 and M2) are the most abundant wetlands on Point Spencer. Although technically deepwater habitat, the next most abundant wetland and deepwater habitat, excluding the open water in Port Clarence, are land-locked estuarine subtidal areas (code E1). These areas likely function similar to estuarine wetlands, and may also be higher-value wetlands. Other less common wetlands on Point Spencer include freshwater emergent wetlands (code PEM) and freshwater ponds (code PUB). Figure 3.2.9 shows roads running through the estuarine wetland east of the north end of the runway. The aerial image from Google Earth (http://www.google.com/earth/), however, suggests the habitat disturbance from these roads may be minimal or mostly recovered from past disturbance.

Wetlands within the immediate vicinity south of Cape Riley and the NOAA Nautical Chart base layer (http://gina.alaska.edu/services) are shown in Figure 3.2.10. By far the most abundant wetland type in this area is a mosaic of saturated freshwater emergent wetlands (code PEM1/SS1B), which is very common (62.1%) in the Port Clarence area (Table 3.2.2). This area also has a 42.3-acre higher-value estuarine wetland (code E2). The scattered freshwater shrub wetlands (code PSS), even when they are not associated with rivers and streams, tend to provide important migratory bird nesting habitat when surround by low tundra like this area. Similarly, the freshwater pond (code PUB) likely provides important nesting and loafing habitat for migratory waterbirds when surrounded by an abundance of low tundra.

Table 3.2.1. General vegetation types and range sites within an 8 km (5 mi) radius of Nome Harbor and the shoreline of Port Clarence.

	Nome		Port Clarence	
Vegetation Type	Acres	% of Total	Acres	% of Total
Barren			**1,846**	**1**
Riverwash			1,846	1
Herbaceous	**4,323**	**17**	**60,122**	**46**
Dunes (Beach)			5,513	4
Marsh (Tidal)			737	1
Marsh (Tidal) - Sedge (Wet Meadow) Complex			2,410	2
Sedge (Wet Meadow)	4,323	17	37,056	28
Sedge (Wet Meadow) - Shrub Meadow (Mountain) Complex			6,598	5
Sedge (Wet Meadow) - Sedge (Drainageway) Complex			1,313	1
Sedge (Drainageway)			1,372	1
Cottongrass-Water Sedge (Low Center Polygons)			256	0
Grass or Sedge (Breached Lake Bed)			861	1
Sedge (Wet Lake Bed)			4,006	3
Herbaceous (Mat)	**12,591**	**49**	**10,950**	**8**
Lichen-Meadow (Mountain)	623	2	213	0
Lichen-Sedge (Coastal Tundra)			1,902	1
Lichen-Sedge (Coastal Tundra) - Sedge (Wet Meadow) Complex			1,277	1
Lichen-Sedge (Coastal Tundra) - Sedge (Drainageway) Complex	11,968	47	7,558	6
Low & High Shrub	**4,195**	**16**	**9,177**	**7**
Tall Shrub (Floodplain)			1,417	1
Tall Shrub (Drainageway)			7,206	6
Tall Shrub (Drainageway) - Low Shrub (Floodplain) Complex			554	0
Low Shrub (Floodplain)	3,825	15		
Shrub-Birch or Shrub-Willow (Hillside)	370	1		
Low Shrub/Herbaceous	**4,252**	**17**	**35,912**	**28**
Shrub Meadow (Mountain)	2,702	11	10,479	8
Shrub Meadow (Mountain) - Low Shrub-Water Sedge or Low Shrub-Cottongrass (Tussock Tundra) Complex			3,831	3
Low-Shrub-Water Sedge or Low Shrub-Cottongrass (Tussock Tundra)			15,598	12
Low Shrub-Water Sedge or Low Shrub-Cottongrass (Tussock Tundra) - Sedge (Drainageway) Complex			2,114	2
Low Shrub-Water Sedge or Low Shrub-Cottongrass (Tussock Tundra) - Cottongrass-Water Sedge (Low Center Polygons) Complex			3,890	3
Low Shrub-Sedge or Low Shrub-Lichen Meadow (Alpine)	1,550	6		
Mat & Cushion	**272**	**1**	**12,438**	**10**
Lichen Granitic Slope (Alpine)	272	1	4,002	3
Dryas Limestone Slope			1,936	2
Bald Limestone Slope			6,500	5
Grand Total	25,633	100	130,445	100

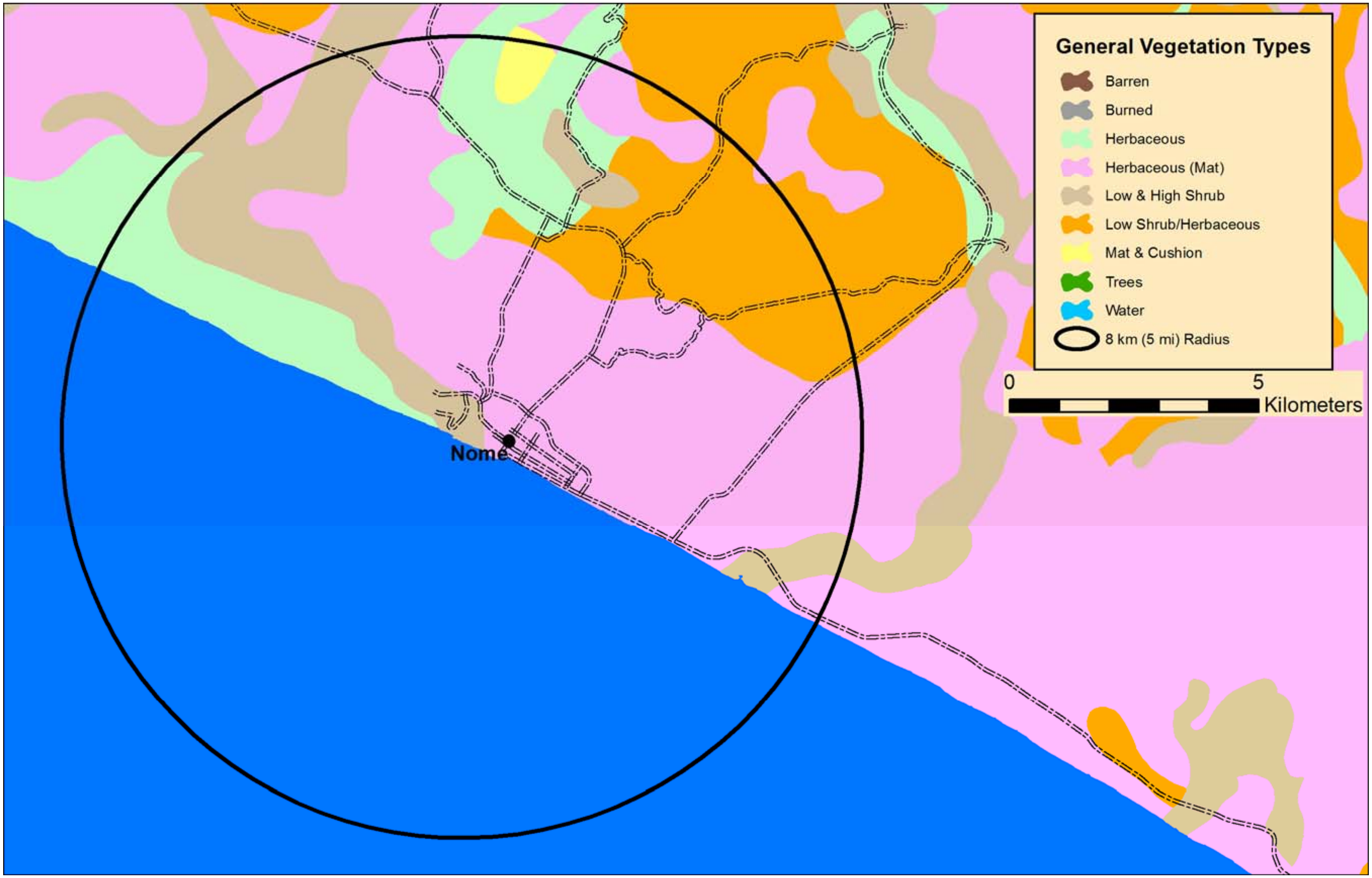

Figure 3.2.1. General vegetation types within the vicinity of Nome Harbor. Vegetation types within an 8 km (5 mi) radius of the intersection of the mouth of Nome Harbor and the coastline were selected for further analysis in Table 3.2.1.

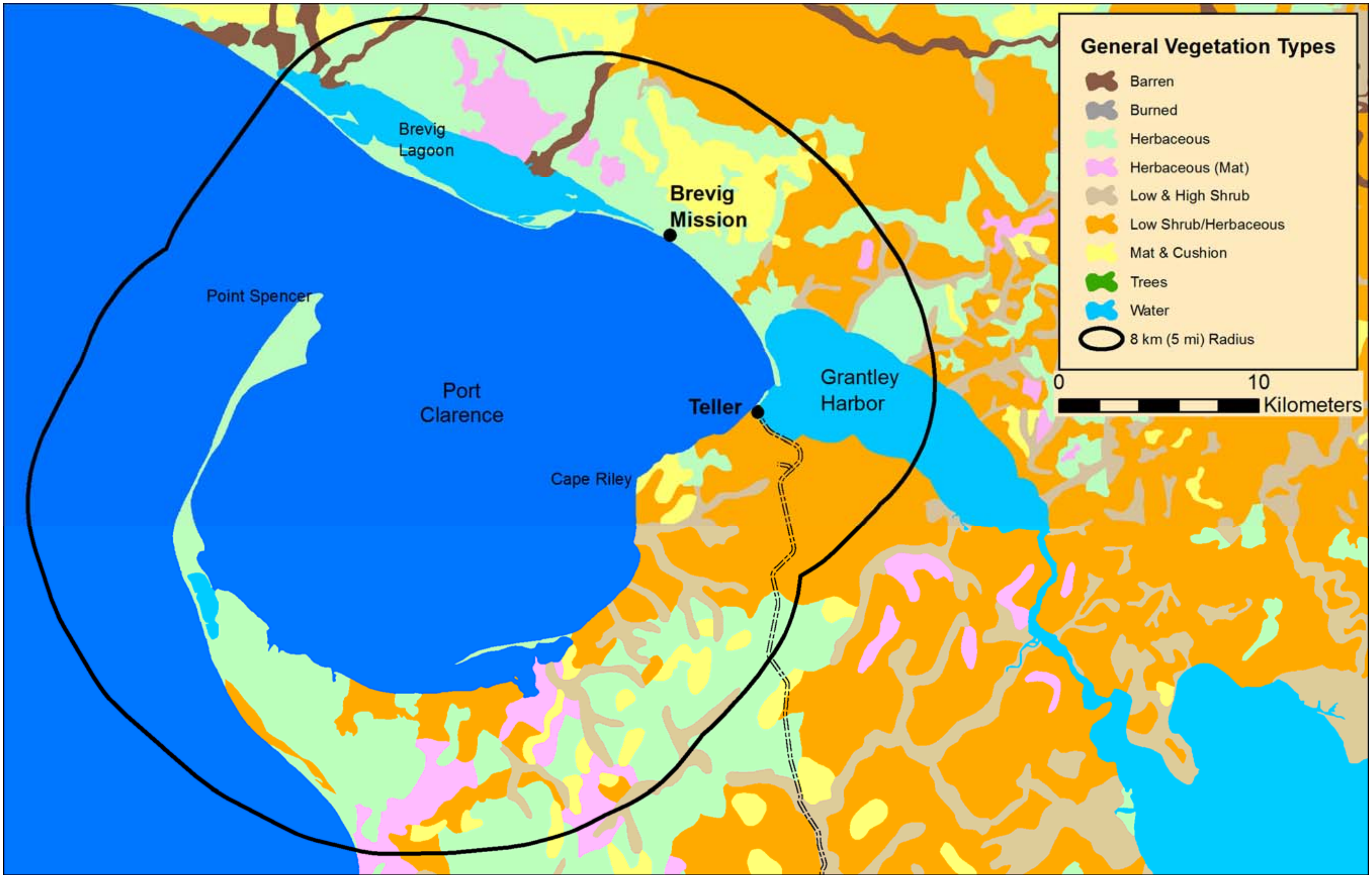

Figure 3.2.2. General vegetation types within the vicinity of Port Clarence. Vegetation types within an 8 km (5 mi) radius of the Port Clarence shoreline were selected for further analysis in Table 3.2.1.

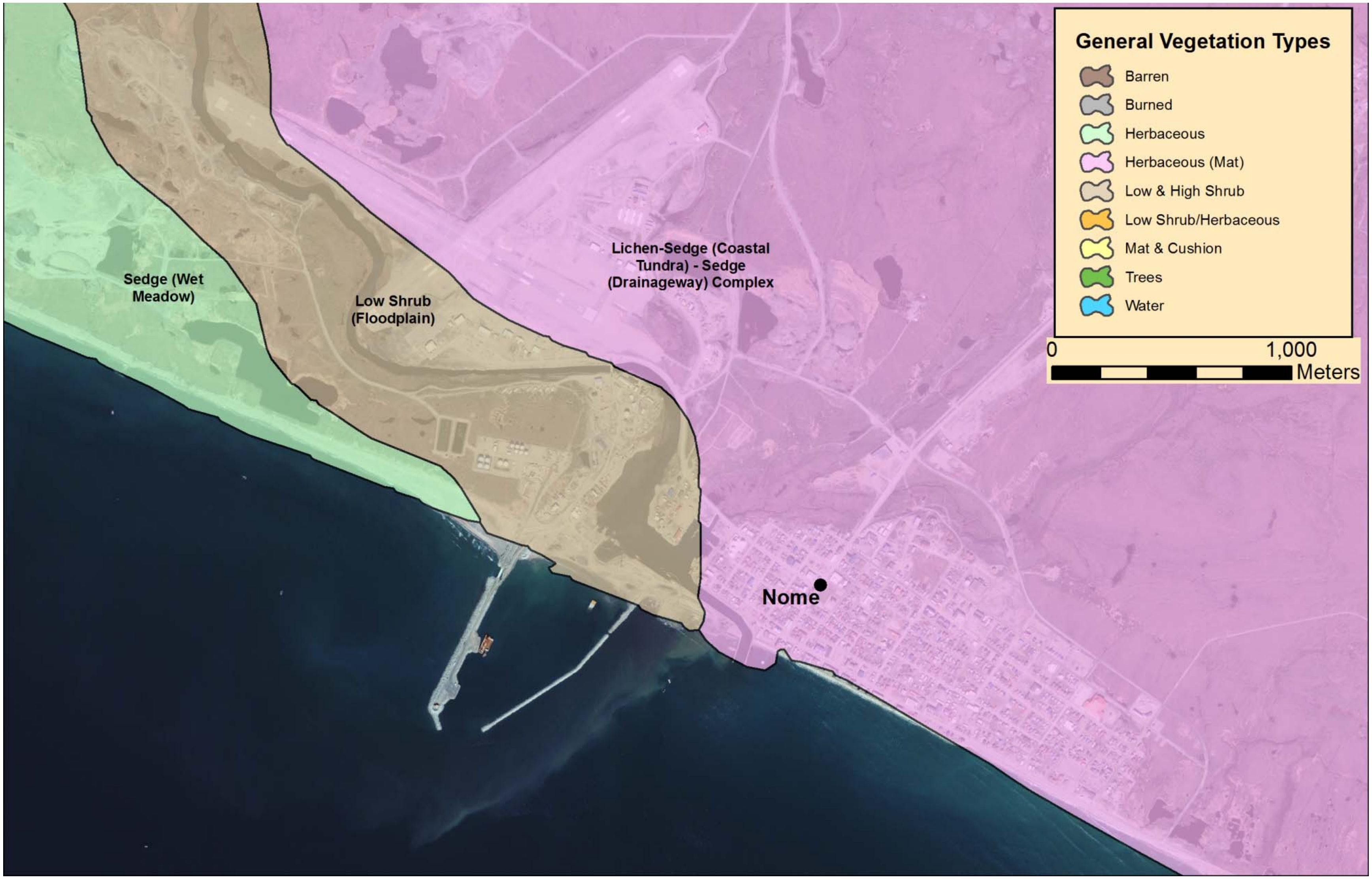

Figure 3.2.3. Range sites within the immediate vicinity of Nome Harbor. Note the aerial image base layer from http://www.gina.alaska.edu/ was taken just before the mouth of the Snake River was closed off and the Nome Harbor was opened to the jetties.

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Figure 3.2.4. Range sites within the immediate vicinity Point Spencer. NOAA Nautical Chart base layer from http://gina.alaska.edu/services

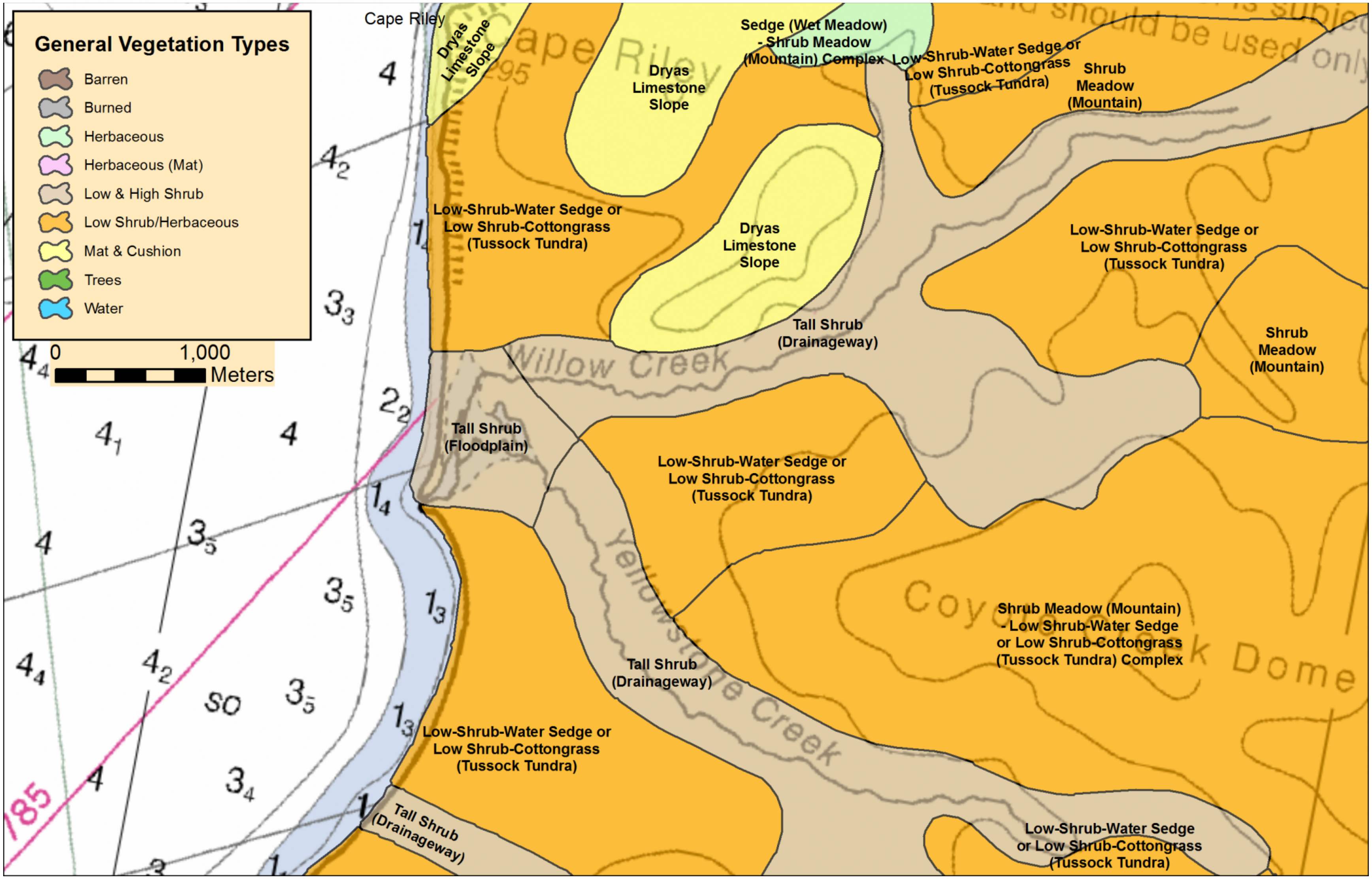

Figure 3.2.5. Range sites within the immediate vicinity south of Cape Riley. NOAA Nautical Chart base layer from http://gina.alaska.edu/services.

Table 3.2.2. Major wetland and deepwater habitats within an 8 km (5 mi) radius of Nome Harbor and the shoreline of Port Clarence. See text for a brief description of the detailed National Wetland Inventory codes associated with each major habitat type.

	Nome		Port Clarence	
Habitat Type	Acres	% of Non-Deepwater	Acres	% of Non-Deepwater
Estuarine and Marine Deepwater	**24,840.1**		**211,977.1**	
E1AB1L			237.9	
E1UBL	108.7		144,239.1	
M1UBL	24,731.3		67,500.1	
Estuarine and Marine Wetland	**214.3**	**0.8**	**5,561.6**	**4.4**
E2AB1N			0.9	0.0
E2EM1N			12.8	0.0
E2EM1P	88.7	0.3	3,966.0	3.1
E2EM1/SS1P	54.2	0.2		
E2EM1/USP	1.5	0.0	25.2	0.0
E2SS1P			8.2	0.0
E2USN			51.5	0.0
E2USP			85.3	0.1
E2US/EM1P			726.0	0.6
M2USP	69.9	0.3	685.7	0.5
Freshwater Emergent Wetland	**15,330.0**	**60.4**	**86,548.7**	**68.0**
PEM1A			24.6	0.0
PEM1B			6.6	0.0
PEM1C	275.3	1.1	5,947.5	4.7
PEM1Cx	10.7	0.0		
PEM1F	27.1	0.1	667.0	0.5
PEM1H	21.9	0.1	8.9	0.0
PEM1R	11.7	0.0		
PEM1/2F			67.4	0.1
PEM1/2H			536.6	0.4
PEM1/SS1A			128.8	0.1
PEM1/SS1B	14,794.0	58.3	79,042.9	62.1
PEM1/SS1C	186.5	0.7		
PEM1/SS1R	2.8	0.0		
PEM1/USA			94.7	0.1
PEM1/USC			23.8	0.0
Freshwater Shrub Wetland	**1,212.0**	**4.8**	**1,961.8**	**1.5**
PSS1A	822.7	3.2	226.1	0.2
PSS1B			544.2	0.4
PSS1C	278.4	1.1	30.2	0.0
PSS1R	5.9	0.0		
PSS1S	25.3	0.1		
PSS1/EM1A			145.4	0.1
PSS1/EM1B			371.1	0.3
PSS1/EM1C	44.9	0.2	57.0	0.0
PSS1/USA	34.8	0.1	587.8	0.5

	Nome		Port Clarence	
Habitat Type	Acres	% of Non-Deepwater	Acres	% of Non-Deepwater
Freshwater Pond	**340.1**	**1.3**	**564.4**	**0.4**
PUBF	0.4	0.0	29.2	0.0
PUBFx	0.9	0.0		
PUBH	236.9	0.9	393.3	0.3
PUBHx	101.9	0.4	3.0	0.0
PUB/EM1H			38.8	0.0
PUS/EM1C			98.4	0.1
PUS/SS1C			1.7	0.0
Lake	**89.4**	**0.4**	**3,274.9**	**2.6**
L1UBH	73.7	0.3	3,274.9	2.6
L2EM2H	15.8	0.1		
Riverine	**176.4**	**0.7**	**172.5**	**0.1**
R1UBV	26.4	0.1		
R2UBH	144.8	0.6	3.5	0.0
R2USC	5.1	0.0		
R2US/UB			153.7	0.1
R3US/UB			15.3	0.0
Upland	**8,030.4**	**31.6**	**29,170.1**	**22.9**
Grand Total	**50,232.6**	**100.0**	**339,231.1**	**100.0**

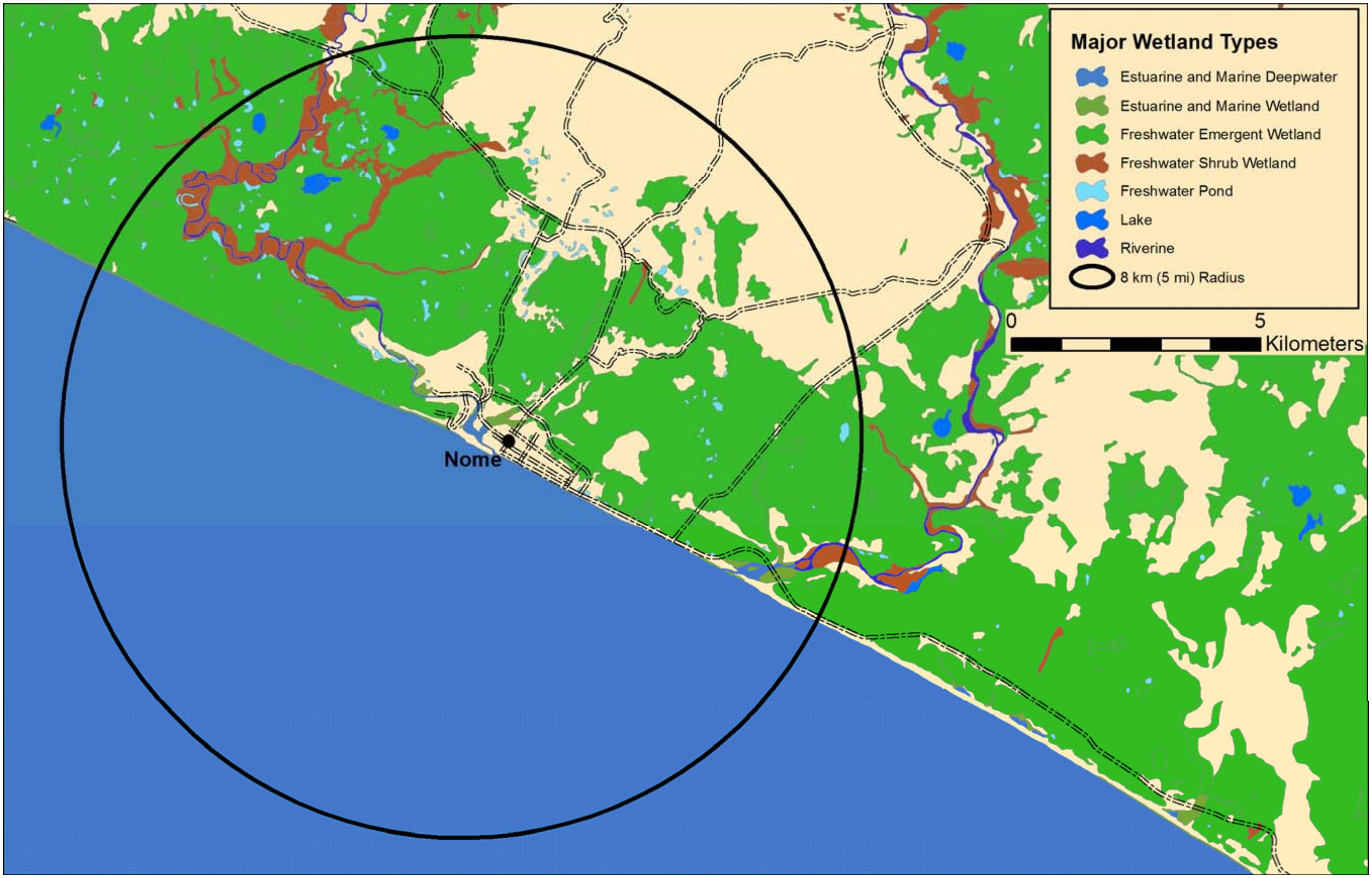

Figure 3.2.6. Major wetland habitat types within the vicinity of Nome Harbor. Wetlands within an 8 km (5 mi) radius of the intersection of the mouth of Nome Harbor and the coastline were selected for further analysis in Table 3.2.2.

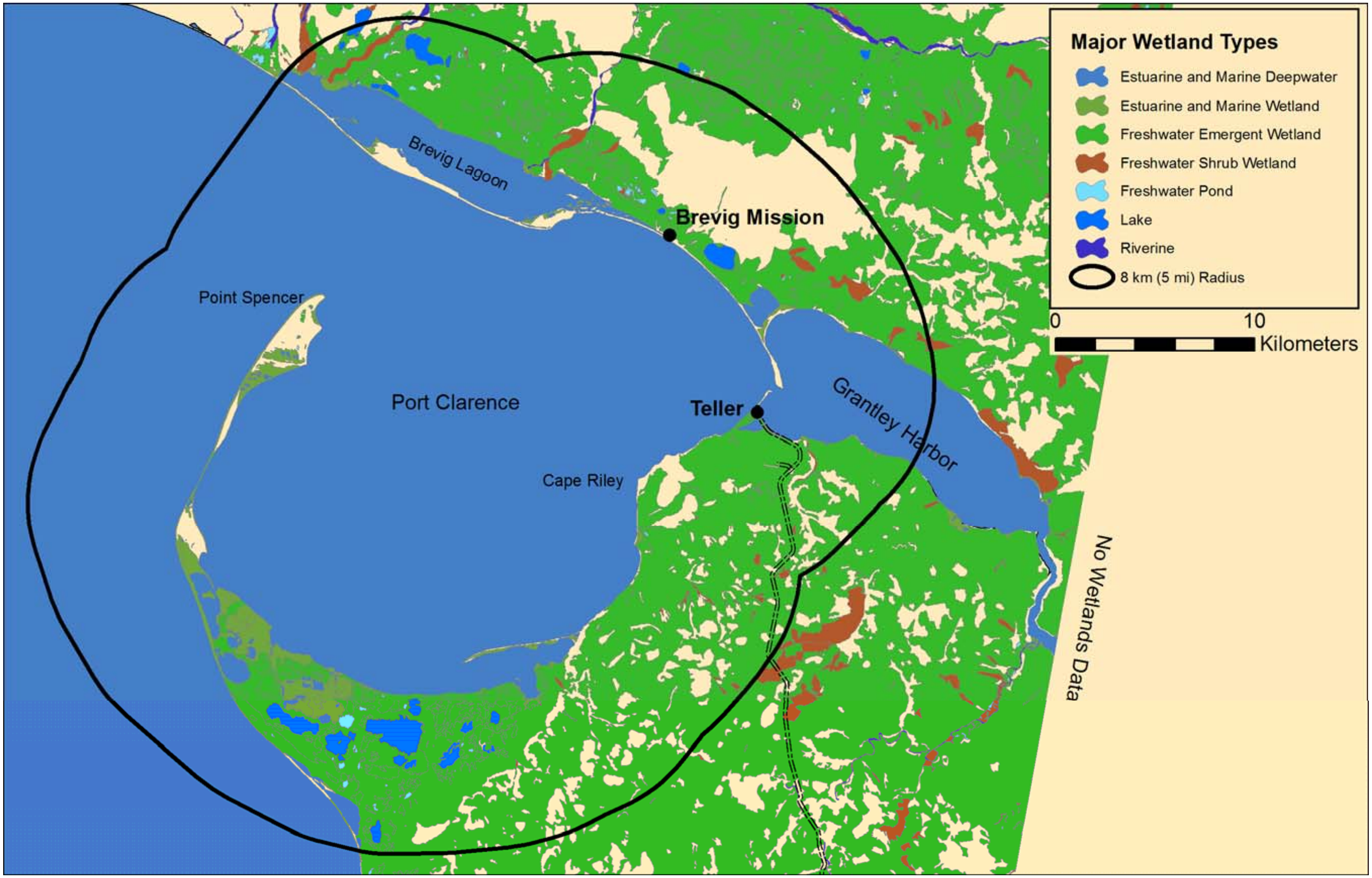

Figure 3.2.7. Major wetland types within the vicinity of Port Clarence. Wetlands within an 8 km (5 mi) radius of the Port Clarence shoreline were selected for further analysis in Table 3.2.2.

Figure 3.2.8. Wetlands within the immediate vicinity of Nome Harbor. Note the aerial image base layer from http://www.gina.alaska.edu/ was taken just before the mouth of the Snake River was closed off and the Nome Harbor was opened to the jetties.

Figure 3.2.9. Wetlands within the immediate vicinity Point Spencer. NOAA Nautical Chart base layer from (http://gina.alaska.edu/services).

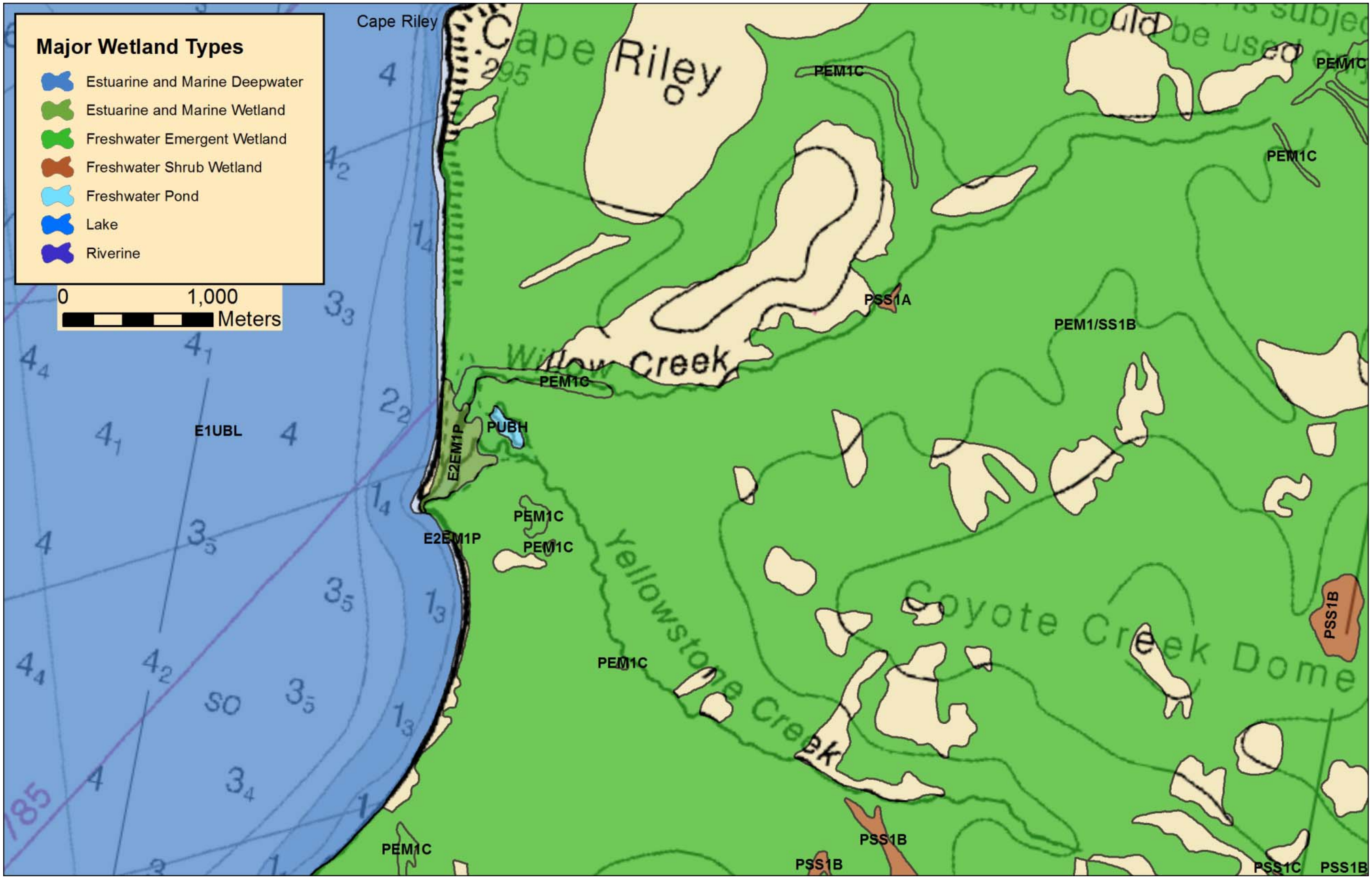

Figure 3.2.10. Wetlands within the immediate vicinity south of Cape Riley. NOAA Nautical Chart base layer from (http://gina.alaska.edu/services).

3.3. Fish and Wildlife Resources

Fish

Wolotira et al. (1977) characterizes the fish of Norton Sound and the eastern Bering Sea into three distinct groups: 1) cold water species indigenous to Arctic marine waters such as longhead dab and Arctic flounder; 2) subarctic boreal species with a distribution centered in the Bering Sea or regions of the eastern and western Pacific such as saffron cod, starry flounder and Pacific herring; and 3) anadromous species such as salmon, whitefish and smelt whose marine distribution occurs only in estuarine and nearshore waters.

Nome Harbor was created by dredging and expanding the mouth of the Snake River to shelter boats from Norton Sound. Port Clarence on the other hand, is a natural harbor connected to several tributaries by way of Grantley Harbor, Tuksuk Channel and Imuruk Basin (Figure 2.1). The total productivity of fish and invertebrates offshore from Nome Harbor is in the highest category (>10 kg/km) for Norton Sound and the eastern Bering Sea, while the total productivity for Port Clarence is in the second highest category (5-10 kg/km; Wolotira et al. 1977). Excluding invertebrates, fish productivity remains in the highest category offshore from Nome Harbor (>10 kg/km), but drops to the third highest category for Port Clarence (0.5-5 kg/km).

The USFWS is partly responsible for the management of interjurisdictional fish, anadromous species that migrate between waters of one or more states and the exclusive economic zone in marine waters. None of the fish species near Nome Harbor or Port Clarence are federally listed as candidate, threatened, or endangered species. However, the estuarine and marine habitat utilized by all five species of Pacific salmon are considered Essential Fish Habitat (EFH), by the North Pacific Fishery Management Council (NPFMC), including marine waters off Nome Harbor and Port Clarence (NPFMC et al. 2012). EFH are those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity (Magnuson-Stevens Fishery Conservation and Management Act, 50 CFR §600.10). The National EFH Mapper (NMFS 2014a) identifies the marine waters from the mean higher tide line to the 200-nautical mile limit of U.S. waters of the Bering Sea and Norton Sound as important habitat for marine juvenile, immature and maturing adult salmon. Any Federal Agency taking an action that could adversely affect EFH by reducing the quantity or quality of habitat must work with National Marine Fisheries Service (NMFS) to identify impacts and steps for conserving the habitat and reducing the impact of that action. In addition, the National EFH Mapper identifies the northern portion of Norton Sound starting about 4.6 nautical miles (8.5 kilometers) south of the Nome coast as EFH for red king crab eggs, late juveniles and adults.

Norton Sound near Nome and Port Clarence provide opportunities for subsistence (see Section 3.5 Subsistence Resources), commercial, and sport fishing. Salmon are the most sought (and best documented) fish resource; however a number of other fish species are also harvested. The following discussion includes salmon and other anadromous fish resources (trust resources) with an emphasis on their estuarine and nearshore marine life histories, followed by other fish species important for subsistence.

<u>Salmon</u>

Salmon are anadromous fish, meaning the adults migrate from the saltwater ocean to spawn in freshwater streams. All five Pacific salmon species migrate through Nome Harbor and Port Clarence to spawn in freshwater streams (Table 3.3.1). The estimated number of adult salmon passing through Nome Harbor and migrating upstream to spawn (i.e., escapement) in the Snake River from 1993 through 2012 is shown in Table 3.3.2. Port Clarence has a number of remote anadromous fish streams, making it too difficult to regularly census all its anadromous fish streams. However, the Pilgrim River which is accessible by road can be used as an index to the number of adult salmon passing through Port Clarence to spawn. The Pilgrim River is a tributary to the Kuzitrin River, which eventually feeds into Port Clarence (Table 3.3.3, Figure 3.3.1). The Pilgrim River also supports one of the northernmost sockeye salmon populations of significant size in North America (Menard et al. 2013).

Considerable information on the life histories and general distribution of salmon in Alaska is available. The following general life-history descriptions for each species of salmon rely heavily on NPFMC et al. (2012), supplemented by others as referenced.

Pink Salmon (*Oncorhynchus gorbuscha*): Pink salmon, also called humpback salmon, differ from other Pacific salmon by having a fixed 2-year life span, being smaller than other Pacific salmon as adults (averaging 1.0 to 2.5 kg), migrating to sea soon after emerging from the gravel, and developing a marked hump in large maturing males. Because of their two-year life cycle, pink salmon are reproductively isolated from their alternate-year stock and have developed into genetically different lines. In Norton Sound, even numbered year runs are more abundant than odd numbered year runs (Menard et al. 2013), while in Port Clarence the difference between even and odd year runs is not so pronounced (Magdanz et al. 2005).

Newly emerged pink salmon fry show a preference for saline water over fresh water, which may facilitate their outmigration to sea, although the timing and dispersal is influenced by many factors. Early marine schools of pink salmon fry tend to follow shorelines, and during their first weeks at sea, spend much of their time in shallow water only a few centimeters deep. Pink salmon juveniles are both opportunistic and generalized feeders, obtaining large quantities of food from a broad range of pelagic and epibenthic habitats. Adults feed on fish, squid, euphausiids, amphipods, and copepods in the open ocean before migrating back to spawn in freshwater and active feeding ceases.

Pink salmon are food for a number of marine mammals, fish and coastal sea birds, including at least 15 different marine mammals, sharks, Pacific halibut and humpback whales.

Chum Salmon (*Oncorhynchus keta*): Chum salmon return to spawn as two- to seven-year-olds, but four- to six-year-olds are more common in their northern range. Fry do not overwinter in streams but migrate (mostly at night) directly to the sea shortly after emergence. They tend to linger and forage in the intertidal wetlands at the head of bays for several months before actively migrating to outside waters. Estuaries are very important for rearing chum salmon during the spring and summer, and juveniles remain in coastal waters mostly July through October.

Juvenile chum salmon in estuarine and marine waters feed on copepods, euphausiids, decapod larva, amphipods, and gelatinous zooplankton. As immature and maturing adults they feed on fish, squid larvae, euphausiids, amphipods, copepods, and gelatinous zooplankton. Chum salmon have a much larger stomach than other salmon species, which may explain why they utilized gelatinous zooplankton more often than other salmon species. Active feeding ceases as they move back into fresh water to spawn.

Sockeye Salmon (*Oncorhynchus nerka*): Juvenile sockeye salmon characteristically utilize lakes more often than other salmon species for rearing habitat. Salmon Lake on the Pilgrim River, a tributary to the Kuzitrin River which eventually feeds into Port Clarence, supports one of the northernmost sockeye salmon populations of significance in North America (Menard et al. 2013). Sockeye salmon typically spend from one-to-three years in lakes, but some may migrate to sea soon after emergence. Depending upon the stock, they may reside in estuarine or nearshore waters before moving into oceanic waters no later than autumn following outmigration. Adults may spend from one-to-four years (usually two or three years) at sea before returning to spawn in fresh water. Sockeye salmon do not grow as rapidly as pink or coho salmon, nor do they attain the larger size of Chinook or chum salmon.

Juvenile sockeye salmon in estuarine waters feed on copepods and amphipods. During their initial marine period, yearling sockeye forage actively on a variety of organisms, apparently preferring copepods and insects, but also eat amphipods, euphausiids, fish larvae, squid, and mysids when available. Adults feed on copepods, amphipods, insects, small fishes, and squid. Active feeding ceases as they move back into fresh water to spawn.

Juvenile sockeye salmon in the marine environment are food for many other fish and coastal sea birds. Adults are known to be eaten by marine mammals and sharks.

Chinook salmon (*Oncorhynchus tshawytscha*): Chinook salmon, also called king salmon, are the largest but least abundant of the Pacific salmon. They are the most piscivorous of the Pacific salmon, and are also distributed deeper in the water column. While other species of salmon generally are surface oriented, utilizing primarily the upper 20 m, Chinook salmon tend to be at greater depths and are often associated with bottom topography. This affinity for deeper depths is one reason Chinook salmon are the most common salmon species taken as bycatch by bottom trawl fisheries.

As a species, Chinook salmon have a diverse and complex life history. They use a wide variety of freshwater habitats, and their seaward migration is timed to arrive in estuaries when food is plentiful. Juveniles in estuarine waters feed on copepods, euphausiids, amphipods, and juvenile fish. After entering saltwater, the juveniles disperse to oceanic feeding areas, although some stocks have a more extended estuarine residency and tend to be more coastal oriented. Adults typically remain at sea for one to six years, and feed primarily on fish including herring, sand lance, smelt, and anchovy. Adults may also feed on squid, pelagic amphipods, copepods, and euphausiids. Active feeding ceases as they move back into fresh water to spawn.

Chinook salmon in marine waters are typically only an incidental food item in the diet of other fish, marine mammals, and coastal sea birds, because they are relatively less common in coastal and oceanic waters.

Coho salmon (*Oncorhynchus kisutch*): Coho salmon, also called silver salmon, use more diverse habitats than other anadromous salmonids. Juveniles may migrate from their summer rearing areas in the fall to winter habitat in their natal stream basin, or between basins through saltwater or connecting estuaries. Intertidal sections of freshwater streams can be important rearing habitat for first year fish from May to October, where they may occupy freshwater lens during high tide. Seward migration usually occurs after one to two years in fresh or estuarine waters. The migration is primarily timed by photoperiod in the spring, and usually coincides with high streamflow. They may spend up to four months in coastal waters before dispersing in the North Pacific Ocean. After 12 to 14 months at sea, they migrate to coastal areas and then along the coast to their natal streams. Adults enter fresh water from early July through December and spawn from September through January.

Marine invertebrates are their primary food when juvenile coho salmon first enter saltwater. Fish, including herring and sand lance, become increasing important for food as the coho salmon grow. Active feeding ceases as they move back into fresh water to spawn.

Juvenile coho salmon are food for a variety of birds (e.g., gulls, terns, and cormorants), and fish (e.g., Dolly Varden). They are also a significant predator of pink salmon during their seaward migration. Adults provide important food for marine mammals and salmon sharks.

Commercial salmon fishing in Norton Sound is summarized by Menard et al. (2013). All commercial salmon fishing in the district is by set gillnets in marine waters; however, fishing effort is usually concentrated near river mouths. Commercial fishing typically begins in June and targets Chinook salmon if sufficient run strength exists. Emphasis switches to chum salmon in July and the coho salmon fishery begins the fourth week of July and closes in September. Pink salmon are much more abundant in even numbered year returns. A pink salmon directed fishery may coincide with or may be scheduled to alternate periods with the historical chum salmon directed fishery. The Nome Subdistrict (Cape Rodney to Topkok Head) salmon production comes from several relatively small coastal streams, which appear more sensitive to variability in environmental conditions than the relatively larger eastern streams in Norton Sound. Furthermore, variability in chum salmon production tends to be higher in the smaller Nome Subdistrict rivers (e.g., Nome and Snake rivers), whereas runs to the eastern Nome Subdistrict rivers tend to be relatively stable.

The commercial salmon catch from 1964 to 2012 for the Nome Subdistrict is shown in Table 3.3.4. Little or no commercial salmon harvest has occurred in Nome and other Norton Bay Subdistricts since the early 1980s. The Nome Subdistrict has had very depressed chum salmon stocks that, until the mid-2000s, required closure or severe restrictions of the subsistence fishery. The Nome Subdistrict has been unable to attract a buyer for pink and coho salmon until recently, and remains closed to commercial chum salmon fishing by regulation (Menard et al. 2013).

Table 3.3.1. Anadromous fish bearing streams with outlets into Nome Harbor and Port Clarence. Streams listed from west to east in a clockwise direction. Port Clarence has two major "collector bays" (Brevig Lagoon and Grantley Harbor) before fish disperse into the Port. Source: ADF&G (2014b).

Water Body	Chinook Salmon	Sockeye Salmon	Coho Salmon	Chum Salmon	Pink Salmon	Dolly Varden	Whitefish	Humpback Whitefish	Broad Whitefish	Bering Cisco
Nome Harbor										
Snake River	X	X	X	X	X	X	X			
Dry Creek			X			X				
Port Clarence										
Brevig Lagoon										
Don River					X	X				
California River					X	X				
Grantley Harbor and Upstream										
Sunset Creek					X					
Agiapuk River		X	X	X	X	X	X	X	X	
Kuzitrin River	X	X	X	X	X	X	X			X
Cobblestone River		X		X		X				
Canyon Creek					X	X	X			
Bluestone River				X	X	X	X			

Table 3.3.2. Historical escapement of salmon and Dolly Varden from the Snake River estimated by aerial survey (1993-1994), counting tower (1995-2002), and weir (2003-2012). After Mernard et al. (2013) Appendices A23, A31 and A32.

Year	Operating Period	Chinook	Chum	Pink	Coho	Sockeye	Dolly Varden
1993	n/a	n/a	2,115	n/a	n/a	n/a	n/a
1994	n/a	n/a	3,519	63,860	n/a	n/a	n/a
1995	July 01 - Aug 18	0	4,393[a]	917	856	0	n/a
1996	July 03 - Aug 22	5	2,772	44,558	1,638	0	n/a
1997	July 07 - Aug 18	12	6,184	6,742	1,157	0	n/a
1998	July 01 - Aug 11	0	11,067	219,679	178	0	n/a
1999	July 01 - Aug 14	20	484	116	90	0	n/a
2000	June 29 - Aug 25	28	1,911	4,723	406	0	n/a
2001	July 08 - Sept 5	33	2,182	1,295	1,335	0	n/a
2002	June 28 - Sept 16	9	2,776	4,103	851[b]	8	149
2003	June 26 - Sept 11	50	2,201	2,856	489	84	111
2004	June 23 - Sept 3	17	2,146[a]	126,917	474	22	290
2005	June 27 - Sept 11	31	2,967[a]	13,813	2,948	275	28
2006	July 01 - Sept 11	32	4,160[a]	74,028	4,776	302	614
2007	July 01 - Sept 14	61	8,147	4,634	1,781	1,354	121
2008	July 06 - Sept 6	13	1,244	145,761	5,206	143	452
2009	July 08 - Aug 30[c]	6	891	769	50	2	14
2010	July 03 - Sept 11	43	6,973	51,099	2,243	124	198
2011	July 08 - Sept 11	1	4,343	7,011	343	14	5
2012	July 06 - Aug 15[d]	1	1,235	5,954	14	3	3

[a] Used Mernard et al. (2013) Appendix A23 values when they differed slightly from Appendix A31 values.

[b] Includes 442 coho salmon estimated by aerial survey to be holding below the weir site after the weir was removed.

[c] Weir was not fish tight last week of August and hundreds of coho salmon passed through the weir without being counted.

[d] Weir was knocked out for 13 days in late July and early August. An interpolation was made for chum salmon.

Table 3.3.3. Historical escapement of salmon and Dolly Varden from the Pilgrim River (a tributary to the Kuzitrin River) estimated by counting tower (1997-2002), and weir (2003-2012). After Mernard et al. (2013) Appendix B2.

Year	Operating Period	Chinook	Chum	Pink	Coho	Sockeye	Dolly Varden
1997	July 12 - Aug 21	356	15,619[a]	5,557	452	15,619[a]	n/a
1998	Did not operate						
1999	July 13 - Aug 6	6	2,617	35,577	104	4,650	n/a
2000	July 05 - Aug 18	72	861	374	21	12,141	n/a
2001	Did not operate						
2002	July 04 - Aug 4	150	5,590	3,882	246	3,888	n/a
2003	June 21 - Sept 14	1,016	15,200	14,100	677	42,729	550
2004	June 21 - Sept 14	925	10,239	50,760	1,573[b]	85,417	264
2005	June 24 - Sept 5	216	9,685	13,218	304	55,951	112
2006	June 30 - Sept 9	275	45,361	17,701	973	52,323	505
2007	June 29 - Sept 10	501	35,334	3,616	605	43,432	339
2008	June 25 - Sept 1	137	24,550	92,471	260	20,452	409
2009	June 26 - Aug 31	52	5,427	483	18	953	130
2010	June 24 - Sept 1	44	25,379	29,239	272	1,654	285
2011	June 28 - Sept 1	44	41,740	3,364	269	8,449	229
2012	June 26 - Aug 18	64	25,521	46,135	95	7,085	65

[a] Chum and sockeye salmon escapements were combined due to species identification problems during 1997.

[b] Coho salmon were misidentified. Nearly 30% of scale samples in 2004 were actually sockeye salmon.

Table 3.3.4. Commercial salmon catch by species for the Nome Subdistrict (Cape Rodney to Topkok Head) in Norton Sound. After Mernard et al. (2013) Appendix A6.

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1964	5	0	0	1	1,194	1,200
1965	1	0	0	193	1,941	2,135
1966	1	0	32	1	581	615
1967	0	0	0	72	406	478
1968	0	0	0	50	102	152
1969	0	0	63	330	601	994
1970	0	0	6	55	960	1,021
1971	11	0	0	14	2,315	2,340
1972	15	0	0	12	2,643	2,670
1973	0	0	0	321	1,132	1,453
1974	19	0	123	7,722	10,431	18,295
1975	2	0	319	2,163	8,364	10,848
1976	2	10	26	1,331	7,620	8,989
1977	8	0	58	65	15,998	16,129
1978	19	0	0	22,869	8,782	31,670
1979	9	0	29	5,860	5,391	11,289
1980	8	0	0	10,007	13,922	23,937
1981	4	0	508	3,202	18,666	22,380
1982	20	0	1,183	18,512	13,447	33,162
1983	23	0	261	308	11,691	12,283
1984	7	0	820	0	3,744	4,571
1985	21	0	356	0	6,219	6,596
1986	6	0	50	0	8,160	8,216
1987	3	0	577	0	5,646	6,226
1988	2	0	54	182	1,628	1,866
1989	2	0	0	123	492	617
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	1	2	693	185	881	1,762
1993	0	2	611	0	132	745
1994	0	1	287	0	66	354
1995	0	1	369	0	122	492
1996	0	0	9	13	3	25
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000 to 2012	0	0	0	0	0	0

Note: Commercial harvest numbers may include a small number of salmon retained for personal use reported on fish tickets that were not commercially sold.

Commercial salmon fishing in the Port Clarence District (Cape Douglas north to Cape Prince of Wales) has been limited (Menard et al. 2013). Since 1966 when 93 sockeye salmon, 131 pink salmon, and 922 chum salmon were harvested in the Grantley Harbor/Tuksuk Channel area, commercial salmon fishing has been prohibited, except for 2007 and 2008, due to relatively small runs in the area. There was a limited commercial salmon fishery in 2007 and 2008, but the fishery has remained closed since 2009 due to poor sockeye salmon runs.

Other Anadromous Fish

Besides the widely recognized salmon species, a number of lesser known anadromous species use or may use the Nome Harbor and/or Port Clarence waters. Dolly Varden and whitefish are anadromous fish known to use freshwater steams flowing into Nome Harbor and Port Clarence (Table 3.3.1). Although the Anadromous Waters Catalog used for Table 3.3.1 contains over 18,000 anadromous streams, rivers and lakes in Alaska, the Alaska Department of Fish and Game (ADF&G) estimates less than half the streams, rivers and lakes actually used by anadromous fish have been identified (ADF&G 2014a). The following describes the anadromous species other than salmon known to use the waters of Nome Harbor and Port Clarence (i.e., Dolly Varden and whitefish), as well as anadromous species whose marine distribution includes the waters near Nome Harbor and Port Clarence, but their use of freshwater streams at these locations is not known or well documented (i.e., lampreys, eulachon, rainbow smelt and sticklebacks).

Dolly Varden (*Salvinus malma*): Unlike Pacific salmon, Dolly Varden (locally called trout, and synonymous with char in this region (Mernard et al. 2013)) are capable of spawning multiple times during their lives, but they rarely survive to spawn more than three times (ADF&G 2014e, Menard et al. 2013). They are found in every anadromous stream associated with the Nome Harbor and Port Clarence (Table 3.3.1). The estimated number of adult Dolly Varden passing through the Nome Harbor and migrating upstream to spawn (i.e., escapement) in the Snake River from 2002 through 2012 is shown in Table 3.3.2. The Pilgrim River provides an index to the number of adult Dolly Varden passing through Port Clarence from 2003 to 2012 to spawn (Table 3.3.3).

Menard et al. (2013), supplemented by ADF&G (2014e), describe the general life history of Dolly Varden in the Nome and Port Clarence area. Fry emerge in spring and migrate to the ocean during early summer after spending from one to six (generally two to five) years in freshwater. Movements of Norton Sound Dolly Varden coincide with salmon. In spring, Dolly Varden are likely to remain longer in streams following a large pink salmon run to feed on abundant out migrating fry. They are sometimes present in streams during summer to feed on salmon eggs, especially during years of high pink salmon abundance. While at sea they feed opportunistically on a variety of prey, including amphipods and small fish such as juvenile salmon and sandlance. They generally stay near shore, but may travel long distances along the coast, frequently ascending rivers to feed or to find a suitable lake or river to spend the winter. Dolly Varden generally appear in commercial catches during the last three weeks of August and are taken as a non-target species in the Kotzebue Sound commercial chum salmon fishery.

Spawning and overwintering Dolly Varden typically pass through the area during September. The northern form Dolly Varden can live up to 16 years.

Whitefish: Three genera are collectively known as whitefish (*Stenodus*, *Prosopium*, and *Coregonus*). *Stenodus leucichthys* (inconnu, sheefish) are more common further north, especially in the Kotzebue Sound (Menard et al. 2013). *Prosopium cylindracium* (round whitefish) is the sole representative of this genus in the Norton Sound/Port Clarence area, but they rarely venture from freshwater into brackish water (Mecklenburg et al. 2002, Menard et al. 2013). Neither inconnu nor round whitefish have been distinguished from other whitefish in the Snake River or Port Clarence anadromous fish streams (Table 3.3.1). The only whitefish that have been distinguished in these anadromous fish streams are humpback (*Coregonus pidschian*) and broad (*Coregonus nasus*) whitefish in the Agiapuk River, and Bering cisco (*Coregonus laurettae*) in the Kuzitrin River (Table 3.3.1). The water from these two rivers flow through Port Clarence where Barton (1978) found least cisco (*Coregonus sardinella*), in addition to broad whitefish and Bering cisco.

Whitefish are an important subsistence resource (see Section 3.5 Subsistence Resources), yet little is known about their life histories, especially in estuarine and marine waters. Some whitefish individuals never go to sea. However, at least some populations of white fish exhibit anadromy (40 to 100%) within 1,200 km of the ocean, including inconnu, broad whitefish, humpback whitefish, least cisco and Bering cisco (Brown et al. 2007). Only round whitefish may not be anadromous; at least populations further than 1,200 km upstream from the ocean (Brown et al. 2007). Most broad whitefish are amphidromous, meaning they can move from freshwater to nearshore marine waters and vice versa at times unrelated to spawning (ADF&G 2014d). Bering cisco can tolerate high salinity and are often found in estuaries (Alt 1994). Whitefish can be found at various times of the year in inshore marine waters, and spawn in freshwater in late August through October when lakes and streams are close to freezing (Menard et al. 2013). Broad and humpback whitefish spawn at age four or five, and Bering cisco spawn on average at age six (Alt 1994). Not all broad whitefish spawn every year, and some individuals live more than 20 years (ADF&G 2014d).

Whitefish are a major food item for many predatory fish (Alt 1994). Limited commercial harvests have been allowed since statehood, and generally limited to large open water areas such as Grantley Harbor near Port Clarence (Menard et al. 2013). Harvest levels have been historically low, with most fish sold to local markets for human consumption, dog food, or more recently, crab bait (Menard et al. 2013).

Lampreys: Arctic lamprey (*Lethenteron camtschaticum*) and Pacific lamprey (*Entosphenus tridentatus*) are parasitic anadromous fish species whose range includes the marine waters near Nome Harbor and Port Clarence, although the Pacific lamprey is apparently rare north of the Alaska Peninsula (ADF&G 2014c, NatureServe 2014). These two species may be more widely recognized by the synonyms for their scientific names: *Lampetra camtschatica* and *Lampetra tridentata*, respectively (NatureServe 2014).

Adult lampreys are anadromous and parasitic, or remain in fresh water and are nonparasitic (Mansfield 2004). Larval lampreys, called ammocoetes, are blind and lack sucking parts. They remain at this stage in fresh water from three to seven years, and metamorphose in the fall into adults with eyes and a sucking mouth. The anadromous parasitic lampreys spend from one to four years at sea before returning in the fall to overwinter in freshwater and spawn in the spring.

Arctic lampreys are the most common lamprey in Alaska (Mansfield 2004). Very little information exists on Arctic lampreys in general (ADF&G 2014c, Estensen et al. 2013). They occur in the Yukon River in sufficient numbers to support an experimental commercial fishery (Estensen et al. 2013), and lamprey ammocoetes that fit the description of Arctic lamprey have been found in the Unalakleet River in eastern Norton Sound (Kirsch et al. 2011).

Although very little information on lampreys in Alaska exists, and Norton Sound is no exception, there is anecdotal evidence that anadromous Arctic lampreys utilize smaller streams near Nome, though not in significant numbers. Additionally, smaller streams could potentially harbor non-anadromous forms difficult to find unless specifically digging in the sediments for the larvae (Kevin Siwicke, graduate student at University of Alaska Fairbanks, March 2014).

Parasitic lampreys feed on other fish and sometimes marine mammals by using their sucking mouthparts (Mansfield 2004). They are also eaten by marine mammals, larger fish, and birds. People have been using lampreys for food and bait for a long time.

<u>Eulachon (*Thaleichthys pacificus*)</u>: Eulachon (also called hooligan, candlefish or smelt) are small anadromous fish that range as far north as the beaches of Nome, but are more abundant further south (Bartlett 2008, ADF&G 2014f). The population status among Alaskan river systems is unknown, since very little information exists on eulachon in general (Bartlett 2008, ADF&G 2014f). They do not home to a particular stream like salmon, but appear to use streams in the general area where they were spawned, and seldom more than a few miles inland. Eulachon are weak swimmers, so they require slow moving rivers to migrate upstream to spawn, and rely upon the river current to carry the young downstream to saltwater to grow and mature. At sea, they occur in nearshore waters out to a depth of about 300 meters (1000 feet) (NMFS 2014b). After three to six years at sea, they return to fresh water to spawn. The majority die after spawning.

As juvenile and adults they feed mostly on euphausiids (Bartlett 2008, ADF&G 2014f). Eulachon are a valuable source of food for many animals because of their extremely high oil content (about 20%; or four to five times higher than most fish of comparable size; NatureServe 2014). They are sometimes called candlefish because they burn like a candle. Predators include salmon, sharks, marine mammals and seabirds.

<u>Rainbow Smelt (*Osmerus mordax*)</u>: Rainbow smelt are small anadromous fish inhabiting all of Alaska's coastal waters, although less common along the Gulf of Alaska (ADF&G 2014i). Limited sampling near shore found rainbow smelt at Port Clarence, but none near the Nome Harbor (Appendix A). Barton (1978) also found boreal smelt (a synonym for rainbow smelt) in near shore samples in Port Clarence, but did not sample nearshore in the vicinity of Nome. Rainbow smelt were more abundant in Port Clarence than off the coast of Port Clarence or Nome (Wolotira et al. 1977). The population status among Alaskan river systems is unknown, since very little information exists on rainbow smelt in general (ADF&G 2014i). Because rainbow

smelt are weak swimmers, they tend to gather in large schools off the mouth of their spawning streams and rivers, which are typically slow moving waterways. Spawning sites are typically in the lower elevations of rivers and streams, and some may even spawn in brackish water behind barrier beaches or in the tidal zone of estuaries (ADF&G 2014i). After emerging from eggs, they migrate downstream to salt water to grow and mature at sea. They can overwinter under the ice in estuaries by producing an antifreeze protein and glycerol (ADF&G 2014i). Rainbow smelt spend two to six years at sea before returning to fresh water to spawn. Most die after spawning. At sea, they remain within two kilometers of shore moving into shallow water at night and returning to waters no deeper than six meters during the day (Buckley 1989).

Adult rainbow smelt feed on decapods and mysid shrimps, copepods, amphipods, crabs, squid, worms, and a variety of small fish and shellfish (ADF&G 2014i). Predators include a variety of fishes, birds, terrestrial and marine mammals.

<u>Sticklebacks</u>: Threespine stickleback (*Gasterosteus aculeatus*) and Ninespine stickleback (*Pungitius pungitius*) are small fish with strictly marine, anadromous or freshwater resident populations (ADF&G 2014j, ADF&G 2014g). Both species are found along the Bering Sea coast, with ninespine stickleback being the most widely distributed species (Barton 1978). However, no ninespine sticklebacks were found in limited sampling near the Nome Harbor or Port Clarence in the fall of 2013 (Appendix A). Threespine sticklebacks were only the only sticklebacks found in the Port Clarence area (Barton 1978, Appendix A), and are rarely found north of Bristol Bay or far inland (ADF&G 2014j). Ninespine sticklebacks appear to be more tolerant of marine waters than threespine stickleback. Adult sticklebacks spawn at one to two years of age. Few sticklebacks live more than three years, although threespine sticklebacks may live perhaps a few years longer. Marine populations are apparently pelagic, but both species usually remain close to shore.

Adult sticklebacks likely have similar feeding habits, feeding on free-swimming crustaceans and bottom organisms (ADF&G 2014j, ADF&G 2014g). Sticklebacks are important prey for predaceous marine, anadromous and fresh water fish, a major prey source for piscivorous birds.

<u>Other Fish Species</u>:

A number of non-anadromous fish species undoubtedly use the nearshore marine waters near Nome Harbor and Port Clarence (e.g., Appendix A). Although these species are not trust species of the USFWS because they are not inter-jurisdictional fish, some are an important subsistence resource (see Section 3.5 Subsistence Resources). Saffron cod, flounder, and Pacific herring are common non-anadromous fish species used for subsistence, and their life histories are discussed below.

<u>Saffron Cod (*Eleginus gracilis*)</u>: Saffron cod (locally called tomcod, Menard et al. 2013) occur in shallow coastal waters less than 50 m deep in the northeastern Bering Sea, including Norton Sound (FAO 2014). In a limited sampling of nearshore fish in the fall of 2013 they were the most abundant nearshore fish species found near the Nome Harbor, and were also present in nearshore samples in Port Clarence (Appendix A). Barton (1978) found saffron cod to be one of the most frequently occurring species in Port Clarence. Wolotira et al. (1977) found the largest

concentrations of saffron cod offshore to be in the outer portions of Norton Sound and the northeastern Bering Sea, accounting for about 75% of the total population estimate in their study area.

Although primarily a marine species, saffron cod are known to enter brackish and even fresh water, but remain within regions of tidal influence (FAO 2014). Juveniles are not migratory and stay in shallow water throughout the year, while adults winter near shore under ice cover and summer offshore. Saffron cod begin to mature during their third year in Norton Sound, and spawn once a year for five to seven times in their lifetime; sometimes up to nine to ten times for long lived fish. Less than one percent survives past five years, however. Spawning occurs during January to February in coastal zones of bays and inlets on sand and gravel substrates in depths of two to ten meters. Juveniles and adults are opportunistic epibenthic feeders; juveniles feed on fish, mysids, decapods, and amphipods.

<u>Flounder</u>: Two species of flounder are commonly found in the waters near Nome and Port Clarence. Both are flatfish species found on or near the ocean bottom. Starry flounder (*Platichthys stellatus*) is found all along the coast of Alaska, and Arctic flounder (*Pleuronectes glacialis*, synonym = *Liopsetta glacialis*) is found in coastal waters from Bristol Bay northward (Mecklenburg et al. 2002). The more common starry flounder was the second most frequent species captured in nearshore gillnets in Port Clarence (sampled east side of Port Clarence), while Arctic flounder was among the 20 most frequent species captured by Barton (1978). Wolotira et al. (1977) assigned the second highest abundance category for starry flounder to waters inside Port Clarence (5-10 kg/km), and the third highest abundance category for marine waters outside Port Clarence and nearshore at Nome (0.5-5 kg/km). The less common Arctic flounder was most abundant (<0.5 kg/km) inside Port Clarence, and was seldom found (0 kg/km) in marine waters outside Port Clarence or nearshore at Nome (Wolotira et al. 1977). However, Arctic flounder was the only species of flounder found in a limited sampling of nearshore fish in the fall of 2013 near Nome Harbor and Port Clarence (Appendix A).

Starry founder are found on soft bottoms from intertidal areas to a depth of 375 m, although usually in waters shallower than 100 m (Mecklenburg et al. 2002). They are common in estuaries and are often found up river to the limit of tidal influence, as well as in marshes and coastal lakes (Mecklenburg et al. 2002). Orcutt (1950) also found starry flounder frequent various types of bottom as shallow as a few inches deep, appearing to only avoid rock bottoms, and they can occasionally be found in strictly freshwater rivers many miles from sea. During the summer starry flounder are usually nearshore, but may move to deeper waters for the winter (NatureServe 2014). Port Clarence residents have found flounders year-round, but they move around seasonally (Raymond-Yakoubian 2013). Males mature at the end of their second year, and females mature at three years of age (Orcutt 1950). Starry founder spawn in shallow water less than 25 fathoms (45.72 meters), and their larvae are pelagic (Orcutt 1950, NatureServe 2014). Teller residents have found starry flounder spawning near Jones Point in southern Port Clarence near the end of May or early June (Raymond-Yakoubian 2013, see also Figure 3.5.x). Starry flounder are benthic feeders, feeding on crabs, polychaetes, mollusks, amphipods, copepods and other invertebrates (NatureServe 2014). Larger starry flounder also feed on fish.

Arctic flounder are found not far from shore in shallow brackish waters of bays and estuaries to a depth of about 19 m, and are rarely found in deeper water (Cooper and Chapleau 1998, Mecklenburg et al. 2002). They prefer mud bottoms, and frequently enter freshwater (Cooper and Chapleau 1998). In the evenings, they move closer to shore, especially on a rising tide (Cooper and Chapleau 1998). Arctic flounder appear to move inshore in the spring and offshore in the fall (Cooper and Chapleau 1998), although Port Clarence residents have found "smooth flounder" (possibly Arctic flounder) overwintering and spawning around March and April in Brevig Lagoon (Raymond-Yakoubian 2013, see also Figure 3.5.x). Arctic flounder are benthic feeders, feeding on small fishes and bottom invertebrates (Cooper and Chapleau 1998).

Pacific Herring (*Clupea pallasii*): Pacific herring are a coastal schooling species found in large schools in waters up to about 400 meters (1,300 feet) deep throughout the North Pacific, including the Bering Sea and Norton Sound (Funk 2007, NMFS 2012, ADF&G 2014h). In a limited sampling effort of nearshore fish in the fall of 2013, they were the third most abundant nearshore fish species found near the Nome Harbor, and were also present in nearshore samples in Port Clarence (Appendix A). Barton (1978) found beach seines captured 95% of all juvenile herring caught in the Port Clarence area, but only 11% of the total adult catch. Most adults in the Port Clarence area were in Grantley Harbor (58%), with 36% in Port Clarence and only six percent in Imuruk Basin.

Pacific herring spawn during the spring in shallow, vegetated areas within the intertidal and subtidal zones. Their eggs are adhesive, and survival is better for those eggs which stick to intertidal vegetation than for those which fall to the bottom (Funk 2007). The young larvae drift and swim in ocean currents for two to three months until they reach the juvenile stage when they rear in sheltered bays and inlets (Funk 2007, NMFS 2012, ADF&G 2014h). Schools of juveniles move to deeper water in the fall where they will spend the next two to three years, apparently separate from the adults until they are mature. They reach sexual maturity at three to four years of age, and spawn every year thereafter throughout their 8 to 16 year life. After spawning, the adults return to their summer feeding areas.

Primary spawning areas in Norton Sound are from Stuart Island to Tolstoi Point in southeastern Norton Sound (Menard et al. 2013). When sea ice remains in this area into June, spawning becomes more extensive along Cape Denbigh and locations along the northern shore of Norton Sound between Bald Head and Bluff. Additional northerly spawning areas have been more difficult to identify because of small herring stock sizes and limited investigations. Menard et al. (2013) identified the Imuruk Basin near Port Clarence as a likely spawning area, and the residents of Teller and Brevig Mission have identified herring spawning areas in southern and northern Port Clarence (Raymond-Yakoubian 2013, see also Figures 3.5.x and 3.5.x). Barton (1978) found no spawning Pacific herring in the Nome area, but observed three schools of potential spawning herring inside the Port Clarence Spit within 50 m of shore.

Pacific herring stocks along the western Seward Peninsula (e.g., Port Clarence) may overwinter in coastal lagoons, bays or inlets, which are warmed by river discharge under the ice, rather than in the ice-covered central Bering Sea (Barton 1978). However, Port Clarence is a sheltered body of water which is covered by ice longer. The ice slows solar gain and water mixing, so fish may move to the warmer ice-free waters outside Port Clarence in the spring before returning to spawn once the shallow lagoons begin to warm (Menard et al. 2013).

Pacific herring travel in large schools, generally feeding in surface waters at night in areas of upwelling and seeking the cover of deeper water during the day (Funk 2007, ADF&G 2014h). They are seasonal feeders, accumulating fat for periods of relative inactivity and spawning. Young feed mainly on crustaceans, but will eat decapods and mollusk larvae. Adults consume mostly large crustaceans and small fish. Herring are an important source of food for a wide variety of fishes, marine mammals and birds (Funk 2007).

Migratory Birds

The Seward Peninsula is in a globally significant location for migratory birds. It is at the overlapping boundaries of migration patterns for both Neartic (North American) and Palearctic (northern Asia) bird species. This situation, combined with its setting at the terrestrial/marine interface, results in an abundance of diverse bird species using the Seward Peninsula. More specifically, up to 116 species of migratory birds may use the coastal habitats of the Southern Seward Peninsula and Port Clarence. A species list, with scientific names, is presented in Table 1 in Appendix B. A brief description of the birds of the southern Seward Peninsula, organized by taxa, is provided below, followed by a detailed description of important bird habitat use.

- Seabirds: according to the surveyed literature, 20 seabird species are found in coastal and marine habitats of the Southern Seward Peninsula, Port Clarence, and northern Norton Sound (Audubon 2013a, AKNHP 2010, Delinger 2006, Dragoo 2006, USFWS 1991, MMS 1990, Springer et al. 1982, Woodby & Divoky 1982a). Information obtained during surveys by the Minerals Management Service (MMS) in the 1980s (MMS 1990), found six species of seabirds in Norton Sound in large numbers: common murre (35,000-70,000), glaucous gull (minimum 20,000), black-legged kittiwake (11,500-15,000), horned puffin (1,600-4,500), pelagic cormorant (1,470-2,500), and thick-billed murre (950-1,250). Tables 2 and 3 of Appendix B show the seabird species that are possibly nesting in colonies within the Project vicinity. Two species of seabirds potentially found in the project area are considered at high conservation risk in both Alaska and North America: the pelagic cormorant and Kittlitz's murrelet (Delinger 2006).

- Shorebirds: according to the surveyed literature, 31 shorebird species use the coastal habitats of the Southern Seward Peninsula and Port Clarence (Audubon 2013b, ADF&G 2012, MMS 1990, Woodby & Divoky 1982a, MMS 1980).

- Waterfowl: according to the surveyed literature, 37 waterfowl species use the coastal habitats of the Southern Seward Peninsula and Port Clarence (Audubon 2013b, ADF&G 2012, MMS 1990, Woodby & Divoky 1982a and b, MMS 1980). These species include ducks, geese, swans, loons, and grebes. Two species of sea ducks potentially found in the Project area, Steller's and spectacled eiders, are listed as threatened under the ESA. The yellow-billed loon, a candidate for listing, uses the project area. These three species are discussed in Section 3.4. Special Status Species.

- Raptors and other birds of prey: according to the surveyed literature, 11 species of raptors and other birds of prey use the coastal habitats of the Southern Seward Peninsula and Port Clarence (Audubon 2013a and b, ADF&G 2012, MMS 1990).

- Other birds: according to the surveyed literature, there are approximately 17 other birds species using the coastal habitats of the Southern Seward Peninsula and Port Clarence (ADF&G 2012, MMS 1990). These species are comprised mostly of migratory and resident species of passerines (songbirds), but also include sandhill cranes and ptarmigan.

Bird Habitats and Activity along the Southern Seward Peninsula Coast

The ways in which birds utilize habitats in the vicinity of the Project area are presented and include spring migration, pre-nesting activities, nesting, post-nesting movements to feeding grounds, pre-migratory staging, and fall migration (Woodby & Divoky 1982a).

The characteristic of coastal habitats on the Southern Seward Peninsula changes between that area bordering the Bering Strait and that area bordering Norton Sound, and vegetation is described as more arctic in nature closer to Bering Strait (Woodby & Divoky 1982a). Generally higher elevation habitats west of Nome can be broadly described as headlands along the shoreline. Eastern Norton Sound can be broadly described as wet tundra lagoons and broad river deltas. This area is lower elevation in general.

Bird abundance varies considerably overall small distances along the coast of Norton Sound, as seen during the Outer Continental Shelf Environmental Assessment Program (OCSEAP) surveys in the early 1980s. See Figure 3.3.2. for a depiction of places named in the surveys. In general terms, the northwest portion was relatively bird-poor, and the northeast portion was relatively bird-rich (Woodby & Divoky 1982a).

The Southern Seward Peninsula coastal area includes three areas currently under consideration by National Audubon Society for designation as Important Bird Areas (Figure 3.3.2). Bluff Colony is important to seabirds and hosts the largest seabird colony in Norton Sound. The remaining two areas, Golovin Lagoon and Safety Sound, are important areas for staging and breeding shorebirds. All three of these areas are located on the southern coast of the Seward Peninsula, east of Nome. These areas are discussed in further detail below. No Important Bird Areas are listed or proposed in the Port Clarence area.

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Figure 3.3.2. Avian habitat place names on the Southern Seward Peninsula coast.

Timing of Bird Use

Phenology of bird activity in Norton Sound has been described from OCSEAP surveys conducted in the early 1980s (Woodby & Divoky 1982a, MMS 1990). The first birds to return from the wintering grounds to Norton Sound and its coastal habitats arrive in early May. These early arrivals include waterfowl and seabirds. Habitats of importance to these first spring migrants are those areas with open water including: open offshore leads; polynyas; open water in the Sound as sea ice retreats; areas near freshwater inputs along the shoreline, and lagoon areas protected by barrier islands. Protected waters in Norton Sound are ice covered October through April. Port Clarence retains ice longer than the nearby exposed waters, with shore ice into early June. Snow cover remains later on terrestrial habitats on the west end of the Seward Peninsula, when compared with the east.

In general during the OCSEAP surveys (Woodby & Divoky 1982a), bird use of coastal and shoreline habitats was highest in August and September, except at Port Clarence, where highest numbers were found in spring. Bird numbers, consisting of both locally-breeding birds and migrants, begin to increase in the second half of May and continue to increase through June. Numbers drop in July, when only local nesters are present. Bird numbers again increase in August, when waterfowl and other birds that had nested further north or inland begin to stage in Norton Sound (primarily in wetlands) before southward migration. Saltmarshes at the lower reaches of rivers are known as waterfowl staging areas (MMS 1990), and lagoons are noted as having intensive use by shorebirds during the post-breeding period (Gill & Handel 1981). Birds from more northerly breeding grounds may be mixing with the local population. Overall, numbers of staging birds peaked in September (Woodby & Divoky 1982a). Gulls remained abundant on the shoreline through October, heading south with the advancing ice.

Coastal Avian Habitat Types

Major avian habitat types along the coast of the Southern Seward Peninsula include bluffs and cliffs, sandy beaches, lagoons and estuaries, and mesic to wet tundra (which begins more inland but slopes down to water's edge) (ADF&G 2012). Ponds may be scattered throughout the tundra habitats. A complete classification of avian shoreline habitats in Norton Sound was compiled by Woodby & Divoky (1982a). Descriptions of those habitat types found in areas potentially affected by the Project are included as Table 3.3.5. Habitats in specific locations within the vicinity of the proposed Project, including wetlands and sea cliffs that receive high bird use, are described in Appendix B. The relative abundance of particular avian shoreline habitat types within distinct shoreline segments is shown in Tables 3.3.7 through 3.3.12. Seabird colonies and Important Bird Areas are shown on Figure 3.3.2.

Table 3.3.5. Descriptions of Norton Sound avian shoreline habitats within the Project area. Information excerpted from Woodby & Divoky (1982a).

Shoreline Habitat Type		Description
Cliffs	Protected	Nearly vertical cliffs at least 5 m high, abutting a lagoon or other sheltered body of water. Sometimes with a narrow sand or gravel beach at the base. Restricted to Port Clarence south of Teller and to Six

		Mile Point in Grantley Harbor.
	Exposed	Nearly vertical rocks at least 5 m high, abutting the water. Sometimes a narrow, rocky or sandy beach may be found between the cliff and the water.
Spits	Protected	Sand or gravel beaches on narrow spits, facing protected bodies of water. Often a convoluted shoreline with pockets of wetlands and muddy ponds. May be richly vegetated.
	Exposed	Sand or gravel beaches on narrow spits, usually forming protection for lagoons.
Moist tundra/uplands	Protected	Similar to below.
	Exposed	General habitat that includes all exposed shores backed by fairly well-drained habitat with a gentle or steeply sloping surface. Often with sedge tussock or tundra polygons. Gravel or sand beach at water line.
Wetlands	Protected	Similar to below. Vegetation is grass-sedge, salt tolerant where the tide flat is salt washed.
	Exposed	Shorelines backed by poorly drained terrain, dotted with ponds and lakes. Salt-tolerant plant communities may abut shoreline, or shoreline may be sand or gravel beach.
Cliffs- Protected		Nearly vertical cliffs at least 5 m high, abutting a lagoon or other protected body of water. Rocky substrate, sparsely vegetated.
River mouths		Water and nearby shore at a river or stream outflow. Sand or silt substrate, generally sparse vegetation.

Bird Use of Coastal Habitats

Habitats vary in their importance to birds across species and life stages. A description of bird use of coastal habitats, as reported in OCSEAP surveys (Woodby & Divoky 1982a, MMS 1990), is given in Table 3.3.6.

Lagoon areas protected by barrier islands, or those areas where rivers empty into lagoons and/or Norton Sound, are usually ice free earlier than other areas. These are important areas for waterfowl during spring (MMS 1990). Ice free areas are also important staging areas for shorebirds en route to their breeding habitats. Species using these areas include rock sandpipers, bar-tailed godwits, red knots, and American golden and black-bellied plovers. They may be found in these habitats for several days or weeks before they move to their breeding grounds (Gill & Handel 1981). Large rafts of red and red-necked phalaropes may form in nearshore waters (in the eastern Bering Sea region in general) in spring (Gill & Handel 1981).

Littoral areas provide important foraging and roosting habitat for many birds, particularly shorebirds and waterfowl. They may be used more pre- and post-breeding than during nesting (Gill & Handel 1981). However the coastal fringe is particularly important nesting habitat for species that include both species of tern, semipalmated plover, black turnstone, long-billed dowitcher, red and red-necked phalarope, semipalmated sandpiper, and dunlin (Gill & Handel

1981, Woodby & Divoky 1982a). Waterfowl gather in saltmarshes at the lower reaches of rivers during fall (MMS 1990).

Table 3.3.6. Bird use of shoreline habitats. Information excerpted/compiled from Woodby & Divoky (1982a) and MMS (1990).

Shoreline Habitat Type		Use
Cliffs	Protected	Used for nest sites by seabirds that feed in shallow water (e.g. Pelagic Cormorants, Pigeon Guillemots, Horned Puffins, Glaucous Gulls). Roosting, feeding, and nesting area for raptors and ravens.
	Exposed	Used by local concentrations of seabirds for nest sites. Roosting, feeding, and nesting area for raptors and ravens.
Spits	Protected	Nesting habitat for terns and shorebirds. Roosting and feeding area for gulls, shorebirds, and waterfowl.
	Exposed	Nesting habitat for terns and a roosting area for gulls, terns, and some waterfowl.
Moist tundra/uplands	Protected	Bird use not described.
	Exposed	Use is limited to large gulls and occasionally sandpipers or songbirds that feed in the drift zone. Occasional use by diving ducks and loons offshore. Rocky shorelines are important feeding areas for diving sea ducks.
Wetlands	Protected	Extensive use by feeding waterfowl; some use by shorebirds.
	Exposed	Variable bird use. Sometimes a feeding area for shorebirds and waterfowl, where mudflats are exposed at low tide.
River mouths		Bird use not described.

Of the coastal avian habitats described during the 1980s OCSEAP surveys, moist tundra was the most common habitat type but was sparsely used by bird species (Woodby & Divoky 1982a). Wet tundra habitat supported over twice the bird densities observed on moist tundra. Of the shoreline habitat types (i.e. the narrow swath of habitats adjacent to marine waters), river deltas and mouths received the most concentrated bird use, followed by protected wetland shorelines within lagoons. Exposed beaches fronting wetlands received moderate avian use, and spit habitats were sparsely used.

During the early 1980s OCSEAP surveys, protected shorelines were found to receive greater use by non-cliff nesting birds, and especially waterfowl, than exposed shorelines. Use +of exposed shorelines was mostly by gulls. Most birds (with the exception of cliff-nesting species) were found on low, coastal wetlands (Woodby & Divoky 1982a). Notably, survey efforts were concentrated *a priori* on wetland areas. The coastal wetlands of this region are located in pockets between coastal cliffs and other areas of raised relief. These discrete wetland areas of high bird use include three areas within the general vicinity of the proposed Project. These are located along the south shore of Port Clarence, within Safety Sound, and within Golovin Lagoon (Woodby & Divoky 1982a). Likewise seabird colonies are concentrated on short stretches of coastal cliffs, including at Port Clarence, Grantley Harbor (within Port Clarence), and the area between Cape Nome and Cape Darby including the Bluff Colonies (see Figure 3.3.2). Although Norton Sound itself is not considered to be a highly-productive marine environment in terms of avifauna (by Woodby & Divoky 1982a), adjacent open ocean (i.e. waters adjacent to Norton Sound proper) was seen to support high bird densities during early 1980s OCSEAP surveys. The average density of seabirds observed during these surveys typically exceeded 200 birds per km of cliff. Note the Woodby & Divoky (1982a) report was based on two seasons of field work.

Bird Use of Coastline Segments in the Project Area

Bird abundance varies considerably overall small distances along the coast of Norton Sound. The general geography of the southern Seward Peninsula changes on a broad scale moving west to east, and habitat characteristics change with the geography and smaller scale processes.

During the two years of OCSEAP surveys in the early 1980s (Woodby & Divoky 1982a), the highest densities of birds using shoreline habitats were found in Golovin Lagoon, and the lowest densities were found from Nome to Cape Nome. The average number of birds found at shoreline habitats was also highest at Golovin Lagoon and was nearly as high from Cape Nome to Rocky Point (including the Safety Lagoon area). In areas landward of the beach (i.e. in coastal habitats), the highest bird densities were found at the Fish River Delta in Golovin Lagoon. Progressively lower numbers were found at Safety Lagoon, the Flambeau and Eldorado Rivers, and Port Clarence. However, these numbers were heavily influenced by gulls. When gulls were eliminated from analyses, peak concentrations of waterfowl, shorebirds, and songbirds were seen at Port Clarence and Safety Lagoon (70 to 80 birds per km during foot-based wetland transects). Both of these areas may fall within the Project area. However, Nome (also in the Project area) had the lowest concentrations of waterfowl, shorebirds and songbirds collectively, compared to the other coastal areas surveyed.

Detailed descriptions are given below for avian habitat characteristics and bird use of specific coastline segments, moving from west to east (beginning at Port Clarence area and moving toward Cape Darby). Place names are depicted on Figure 3.3.2. Geographic bounds and descriptions are taken from Woodby & Divoky (1982a), unless otherwise noted.

<u>Brevig Mission to Cape Douglas, including Port Clarence and Grantley Harbor</u>

Habitat types and their relative proportion in the coastline segment stretching from Brevig Mission to Cape Douglas, including Port Clarence, are shown in Table 3.3.7. In this stretch, Port Clarence, an 18 km-wide embayment enclosed by the Point Spencer Spit, is the area of interest for the proposed Project.

Table 3.3.7. Avian habitats within Norton Sound: Brevig Mission to Cape Douglas, including Port Clarence.

Habitat Type		Percent
Spits	Protected	30
	Exposed	22
Moist tundra/uplands	Protected	19
	Exposed	8

Wetlands	Protected	13
	Exposed	3
Cliffs- Protected		3
River mouths		1

Grantley Harbor is a well-protected embayment within Port Clarence. Grantley Harbor receives freshwater input from Imuruk Basin via the Tuksuk Channel. Habitat types in Grantley Harbor and the Tuksuk Channel are shown in Table 3.3.8.

Table 3.3.8. Avian habitats within Norton Sound: Grantley Harbor and Tuksuk Channel.

Habitat Type	Percent
Spits- Protected	1
Moist tundra/uplands- Protected	95
Cliffs- Protected	2
River mouths	2

The Port Clarence area has a variety of habitats, and information from OCSEAP surveys shows that it supports a moderate population of migratory and nesting birds, including waterfowl, shorebirds, and seabirds (Woodby & Divoky 1982a, MMS 1990). The Point Spencer Spit is comprised of coarse sand and fine gravel with poorly vegetated beach ridges, which are used as roosting sites for gulls and waterfowl. Shorebirds and waterfowl concentrate on the southwestern shores of the Port Clarence embayment. This area is low in elevation, with salt-tolerant vegetation (Woodby & Divoky 1982a) and thaw ponds and salt pans (MMS 1990). The southeastern shores are protected by Jones Spit and are backed by higher, moist tundra. Resting ducks have been noted using open water in Grantley Harbor in early spring.

Based on information found in the Alaska Seabird Information Series (Denlinger 2006) and species range maps compiled by the Alaska Natural Heritage Program (AKNHP 2010), up to 14 species of seabirds may nest in the Point Spencer/Port Clarence area (Table 2 of Appendix B). The most common breeding species in this area appear to be glaucous gull, common murre, thick-billed murre, and parakeet auklet (Denlinger 2006). The small stretch of coastal bluff at Port Clarence may also provide nesting habitat for raptors and ravens (MMS 1990). At Teller Spit, sea cliffs meet the shoreline. They are 70 meters high and support a seabird colony comprised of cormorants, gulls, guillemots, and puffins. Low sea cliffs lining Grantley Harbor support a small population of nesting cormorants, guillemots, and horned puffins.

Nome to Cape Nome

The tundra between Nome and Cape Nome has been heavily modified by gold dredging and excavation, and bird use of this section of coastline is low. Shoreline habitat types and their relative proportion between Nome and Cape Nome are shown in Table 3.3.9.

Table 3.3.9. Avian habitats within Norton Sound: Nome to Cape Nome.

Habitat Type	Percent

Moist tundra/uplands- Exposed	90
Disturbed beach	7
River mouths	3

Cape Nome to Rocky Point, including Safety Lagoon and Bluff Colony

The area between Cape Nome and Rocky Point has a variety of habitats (Woodby & Divoky 1982a, MMS 1990) and includes internationally-recognized Important Bird Use Areas (Audubon 2013). Habitat types and their relative proportion in the Cape Nome to Rocky Point stretch of coastline are shown in Table 3.3.10.

Table 3.3.10. Avian habitats within Norton Sound: Cape Nome to Rocky Point, including Safety Lagoon and Bluff Colony.

Habitat Type		Percent
Spits	Protected	21
	Exposed	21
Moist tundra/uplands	Protected	17
	Exposed	26
Wetlands- Protected		6
Cliffs- Exposed		8
River mouths		<1

Within this stretch is Safety Sound, a 98,422 acre estuary fed by two prominent rivers, the Flambeau and Eldorado Rivers. Included in Safety Sound is a coastal lagoon, protected by nearly continuous barrier island sand spits. Extensive vegetated and unvegetated intertidal flats are exposed in the lagoon at low tides, and eelgrass beds are present in the summer (Woodby & Divoky 1982a, MMS 1990, Audubon 2013b).

Safety Sound is an important area for breeding arctic and Aleutian terns, shorebirds (including western and semipalmated sandpipers, dunlin, red-necked phalarope, long-billed dowitcher, and black turnstone), and breeding and staging waterfowl (including species of ducks and geese; tundra swans; and Pacific, arctic, and red-throated loons) (Audubon 2013b, ADF&G 2012, MMS 1990, Woodby & Divoky 1982a, Gill & Handel 1981). Birds of prey, including peregrine falcons and snowy owls, may also breed here (ADF&G 2012). The number of Aleutian terns nesting here exceeds 1% of the global population, such that this site is pending review as a globally or continentally Important Bird Area (Audubon 2013). It is also proposed as a Western Hemisphere Shorebird Reserve Network site (WHSRN) as identified in an Alaska Shorebird Working Group (ASWG) report (ASWG 2000).

Also included in this stretch of coastline are five closely-spaced seabird cliffs, collectively known as Bluff Colony and the Topkok cliff, part of the rocky shoreline that extends east from Taylor Lagoon to Rocky Point. Audubon (2013a) lists Bluff Colony as a state-level Important Bird Area. It is the breeding location of more than 1% of the continental population of common murres. Bluff Colony supports the largest seabird colony in Norton Sound at Bluff Cliff, and the second largest colony at Square Rock (MMS 1990). An Audubon report identifies Bluff Colony having as many as 125,000 nesting seabirds. In the 1980s, the two largest seabird colonies, Bluff and Square Rock, were estimated to have 40,000-60,000 and 4,000-8,000 birds, respectively (MMS 1990). These two sites are now part of what is known as Bluff Colony, and we might surmise that the overall population of this colony has been increasing.

The seabird colony at Bluff Colony has been studied more continuously than any other colony in Alaska (Audubon 2013a), with long-term monitoring focused on the two most common species: common murre and black-legged kittiwake (Springer et al. 1982, USFWS 1991). Common murre numbers were estimated to have declined sharply between 1975 and 1981 (69,900 to 28,910 birds), whereas black-legged kittiwakes increased in numbers between 1975 and 1981 (7,250 to 10,700 birds). Bluff Colony currently shows significant increases in both common murres and black-legged kittiwakes, the two dominant species in the colony (Audubon 2013a). Several other species of seabirds may nest at the Bluff Colony (see Table 3 of Appendix B), including pelagic cormorant, horned puffin, and several gull species (Audubon 2013a, Denlinger 2006, Dragoo 2006).

Raptor species and ravens have also been documented nesting at Bluff Colony, where they may prey on seabird eggs, chicks, and adults. Raptors documented in this area include golden eagles, peregrine falcons, gyrfalcons, rough-legged hawks, and harriers (MMS 1990).

Rocky Point to Cape Darby, including Golovin Bay and Golovin Lagoon

Included in the stretch of shoreline between Rocky Point and Cape Darby are Golovin Bay and Golovin Lagoon, which comprise an Important Bird Area. Habitat types and their relative proportion in the Rocky Point to Cape Darby stretch of coastline are shown in Tables 3.3.11 and 3.3.12.

Golovin Bay is flanked by rocky headlands on either side, which provide only limited protection for the waters here. Terrain behind the beaches is steepest near the capes. Shrubby, moist tundra is predominant and provides habitat for songbirds, ptarmigan, and other land birds. Coastal waters are feeding grounds for diving ducks and cormorants. There are narrow eelgrass beds near the head of the bay, and the mudflats exposed at low tide are well known as clamming grounds.

Table 3.3.11. Avian habitats within Norton Sound: Rocky Point to Cape Darby, including Golovin Bay and Golovin Lagoon.

Habitat Type		Percent
Spits	Protected	1
	Exposed	3
Moist tundra/uplands	Protected	2
	Exposed	72
Cliffs- Exposed		20
River mouths		1

Table 3.3.12. Avian habitats within Norton Sound: Golovin Lagoon.

Habitat Type	Percent
Spits- Protected	13
Moist tundra/uplands- Protected	52
Wetlands- Protected	9
River delta	26
River mouths	1

Golovin Lagoon is a 109,023-acre lagoon located at the head of Golovin Bay, where the Fish River discharges into intertidal flats (Audubon 2013b). Golovin Lagoon is enclosed by a sandy spit. Habitats include 38.5 sq. km of wetlands at the Fish River Delta, including that area known as Kachavik wetlands, and 2-3 km of unvegetated mudflats that are exposed at low tide. Eelgrass beds are found nearshore, and shrubby moist tundra backs the beaches. Nesting and migrant waterfowl and shorebirds are abundant in the delta wetlands where Fish River empties into Golovin Lagoon. Golovin Lagoon and nearby tundra are important feeding grounds and gathering sites for swans, geese, and cranes, especially in late summer (Woodby & Divoky 1982a, Audubon 2013b). The site is under review as a global- or continental- Important Bird Area (Audubon 2013b), and has been proposed as a WHSRN Regional Reserve for staging shorebirds (ASWG 2000). Key shorebird species using Golovin Lagoon are dunlin, semipalmated and western sandpipers, and red-necked phalarope; arctic and Aleutian terns and several species of gull also breed at this site (ADF&G 2012, MMS 1990).

Bird Species of Conservation Concern Using Habitats of the Southern Seward Peninsula

In addition to bird species with status under the ESA (see Section 3.4 Special Status Species), there are several species of seabirds, shorebirds and waterfowl of particular conservation concern in the general Project area. The species are considered sensitive or vulnerable for a variety of reasons or threats.

The list of birds has been compiled according to best available information regarding bird species presence, abundance, and habitat use. It should not be considered an exhaustive list of birds the Service may consider as vulnerable to potential impacts from the Project. As the Project actions are more fully described, and as new information becomes available regarding birds in the general area, additional species may be added to this list.

(Some of this paragraph may go, or be repeated, in Impacts section). Each bird listed as a species of conservation concern is considered particularly vulnerable to impacts associated with an oil spill because of their use of the nearshore and/or marine environment. However, most other birds not listed as a species of particular conservation concern would also be vulnerable to the effects of an oil spill in the nearshore or marine environment, particularly during critical times of their annual cycle. For example, shorebirds aggregate in shoreline or nearshore marine habitats during their post-breeding season, fattening up before long migrations to wintering areas. Waterfowl may likewise aggregate prior to southerly migration, and they commonly aggregate in open water marine habitats during spring.

Seabirds may have a year-round presence in the vicinity of the Project, depending on availability of open water. Their dependence on the marine environment for foraging makes them vulnerable to oil spills at all times during their annual cycle.

Furthermore, some birds may be especially vulnerable to disturbance associated with human activities during certain times of their annual cycle. For example, if flightless, molting waterfowl are using habitats in the vicinity of the Project area, special consideration would need to be undertaken during this energetically demanding, vulnerable time.

Kittlitz’s murrelet: The Kittlitz's murrelet (*Brachyramphus brevirostris*) is a small seabird in the Alcid family that also includes auklets and puffins. Relatively little is known about the life history and behavior of this species. They are solitary nesters that rely on secretive behavior and camouflage to avoid predation (Denlinger 2006). Like other seabirds, the Kittlitz’s murrelet is considered vulnerable to oil spills and spill response activities. It is also sensitive to vessel, small boat, and aircraft traffic during nesting (Denlinger 2006).

This species’ historic range includes the coastal waters off the Seward Peninsula (USFWS 2011). The species’ range appears to have contracted and likely does not currently include the Project area or the Seward Peninsula (ECOS 2014, USFWS 2011). However Kittlitz’s murrelet are known to have nested in the general vicinity of the Project area, both in the Port Clarence and Nome areas (USFWS 2011). Their use of habitats in the general vicinity of the Seward Peninsula and Norton Sound could have historically been year-round, depending on availability of open water (USFWS 2013, 2011).

The Kittlitz's murrelet has been classified as critically endangered by the International Union for the Conservation of Nature (IUCN) (BirdLife International 2013), and has twice been reviewed for listing under the ESA. In 2004 it was found warranted for listing but precluded by higher priority species (USFWS 2011), whereas the second review found the species not warranted for listing at this time (USFWS 2013). In part this decision reflects the status of the Kittlitz's murrelet population at Glacier Bay, Alaska, which is a significant portion of the global population. Steep population declines were previously reported for the Glacier Bay population, but recent analyses indicate this population may in fact be stable or only slightly declining (Kirchhoff et al. 2014, USFWS 2013).

Pelagic Cormorant: The pelagic cormorant (*Phalacrocorax pelagicus*) is a large seabird that nests in small, dispersed colonies, primarily on cliffs and rocky headlands. This species has been documented in colonies along the southern Seward Peninsula, although it is considered uncommon in the area (MMS 1980, 1990; ADF&G 2012; Audubon 2013a, Delinger 2006). In particular, pelagic cormorants have been noted at the sea cliffs at Teller Spit and at the low sea cliffs lining Grantley Harbor (Woodby & Divoky 1982a), as well as at the Bluff Colony (Audubon 2013a, Woodby & Divoky 1982a). Nests are reused from year to year. The species may have year-round presence at colonies and marine waters in the general Project vicinity, depending on the availability of open water (Denlinger 2006). Year-round, pelagic cormorants prefer nearshore waters, feeding primarily on fish and bottom-dwelling invertebrates (Denlinger 2006).

The pelagic cormorant is considered a seabird of high conservation concern in Alaska, and a species at high risk in North America (Denlinger 2006). However the IUCN lists this species as Least Concern (BirdLife International 2012a). Pelagic cormorants are sensitive to disturbance at their nesting sites, and flushing adults leaves eggs and chicks vulnerable to predators and weather (Denlinger 2006). Like other cormorants, pelagic cormorants are considered vulnerable to oil spills and other contaminants (Denlinger 2006).

Aleutian Tern: The Aleutian tern *(Onychoprion aleuticus*) breeds in loose colonies, typically located at heads of bays, reefs, permanent and ephemeral islands, estuaries in lagoons, and at river mouths (AKNHP 2012). The species feeds on small fish in both fresh and marine waters. The breeding range for the Aleutian tern includes the entire Seward Peninsula coastline, with more than one percent of the global population of species nesting in Safety Sound (Audubon 2013b). This species warrants special consideration in evaluation of potential impacts associated with the proposed Project because of the relatively large proportion of the world population nesting near the Project activities.

The Aleutian tern is considered a Bird of Conservation Concern by the USFWS (USFWS 2008). Although the IUCN currently lists this species as Least Concern (BirdLife International 2012b), recent evidence suggests the species may be experiencing significant declines throughout parts, if not all, of its range (BirdLife International 2014, Denlinger 2006). This species is very sensitive to disturbance at nest sites and vulnerable to oil spills (BirdLife International 2014, AKNHP 2012, Denlinger 2006). Reproductive success may be substantially negatively impacted by fox predation, and rat introductions and domestic dogs also pose a significant threat to reproductive success.

Dunlin: The dunlin (*Calidris alpina*) is one of the most abundant shorebirds in both the Northern Hemisphere and the southern Seward Peninsula. Three subspecies of dunlin are known to occur in North America, and two of these subspecies may be found in the general vicinity of the Project: *C. a. pacifica* and *C. a. articola*. The *pacifica* subspecies breeds in coastal Western Alaska, and eastern Norton Sound is considered an important breeding area (Fernández et al. 2010). The habitat on the Seward Peninsula that supports the highest densities of breeding dunlin is wet meadow mixed with drier dwarf shrub meadow (Kessel 1989 *in* Fernández et al. 2010). Substantial numbers of dunlin breed in habitats in Safety Sound (Audubon 2013b). Both subspecies can be found in the Project area during migration (with *articola* occurring in western Alaska primarily during the fall migration; Fernández et al. 2010). Habitats preferred during migration and post-breeding staging include littoral flats and brackish and freshwater wetlands (Fernández et al. 2010). Golovin Lagoon is known to support large numbers of dunlin during the post-breeding season (Audubon 2013b). None of the most critical staging areas for dunlin appear to be located in the Project vicinity (Fernández et al. 2010).

Although the IUCN Red List considers dunlin a species of Least Concern (BirdLife International 2012c), other entities have designated particular subspecies as in decline and of high conservation priority. The U.S. Shorebird Conservation plan lists dunlin as a Species of High Conservation Concern, with both ssp. *articola* and ssp. *pacifica* included in this designation (U.S. Shorebird Conservation Plan 2004 *in* Fernández et al. 2010). Although both subspecies are thought to be declining, *articola* is considered to be the more imperiled of the two (Brown et al. 2001). The *articola* subspecies has been officially designated as a Bird of Conservation Concern by the USFWS (USFWS 2008). Concerns over this species' status are partly due to its tendency to aggregate, a behavior that makes the species vulnerable to a variety of impacts, including oil spills in the shoreline environment.

Red-throated loon: The red-throated loon (*Gavia stellata*) nests in solitary pairs, primarily in coastal tundra habitat throughout Alaska (Barr et al. 2000). The species is most common in northern and western Alaska, and the Seward Peninsula may support some of the "highest" population densities (estimated at 0.34/km^2, Groves et al. 1996) for this widely dispersed nester. They arrive on the breeding grounds beginning in late May and remain through late August.

Red-throated loons prefer habitats in remote, relatively undisturbed areas. Like other loons, the red-throated is considered a timid species that is easily displaced from normal activities when disturbed. However, unlike other loon species, red-throated loons have some limited ability to take flight from land. As such, their nest sites may be located on smaller bodies of water than those of other loon species (Barr et al. 2000). Nest sites are typically located on marshy islands or dry shores of small, oligotrophic lakes and may be hidden in stands of water sedge (*Carex aquatilis*). Nests may also be found on small (<1 ha), shallow ponds that thaw earlier in the season. Use of small ponds is more common in the parts of their range that overlap with Pacific loons (Barr et al. 2000), including the Project area. Typically only one pair will nest on small ponds, but larger ponds and lakes may support multiple pairs (Barr et al. 2000).

The availability of a sufficient quantity and quality of prey (e.g. small fish) limits distribution of breeding red-throated loons. Breeding pairs regularly forage away from their nesting ponds (Barr et al. 2000, Andes 1993), and proximity to marine foraging habitat influences reproductive success (AKNHP 2011). Foraging habitat includes tidal estuaries and mudflats near rivers and streams (Barr et al. 2000). Feeding flights may be low (< 4 m) and fast (Davis 1971).

In spring, red-throated loons congregate on rivers, lakes, and open water leads, while they await open water on nesting ponds (Barr et al. 2000). Post-breeding, red-throated loons may gather in small, loose flocks adjacent to breeding areas (AKNHP 2011). They migrate in small, loose aggregations, over water or inland (Barr et al. 2000), often along rivers from lake to lake or along the coast from lagoon to lagoon (AKNHP 2011). They tend to fly low over water (Barr et al. 2000). Their winter distribution is outside of the proposed Project area.

The USFWS considers the red-throated loon a Bird of Conservation Concern (USFWS 2008), and the State of Alaska classifies it as a Species of Greatest Conservation Need. It is on the Audubon Alaska Red List but is an IUCN Species of Least Concern. Red-throated loon populations have declined rapidly in several parts of this species range, including Alaska; and no causal relationship has been identified (AKNHP 2013, Barr et al. 2000). The breeding population in Alaska has been estimated at approximately 10,000 individuals, which was a 53% observed decline over a roughly twenty-year period (Groves et al. 1996). An analysis by area indicates the most significant declines were on the Yukon Delta, Seward Peninsula, and Kotzebue Sound (McCaffery 1998 *in* Barr et al. 2000). Red-throated loons may be vulnerable to threats similar to those for the yellow-billed loon. These include habitat degradation, oil spills in the nearshore marine environment, and contaminants (AKNHP 2013).

3.4. Special Status Species

Yellow-Billed Loon

The yellow-billed loon (*Gavia adamsii*) is a candidate for listing under the ESA due to its small population size and range-wide concerns about levels of subsistence harvest and other potential impacts to the species (USFWS 2009). By October 2014 the USFWS must either propose the yellow-billed loon be listed or determine that it does not need the protection of the ESA and it will no longer be a candidate.

The yellow-billed loon is the largest of the five loon species, and is a fish-eating, diving bird. It nests near large, permanent lakes with abundant fish and complex shorelines. Yellow-billed loons are intrinsically vulnerable due to a combination of small population size, low reproductive rate, and very specific breeding habitat requirements. Factors that reduce productivity, including loss of productive breeding habitats, reduction in prey populations, and increases in nest predators, may impact the recovery potential of yellow-billed loons as a species.

Figure 3.4.1. An adult yellow-billed loon in breeding plumage. Photo by Gerrit Vyn/VIREO

Yellow-billed loons have a circumpolar distribution from latitude 62° to 74°N, nesting in high latitude coastal and inland low-lying tundra, near freshwater lakes (Figure 3.4.2). Their breeding range includes northwest Alaska, although the area associated with the Project is outside of the two primary Alaska breeding areas. These are the North Slope region, north of the Brooks Range, and the northern Seward Peninsula, surrounding Kotzebue Sound in northwest Alaska (Earnst 2004, North 1993; Figure 3.4.2). Nevertheless there is potential for yellow-billed loons to nest on the tundra adjacent to the proposed project area.

During fall and spring, yellow-billed loons may be found in open marine waters in the Bering Strait Region and/or adjacent to breeding grounds. Yellow-billed loons winter outside of the project area. Wintering areas may include Alaskan waters and coastlines (Figure 3.4.2).

The nesting season is June to September, when yellow-billed loons construct nests of mud or peat on the shore of large, permanent lakes. Satellite telemetry data indicate some yellow-billed loons depart breeding areas in late September, and arrive in wintering locations in mid-November. They begin spring migration in April, and arrive on breeding grounds in the first half of June. These dates are consistent with breeding ground arrival dates reported by North (1994). Non-breeders or failed nesters may start their fall migration in July.

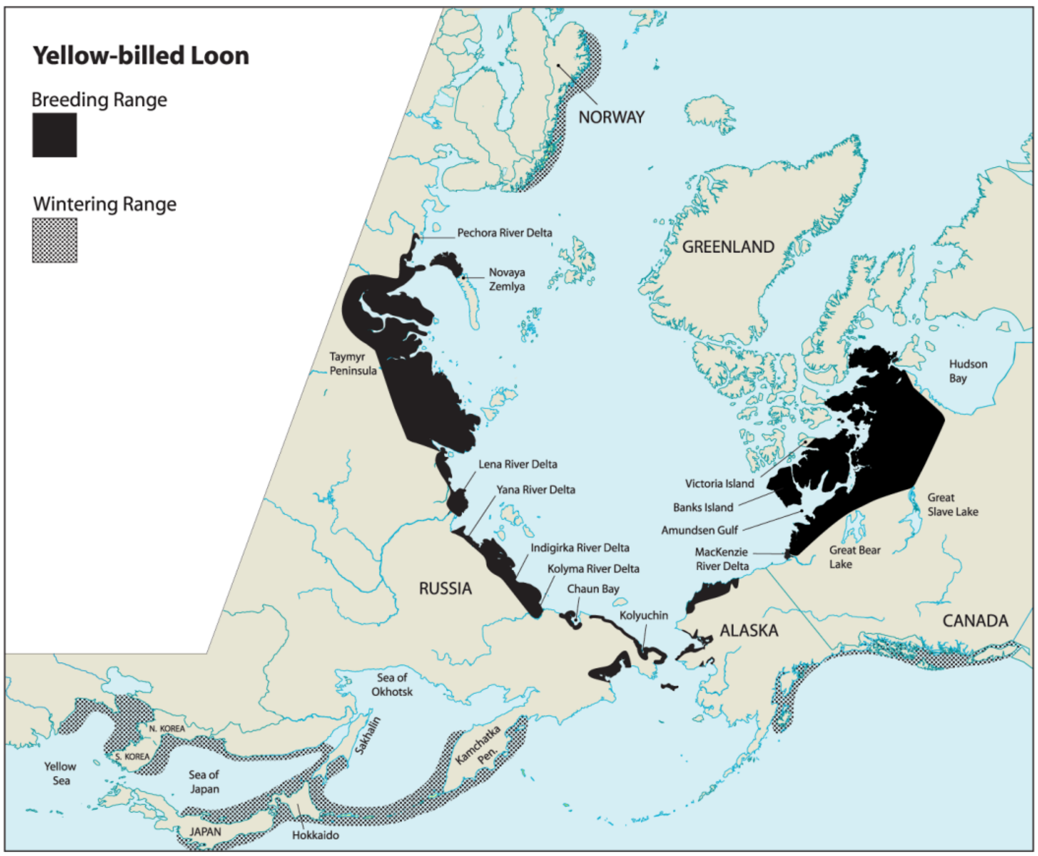


Figure 3.4.2. Breeding and wintering range of the yellow-billed loon.

Yellow-billed loons are especially adapted for aquatic foraging, with a streamlined shape and legs near the rear of their body. These aquatic adaptations make them unable to walk on land. They are also unable to take flight from land and must have access to large bodies of water during all seasons.

Spring Migration

Yellow-billed loons use primarily marine migration routes. Individuals marked with satellite transmitters occurred from 1 to 20 miles offshore throughout migration (Schmutz 2008). In spring, yellow-billed loons gather in polynyas, ice leads, and early-melting areas off river deltas near breeding grounds (Barry et al.1981; Barry & Barry 1982; Woodby & Divoky 1982; Johnson & Herter 1989; Barr 1997; Alexander et al. 1997; Mallory & Fontaine 2004).

Breeding Season

Yellow-billed loons are sparsely distributed during the breeding season. Nests sites are located in coastal or low-lying tundra, near large lakes. During the breeding season, loons require remote freshwater lakes that provide shorelines suitable for nest building, are large enough from which to take flight, are relatively free from disturbance, and have or are a short distance from a sufficient quantity and quality of prey (e.g. small fish).

Breeding lake habitat characteristics associated with loon presence include highly convoluted, vegetated, and low-lying shorelines, and water levels that do not change between years or within the breeding season (Earnst et al. 2006; Stehn et al. 2005; North 1994). These characteristics result in stable areas, close to the water, on which to build nests. Other lake characteristics associated with breeding yellow-billed loons include clear water, which presumably makes it easier to hunt prey fish (Earnst et al. 2006; Stehn et al. 2005; North 1994); often, water depths greater than 2 meters or 6.5 feet, which may create overwintering fish habitat; and large lake areas (at least 13.4 ha, or 33 ac) and connections to streams, which may increase fish availability (Earnst et al. 2006; Stehn et al. 2005; North 1994).

The nest location often provides a better view of the surrounding land and water than other available lakeshore locations (e.g. islands, hummocks, or peninsulas along low shorelines and within 1 m of water). Nest locations may be used in multiple years.

Breeding territories are defended against other yellow-billed loons and other loon species. They may include one or more lakes or parts of lakes (North 1994). Territory size likely depends upon lake size and quality, but has been seen to range from approximately 14 to greater than 100 ha on the Colville River Delta of the North Slope (North 1986, as cited in North 1994). It is thought that loons occupy the same breeding territory throughout their reproductive lives. In the western Alaska breeding area, yellow-billed loon reuse of individual lakes, including for nesting, was >0.70, suggesting, "either site fidelity or long-term attractiveness of specific lakes was high," (Schmidt et al. 2014).

Probability of yellow-billed loon presence on a lake increases with the absence of Pacific loons (Earnst et al. 2006; Stehn et al. 2005). In the western Alaska breeding area, 2/3 of lakes > 7 ha (17.3 ac) were occupied by Pacific loons, and 1/3 were occupied by yellow-billed loons, with very little overlap between the two species (Schmidt et al. 2014). Use of lakes > 7 ha, including for nesting, by both species was high (0.83), indicating that large lakes are heavily utilized by competing species.

Yellow-billed loon nest predators include glaucous gull, parasitic and pomarine jaegers, common raven, snowy owl, arctic fox (*Alopex lagopus*), red fox (*Vulpes fulva*), and grizzly bear (*Ursus arctos horribilis*) (North 1994; Earnst 2004). Many predators of yellow-billed loons (generally eggs and chicks) are attracted to human-built structures or to anthropogenic food sources. Nest predation rates may therefore be higher in areas close to human development.

Young leave the nest soon after hatching (hatch occurs after 27 to 28 days of incubation), and the family may move between natal and brood-rearing lakes. Young remain at or near the brood-rearing lake for at least 8-9, and possibly up to 11, weeks, at which time they are capable of flying. Successfully breeding adults feed their young almost entirely from the brood-rearing lake (North 1994). In summer, both non-breeding and breeding yellow-billed loons use nearshore and offshore marine waters adjacent to the breeding areas for foraging (Rizzolo & Schmutz 2010). However, satellite data suggests that at least some birds on the Seward Peninsula in northwest Alaska make multiple daily movements between brood lakes and the marine environment (J. Schmutz, USGS, pers. comm.).

Post-breeding/Fall Migration
Yellow-billed loons from both the North Slope and Seward Peninsula may use the Bering Strait region after leaving their breeding grounds. Their migration routes are primarily marine, within 1 to 20 miles of the shore (Schmutz 2008).

Winter
During the winter season (October through May), yellow-billed loons are found principally in coastal marine waters at mid to high latitudes (but outside of the proposed project area). Throughout the winter season, individual yellow-billed loons marked with satellite transmitters occurred from 1 to 20 miles offshore (Schmutz 2008).

Yellow-billed Loon Behavior/Sensitivity
Loons in general are susceptible to disturbance. Yellow-billed loons in particular are considered a timid species (i.e. one that is easily displaced from normal activities when disturbed) and prefer habitats in remote, relatively undisturbed areas. This is particularly true during breeding (North 1994), when yellow-billed loons may even be sensitive to foot traffic (Earnst 2004, North 1994). However, individuals may become acclimated to predictable disturbance (Vogel 1995, Barr 1997, Evers 2004, Earnst 2004, Mills & Andres 2004, North 1994), especially if no deleterious effects (i.e. depredation of eggs or young) occur.

Where human activities overlap with yellow-billed loons in the breeding season, foot, vehicle, aircraft, and vessel traffic and construction and maintenance of infrastructure may cause temporary displacement of adult yellow-billed loons from nests or permanent displacement of yellow-billed loons from preferred aquatic habitats. Disturbance could cause yellow-billed loons to abandon reproductive efforts or leave eggs or chicks unattended and exposed to predators or bad weather (Earnst 2004).

Their use of marine habitats puts yellow-billed loons at risk from spills of crude and refined oils that may result from oil and gas development or shipping traffic.

Spectacled Eider

Spectacled eiders (*Somateria fischeri*) were listed as a threatened species throughout their range in 1993 based on indications of steep declines in the two Alaska-breeding populations (USFWS 1993). Spectacled eiders are large sea ducks that spend their entire life cycle in the arctic environment. Males in breeding plumage have a white back, black breast, and pale green head with large white "spectacles" around the eyes (Figure 3.4.3). In late summer and autumn adult males molt into a mottled brown plumage that lasts until late fall when they re-acquire breeding plumage. Females are mottled brown all year, with pale tan spectacles. Juveniles attain breeding plumage in their second (female) or third (males) year. Until then females are mottled brown and males are mottled brown and white. Both males and females have sloped foreheads and bills, giving them a characteristic profile.

Figure 3.4.3. Male and female spectacled eiders in breeding plumage.

There are three primary spectacled eider populations, each corresponding to breeding grounds on Alaska's Arctic Coastal Plain (ACP), the Yukon–Kuskokwim Delta (Y-K Delta), and northern Russia (Figure 3.4.4). The Y-K Delta population declined 96% between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, AK (R. Suydam, pers. comm.in USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available. The most recent range wide estimate of abundance of spectacled eiders was 369,122 (364,190–374,054 90% CI), obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 2010 (Larned et al. 2012).

Spectacled eiders spend most of the year in marine waters, where they feed on benthic invertebrates, primarily clams (Petersen et al. 1998, Lovvorn et al. 2003). From November through March or April, they remain in open sea or in polynyas (areas of open water at predictable, recurrent locations in sea ice covered regions), or open leads (more ephemeral breaks in the sea ice, often along coastlines) in the sea ice of the northern Bering Sea at water depths of less than 80 meters (Petersen et al. 2000). Lovvorn et al. 2009 suggest that in winter foraging areas, the availability of ice as a resting platform is important for energy conservation.

Figure 3.4.4. Distribution of spectacled eiders. Molting areas (green) are used from July to October. Wintering areas (yellow) are used October –April. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown.

As open water becomes available in spring, breeding pairs move to nesting areas on wet coastal tundra (Petersen et al. 2000, Bart and Earnst 2005). They establish nests near shallow ponds or lakes, usually within 3 m of water. During the breeding season hens and broods feed in freshwater ponds and wetlands, eating aquatic insects, crustaceans, and vegetation (Petersen et al. 2000). Males return to the marine environment after incubation begins. Petersen et al. (1999) suggested that molt is synchronous among males based on arrival dates of marked birds. Females move to molting areas in July if unsuccessful at nesting, or in August/September if successful (Petersen et al. 1999).

When moving between nesting and molting areas, spectacled eiders travel along the coast up to 60 km offshore (Petersen et al. 1999). Molting flocks gather in relatively shallow coastal water, usually less than 36 m deep. Spectacled eiders molt in several discrete areas (Figure x) during late summer and fall, with birds from the different populations and genders apparently favoring different molting areas (Petersen et al. 1999, Sexson and Pearce 2013). All three spectacled eider populations overwinter in openings in pack ice of the central Bering Sea, south and southwest of St. Lawrence Island (Petersen et al. 1999, Sexson and Pearce 2013), where they remain until March–April (Lovvorn et al. 2003, Sexson and Pearce 2013).

As with many other sea ducks, spectacled eiders spend the 8- to 10-month non-breeding season at sea, but until recently much about the species' life in the marine environment was unknown. Satellite telemetry and aerial surveys led to the discovery of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995 and 1999), Larned et al. (1995). Results of recent satellite telemetry research conducted during 2008–2011 are consistent with earlier studies (Sexson and Pearce 2013).

Phenology of spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is 3–4 weeks earlier on the Y-K Delta than to the north on the ACP. However, phenology of fall migration is similar between areas. Individuals depart breeding areas during July to September, depending on their breeding status and molt in September to October (Sexson and Pearce 2013).

Males generally depart breeding areas on the ACP when the females begin incubation in late June (Anderson and Cooper 1994, Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable. Some appear to move directly to the Chukchi Sea over land, while the majority moved rapidly (average travel of 1.75 days), over near shore waters from breeding grounds to the Chukchi Sea [Troy Ecological Research Associates (TERA) 2002]. Of 14 males implanted with satellite transmitters, only four spent an extended period of time (11–30 days), in the Beaufort Sea (TERA 2002). Preferred areas for males appeared to be near large river Deltas such as the Colville River where open water is more prevalent in early summer when much of the Beaufort Sea is still frozen. Most adult males marked in northern and western Alaska in a recent satellite telemetry study migrated to northern Russia to molt (Sexson and Pearce 2013). Results from this study also suggest that male eiders are likely follow coast lines but also migrate straight across the northern Bering and Chukchi seas in route to northern Russia.

Spectacled eiders use specific molting areas from July to late October/early November. Larned et al. (1995) and Petersen et al. (1999) discussed spectacled eiders' apparently strong preference for specific molting locations, and concluded that all spectacled eiders molt in four discrete areas (Figure 3.4.4). Females generally used molting areas nearest their breeding grounds. All marked females from the Y-K Delta molted in nearby Norton Sound, while females from the North Slope molted in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. Males did not show strong molting site fidelity.

Research on satellite-tracked spectacled eiders during 2008-2011 (Sexson and Pearce 2013) had similar findings regarding use of Norton Sound. Adult spectacled eiders marked in the Y-K Delta in 2008 used Norton Sound to stage and molt in subsequent seasons. Females also generally arrived to stage in Norton Sound in late April before departing to breeding grounds in mid-May. In that study, no males staged at Norton Sound, and no females remained through the breeding season. A portion of the males used Norton Sound during molt migration, with females arriving to molt in Norton Sound in late July through late August and departing in October, with adult female spectacled eiders staying in Norton Sound from 41 to 88 days during their molt migration.

Large flocks of molting spectacled eiders are susceptible to disturbance and environmental perturbations during this portion of their annual life cycle because each bird is flightless for a few weeks as old flight feathers are shed and new feathers grow in. However, there is not a time when all birds are simultaneously flightless (Peterson et al. 1999).

Avian molt is energetically demanding, especially for species such as spectacled eiders that complete their molt in a few weeks. Molting birds must have ample food resources, and apparently the rich benthic communities of Ledyard Bay (Feder et al. 1989, 1994a, 1994b) and eastern Norton Sound meet the energetic requirements of molting spectacled eiders. Recognizing the importance of these marine areas for molting spectacled eiders, Ledyard Bay and eastern Norton Sound were designated Critical Habitat for spectacled eiders in 2001 (66 FR 9146).   The eastern Norton Sound spectacled eider critical habitat unit is in the vicinity of the Project and its location is shown in Figure 3.4.5.

Although all waterfowl undergo an annual brief flightless stage, the spectacled eider is at a somewhat unusual risk because the entire world population of the species molts in just four locations in Alaska or Russian waters, and winters entirely together in one location (Figure 3.4.4).

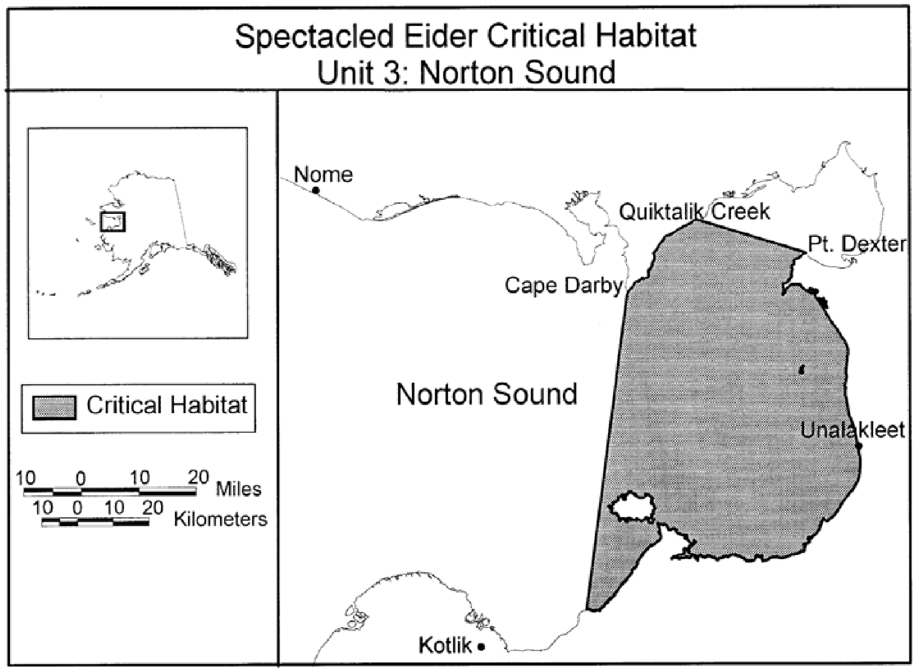


Figure 3.4.5. Norton Sound Critical Habitat for spectacled eiders.

Spectacled eiders generally depart all molting sites in late October/early November (Sexson and Pearce 2013), migrating offshore in the Chukchi and Bering Seas to a single wintering area in openings in pack ice of the central Bering Sea south/southwest of St. Lawrence Island. In this relatively shallow area, it has been estimated that more than 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 70 m to eat bivalves, other mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Lovvorn et al. 2003, Petersen and Douglas 2004).

Recent information about spectacled and other eiders indicates they probably make extensive use of the eastern Chukchi spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring aerial observations in the eastern Chukchi have documented dozens to several hundred common eiders (*Somateria mollissima)* and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (W. Larned, USFWS; J. Lovvorn, University of Wyoming, pers. comm.). Woodby and Divoky (1982) documented large numbers of king eiders (*Somateria spectabilis*) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is probably requisite for the spring eider passage in this region.

Adequate foraging opportunities and nutrition during spring migration are critical to spectacled eider productivity. Like most sea ducks, female spectacled eiders do not feed substantially on the breeding grounds, but produce and incubate their eggs while living primarily off body reserves (Korschgen 1977, Drent and Daan 1980, Parker and Holm 1990). Clutch size, a measure of reproductive potential, was positively correlated with body condition and reserves obtained prior to arrival at breeding areas (Coulson 1984, Raveling 1979, Parker and Holm 1990). Body reserves must be maintained from winter or acquired during the 4-8 weeks (Lovvorn et al. 2003) of spring staging, and Petersen and Flint (2002) suggest common eider productivity on the western Beaufort Sea coast is influenced by conditions encountered in May to early June during their spring migration from the Bering to the Chukchi Sea. Common eider female body mass increased 20% during the 4-6 weeks prior to egg laying (Gorman and Milne 1971, Milne 1976, Korschgen 1977, Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was 1,550 ± 35 g (n = 12), and slightly (but not significantly) more upon arrival at breeding sites (1,623 ± 46 g, n = 11; Lovvorn et al. 2003), indicating that spectacled eiders must maintain or enhance their physiological condition during spring staging.

Steller's Eider

The Steller's eider (*Polysticta stelleri*) is a sea duck that has both Atlantic and Pacific populations. The Pacific population consists of both a Russia-breeding population (which nests along the Russian eastern arctic coastal plain) and an Alaska-breeding population. The Alaska-breeding population of the Steller's eider was listed as threatened on July 11, 1997 based on substantial contraction of the species' breeding range in Alaska, overall reduced numbers breeding in Alaska, and vulnerability of the Alaska-breeding population to extirpation (USFWS 1997).

The Steller's eider is the smallest of the four eider species, weighing approximately 700–800 g (1.5–1.8 lbs). Males are in breeding plumage (Figure 3.4.6.) from early winter through mid-summer. During late summer and fall, males molt to dark brown with a white-bordered blue wing speculum. Following replacement of flight feathers in the fall, males re-acquire breeding plumage, which lasts through the next summer. Females are dark mottled brown with a white-bordered blue wing speculum year round. Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage.

Figure 3.4.6. Male and female Steller's eiders in breeding plumage.

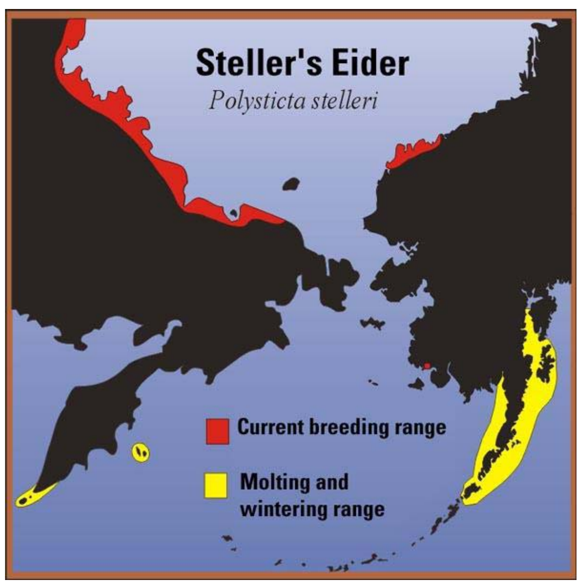


Figure 3.4.7. Distribution of Pacific- breeding Steller's eiders.

The majority of the world population of Steller's eiders migrates along the Bristol Bay coast of the Alaska Peninsula in the spring, where they linger en route to feed at the mouths of lagoons and other productive habitats. Spring migration usually includes movements along the coast, although some Steller's eiders may take shortcuts across water bodies such as Bristol Bay (W. Larned, USFWS, pers. comm. 2000). Interestingly, despite many daytime aerial surveys, Steller's eiders have never been observed during migratory flights (W. Larned, USFWS, pers.

comm. 2000). Like other eiders, Steller's eider probably use spring leads for feeding and resting as they move northward, but there is little information on habitat use after departing spring staging areas.

The best available estimate of North Slope breeding Steller's eiders (576 birds; Stehn and Platte 2009) is approximately 1% of the estimate of Pacific-wintering Steller's eiders from 2011 (74,369; Larned 2012). Thus, the listed Alaska-breeding population is thought to represent only a small proportion of the Pacific-wintering population of Steller's eiders.

Steller's eiders arrive in small flocks of breeding pairs on the ACP in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Long-term studies of Steller's eider breeding ecology near Barrow indicate periodic non-breeding by the entire local population. From 1991-2010, Steller's eiders nests were detected in 12 of 20 years (Safine 2011). Periodic non-breeding by Steller's eiders near Barrow seems to correspond to fluctuations in lemming populations and risk of nest predation (Quakenbush et al. 2004). During years of peak abundance, lemmings are a primary food source for predators including jaegers, owls, and foxes (Quakenbush et al. 2004).

It is hypothesized that Steller's eiders and other ground-nesting birds increase reproductive effort during lemming peaks because predators preferentially select (prey-switch) for hyper-abundant lemmings and nests are less likely to be depredated (Roselaar 1979, Dhondt 1987, Quakenbush et al. 2004). Furthermore, during high lemming abundance, Steller's eider nest survival (the probability of at least one duckling hatching) has been reported as a function of distance from nests of jaegers and snowy owls (Quakenbush et al. 2004). These avian predators aggressively defend their nests against other predators and this defense likely indirectly imparts protection to Steller's eiders nesting nearby. Steller's eider nest failure has been attributed to depredation by jaegers, common ravens, arctic fox, glaucous gulls, and in at least one instance, polar bears (Quakenbush et al. 1995, Rojek 2008, Safine 2011).

Hatching occurs from mid-July through early August, after which hens move their broods to adjacent ponds with emergent vegetation dominated by *Carex* spp. and *Arctophila fulva* (Quakenbush et al. 2000, Rojek 2006, 2007, and 2008). In these brood-rearing ponds, hens with ducklings feed on aquatic insect larvae and freshwater crustaceans.

Following departure from the breeding grounds, Steller's eiders migrate to southwest Alaska where they undergo complete flightless molt for about 3 weeks. Preferred molting areas are shallow with extensive eelgrass (*Zostera marina*) beds and intertidal mud and sand flats where Steller's eiders forage on bivalve mollusks and amphipods (Petersen 1980, 1981; Metzner 1993).

The Russia- and Alaska-breeding populations both molt in southwest Alaska, and banding studies found at least some individuals had a high degree of molting site fidelity in subsequent years (Flint et al. 1999, Flint et al. 2000). Primary molting areas include the north side of the Alaska Peninsula (Gill et al. 1981, Petersen 1981, Metzner 1993) as well as the Kuskoskwim Shoals in northern Kuskokwim Bay (Martin et al. *in prep*). After molt, many of the Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, the Alaskan Peninsula, and the western Gulf of Alaska including Kodiak Island (Larned 2000b, Martin et al. *in prep*).

Polar Bear

The polar bear (*Ursus maritimus*) is an ice-dependent marine mammal (Figure 3.4.8) that was listed as a threatened species throughout its range due to threats to its sea ice habitat (73 FR 28212). Polar bears are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. The number of polar bears worldwide is estimated to be 20,000-25,000 with 19 recognized management subpopulations or stocks (Obbard et al. 2010). In the United States, the polar bear is also protected under the Marine Mammal Protection Act (MMPA) and the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora.

Figure 3.4.8. A female and juvenile polar bear. Photo by Steve Hildebrand, USFWS.

Two stocks of polar bears inhabit Alaska, the Southern Beaufort Sea (SBS) and the Chukchi/Bering Sea (CBS) stocks, shown in Figure 3.4.9.

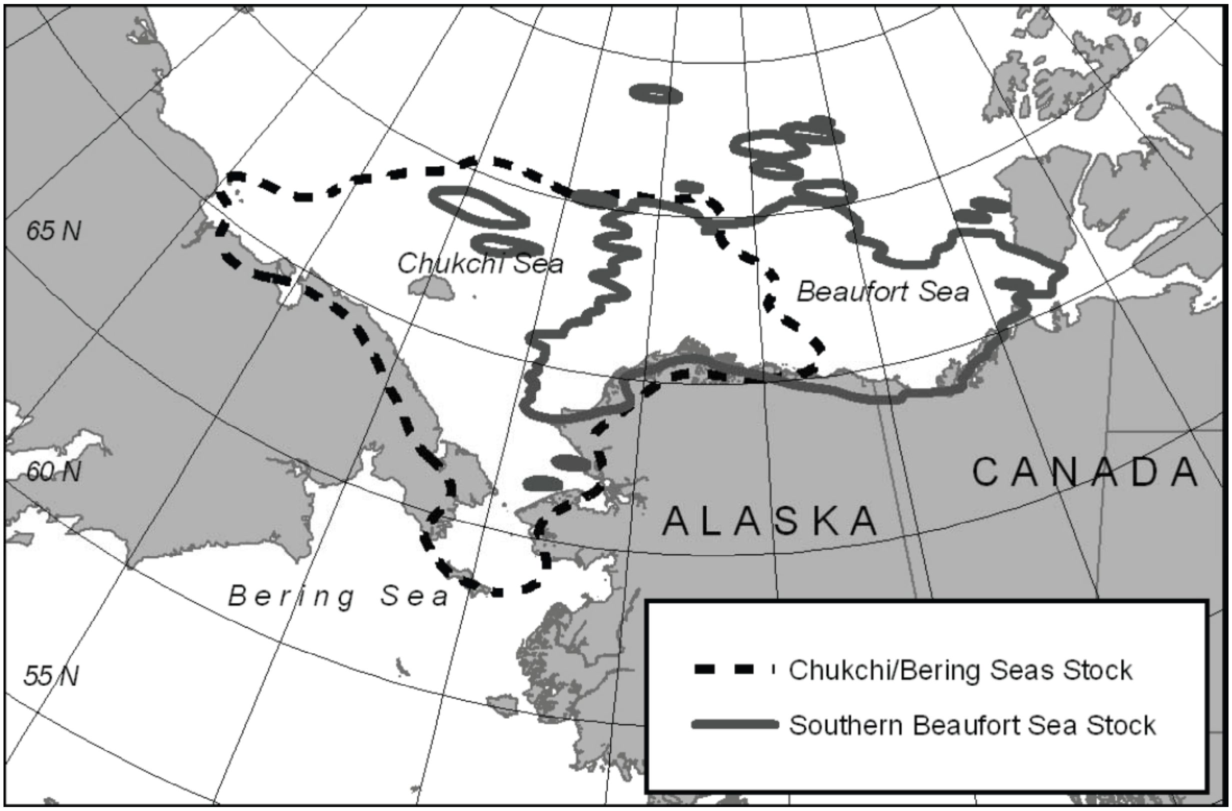


Figure 3.4.9. Map of the SBS and CBS polar bear stocks.

The CBS stock is widely distributed on the pack ice of the northern Bering, Chukchi, and eastern Siberian seas (Garner et al. 1990, Garner et al. 1994). The constant movement of pack ice influences the movement of polar bears, and this makes obtaining a reliable population size estimate challenging. For example, polar bears of this stock move south with advancing ice during fall and winter and north in advance of receding ice in late spring and early summer (Garner et al. 1990). Experts estimate the stock numbers approximately 2,000 polar bears (Aars et al. 2006). Currently, the Polar Bear Specialist Group classifies the CBS stock as declining based on reported high levels of illegal killing in Russia, continued legal harvest in the United States, and observed and projected losses in sea ice habitat (Obbard et al. 2010). Under the MMPA, the stock is considered depleted because it is listed as threatened under the ESA.
Most populations of polar bears use terrestrial habitat partially or exclusively for maternity denning; therefore, females must adjust their movements to access land at the appropriate time (Stirling 1988, Derocher et al. 2004). Most pregnant female polar bears excavate dens in the fall-early winter period (Harington 1968, Lentfer and Hensel 1980, Ramsay and Stirling 1990). The only known exceptions are in Western and Southern Hudson Bay where polar bears excavate earthen dens and later reposition into adjacent snow drifts (Jonkel et al. 1972, Richardson et al. 2005), and in the southern Beaufort Sea where a portion of the population dens in snow caves on sea ice (Schliebe et al. 2006). Polar bears give birth in the dens during midwinter (Kostyan 1954, Harington 1968, Ramsay and Dunbrack 1986). Females and cubs emerge from dens in March and April when cubs are approximately three months old (Schliebe et al. 2006).

Polar bears are characterized by a late age of sexual maturity, small litter sizes, and extended parental investment in raising young, factors that combine to contribute to a very low reproductive rate (Schliebe et al. 2006). Likewise, litter size and production rate vary geographically with hunting pressure, environmental factors and other population perturbations. Two-cub litters are most common (Schliebe et al. 2006). Body weights of mothers and their cubs decreased markedly in the mid-1970s in the Beaufort Sea following a decline in ringed and bearded seal pup production (Stirling et al. 1976, 1977, Kingsley 1979, DeMaster et al. 1980, Amstrup et al. 1986). Declines in reproductive parameters varied by region and year with the severity of ice conditions and corresponding reduction in numbers and productivity of seals (Amstrup et al. 1986).

Sea ice provides a platform for hunting and feeding, seeking mates and breeding, denning, resting, and long-distance movements. Ringed seals are polar bear's primary food source, and areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds (Durner et al. 2004). While polar bears primarily hunt seals, they may occasionally consume other marine mammals (73 FR 28212); for example, bowhead whale carcasses have been available as a food source on the North Slope since the early 1970s (Koski et al. 2005) and may affect local polar bear distributions.

Loss of sea ice habitat due to climate change is identified as the primary threat to polar bears (Schliebe et al. 2006, 73 FR 28212, Obbard et al. 2010). Warming-induced habitat degradation and loss are negatively affecting some polar bear stocks, and unabated global warming will ultimately reduce the worldwide polar bear population (Obbard et al. 2010). Positive feedback systems (i.e., sea-ice albedo) and naturally-occurring events such as warm water intrusion into the arctic and changing atmospheric wind patterns can cause fragmentation of sea ice, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al. 1999, Rothrock et al. 1999, Comiso 2003, Fowler et al. 2004, Lindsay and Zhang 2005, Holland et al. 2006, Comiso 2006, Serreze et al. 2007, Stroeve et al. 2008). These climatic phenomena may affect seal abundances, the polar bear's main food source (Kingsley 1979, DeMaster et al. 1980, Amstrup et al. 1986, Stirling 2002). Patterns of increased temperatures, earlier spring thaw, later fall freeze-up, increased rain-on-snow events (which can cause dens to collapse), and potential reductions in snowfall are also occurring. However, threats to polar bears will likely occur at different rates and times across their range, and uncertainty regarding their prediction makes management difficult (Obbard et al. 2010).

Declines in sea ice have occurred in optimal polar bear habitat in the southern Beaufort and Chukchi seas between 1985 to 1995 and 1996 to 2006, and the greatest declines in 21st century optimal polar bear habitat are predicted to occur in these areas (Durner et al. 2009). These stocks are vulnerable to large-scale dramatic seasonal fluctuations in ice movements which result in decreased abundance and access to prey, and increased energetic costs of hunting. Both the SBS and CBS stock are currently experiencing the initial effects of changes in sea ice conditions (Rode et al. 2010, Regehr et al. 2009, and Hunter et al. 2007). Regehr et al. (2010) found that the vital rates of polar bear survival, breeding rates, and cub survival declined with an increasing number of ice-free days/year over the Continental Shelf, and suggested that declining sea ice affects these vital rates via increased nutritional stress.

Pacific Walrus

The USFWS recently completed a status review of the Pacific walrus (*Odobenus rosmarus divergens*) under the ESA (Garlich-Miller et al. 2011) and concluded listing the Pacific walrus is warranted because the loss of sea ice will lead to a population decline that is a threat to the species in the foreseeable future (76 FR 7634, February 10, 2011). However, listing the Pacific walrus is currently precluded by the need to address higher priority species nationwide and the USFWS is scheduled to reconsider the walrus for listing by October 2017.

The Pacific walrus is the largest pinniped species in the Arctic and is easily distinguished by their enlarged upper canine teeth that form prominent tusks (Figure 3.4.10). The Pacific walrus is represented by a single population of animals that inhabits the shallow continental shelf waters of the Bering and Chukchi Seas. The population ranges across the international boundaries of the United States and Russia and both nations share common interest in the conservation and management of the species (Garlich-Miller 2011).

Figure 3.4.10. Pacific walrus with young.

The distribution of Pacific walrus is closely linked to the seasonal advance and retreat of sea ice (Fay 1982) and is shown in Figure 3.4.11. During the late winter breeding season, walruses aggregate in the Bering Sea pack ice in areas where ocean currents and upwellings create areas of open water. In spring, as the sea ice deteriorates in the Bering Sea, most of the population migrates north through the Bering Strait to summer feeding areas in the Chukchi sea. In autumn, walruses return to winter feeding areas in advance of the sea ice which forms rapidly in the Chukchi Sea. During summer months the majority of subadults, females and calves move into the Chukchi Sea where they tend to concentrate in areas of unconsolidated pack ice within 100 km of the leading edge of the pack ice.

Walrus habitat requirements include large areas of shallow water that supports a productive bivalve community, the reliable presence of open water over these feeding areas, and suitable ice or land nearby on which to rest (Garlich-Miller et al. 2011).

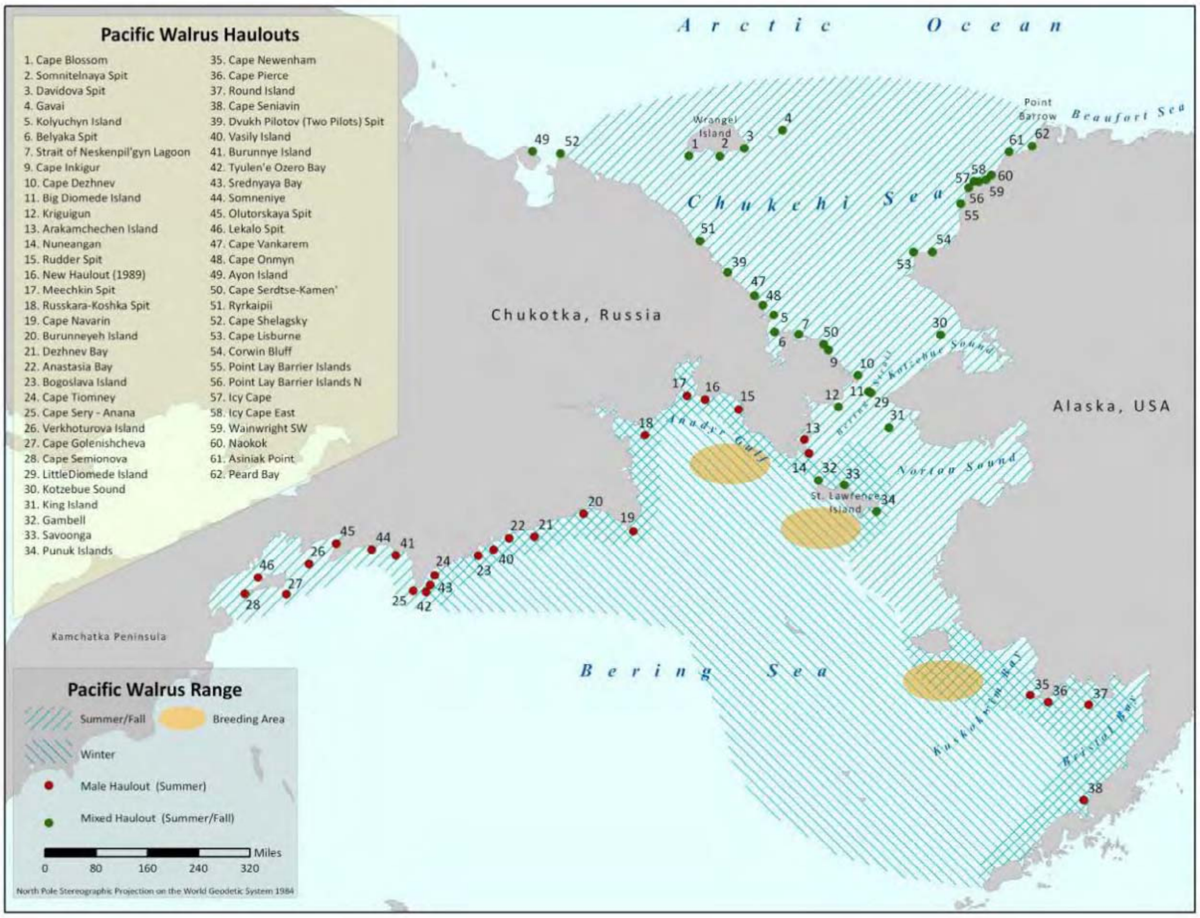


Figure 3.4.11. Seasonal distribution of the Pacific walrus in the Bering and Chukchi Seas, and known haulout areas. Modified from Smith 2010.

The shallow, ice-covered waters of the Bering and Chukchi Seas support some of the highest densities of benthic invertebrates in the world (Grebmeier et al. 2006). Sea-ice algae provide a highly concentrated and high food quality food source for planktonic food webs in the spring (Grebmeier et al. 2006, McMahon et al 2006, and Gradinger 2009). Because zooplankton populations are relatively low in areas where ice is present, much of this primary production falls to the sea floor where it is converted to benthic biomass (Grebmeier 2006).

Walrus rely on sea ice as substrate for resting and giving birth (Angliss and Outlaw 2005). They generally require sea ice of at least 50 cm thick to support their weight (Fay 1982). When suitable pack ice is not available, walrus will haul out on land, preferring sites sheltered from wind and surf.

Walrus are generally found along the edge of pack ice where ice cover is less than 80 percent. They feed primarily on clams and other invertebrates found on the seafloor. Although capable of diving to greater depths, walruses usually feed in waters less than 80 m deep over the continental shelf where their prey is more abundant and easier to obtain (Fay 1982, Fay and Burns 1988, Jay et al. 2001). Between feeding dives walrus rest on sea ice or land. Sea ice provides walruses with a resting platform, access to offshore feeding areas, and seclusion from humans and predators.

The shallow Chukchi Sea and eastern Siberian Sea serve as the main feeding grounds for most of the Pacific walrus population in the summer and autumn (Kochnev 2004). The constant motion of the sea ice transports resting walruses over widely dispersed prey patches (Fay 1974). Walrus are specialized predators of clams and other benthic invertebrates that are abundant in arctic ice covered waters (Fay 1985, Born et al. 2003, Sheffield and Grebmeier 2009). Walruses can have a large effect on their prey feeding areas and play an important role in the Arctic ecosystem by influencing the structure of benthic communities (Oliver et al. 1983 and Klaus et al. 1990). They eat large quantities of invertebrates daily, and as they root along the sea floor in search of food, they plow through large quantities of sediment (Nelson and Johnson 1987, Nelson et al. 1994). Those activities remove large quantities of prey from the seafloor, affect the size of clam populations, mix bottom sediments, create new microhabitats from discarded shells, and generate food for seafloor scavengers from uneaten scraps of prey (Oliver et al. 1983). Ray et al. (2006) estimated walruses consume approximately 3million metric tons (3,307 tons) of benthic biomass annually and that the area affected by walrus foraging is in the order of thousands of square kilometers annually. Consequently, walruses play a major role in benthic ecosystem structure and function, which Ray et al. (2006) suggested increased nutrient flux and productivity.

The juxtaposition of broken ice over relatively shallow continental shelf waters is important for walrus to rest between feeding bouts, particularly females with dependent young that are not yet capable of deep diving or tolerant of long exposure to frigid water. Although walrus calves are capable of swimming shortly after birth, they must haul-out frequently until their swimming ability and blubber layer is well developed. Cows brood young calves to aid in their thermoregulation, and carry them on their backs or under their flipper while in the water. Females with newborns often join together and form nursery herds.

Walruses are very social and gregarious animals. They tend to travel in groups and haul-out on ice or land in groups. Walruses spend about one-third of their time hauled-out on ice or land. When hauled out, walrus tend to lie in close physical contact with each other and youngsters often lie on top of adults. Group size can range from a few individuals to several thousand animals (Gilbert 1999, Jefferson et al. 2008). Disturbance of hauled-out walrus can cause them to rush into the water where they feel safer. This response is commonly called a walrus stampede and can result in injuries and mortalities of many walruses; the risk of stampede-related injuries increases with the number of animals hauled out (Ovsyanikov 1994). Calves and young animals at the perimeter of these herds are particularly vulnerable and trampling-related injuries and mortalities have been reported at coastal walrus haulouts used by adult females and young (Fay and Kelly 1980, Ovsyanikov 1994, Kavry et al. 2008).

Walrus mating occurs primarily in January and February in broken pack ice habitat in the Bering Sea. Breeding bulls follow herds of females and compete for access to groups of females hauled out onto sea ice. Males perform visual and acoustical displays in the water. Individual females leave the resting herd to join a male in the water where copulation occurs (Fay et al. 1984, Sjare and Stirling 1996).

When suitable sea ice is not available, walruses haul out to rest on land, and established haulout locations for the Pacific walrus are shown in Figure x. Factors thought to influence terrestrial haulout site selection include: proximity to food resources, isolation from disturbances and predators, social factors and learned behavior, and protection from strong winds and surf (Richard 1990). Walruses tend to use established haulout sites repeatedly and exhibit some degree of fidelity to those sites (Jay and Hills 2005).

Coastal haulouts in the Bering Sea tend to be used primarily by adult males during the summer months. The most consistently used haulout sites are in Bristol Bay, Alaska and in the Gulf of Anadyr, Russia. Intermittently used summer haulouts have also been reported at Big Diomede Island in the Bering Strait regions, on St Mathew and Hall islands in the central Bering Sea and along the Koryak coast of Russia (Figure x).

The size of the Pacific walrus population has never been known with certainty. There is concern the Pacific walrus has undergone a population decline from the estimated pre-exploitation population of approximately 200,000 Pacific walrus in the 1970s and 1980s (Fay 1982). A 2006 survey of Pacific walrus estimated a minimum population size of 129,000 (55,000-507,000) (Speckman et al. 2011). Some researchers believe the population may be in decline based upon age structure and productivity information (Garlich-Miller et al. 2006).

Pacific walrus is an important subsistence resource in many coastal communities along the Bering and Chukchi Sea coasts of Alaska and Chukotka, Russia. Over the past fifty years the Pacific walrus population has sustained annual harvests ranging from 3,200 to 16,000 animals per year (Fay et al. 1994). Presently, walrus hunting in Alaska and Chukotka is restricted to meet the subsistence needs of aboriginal peoples. Harvests from 2006 t0 2010 averaged 4,854 walruses per year (USFWS unpublished data) for the U.S. and Russian harvests combined, including corrections for under-reported harvest and struck and lost animals (Federal Register Vol. 78, No. 113, June 12, 2013).

Because the Pacific walrus is an ice-dependent species, there are concerns that climate change related sea ice loss will have numerous adverse effects on the Pacific walrus (Garlich-Miller et al. 2011). Changes in the extent, volume and timing of the sea-ice melt and onset of freezing in the Bering and Chukchi Seas are projected to cause significant changes in the distribution and habitat-use patterns of walruses. With the loss of summer sea ice, a change already being observed is a greater dependence on terrestrial haulouts by both sexes and all age groups.

The sharp decline in the extent of sea ice in recent years has resulted in less ice over the continental shelf of the Chukchi Sea during summer months (Meier et al. 2007, Stroeve et al. 2008). When sea ice recedes away from the shallow continental shelf, walrus must either stay with the sea ice as it retreats over deep water with little access to food, or abandon the sea ice and move to coastal areas where they can rest on land. It is anticipated that Pacific walrus will increasingly be forced to rely to a greater extent on terrestrial haulouts in late summer, exposing all individuals, but especially calves, juveniles, and females to increased levels of stress from depletion of prey, increased energetic costs to obtain prey, trampling injuries and mortalities, predation, and hunting.

Summer and autumn haulout behavior of the Pacific walrus appears to be changing in response to the increasing retreat of summer sea ice. Historically, haulouts of tens of thousands of walrus have occasionally occurred on coasts in Chukotka (Kochnev 2006). Large onshore aggregations of walrus were unknown on the Alaskan side of the Chukchi Sea until 2007 (Fischbach et al. 2009), but have become a nearly regular occurrence since then. Walrus have begun hauling out in large numbers (hundreds to thousands) along the Chukchi Sea coast in late August through October, in recent years when no offshore sea ice persisted in that vicinity.

In September 2010 approximately 10,000-20,000 walrus congregated on a Kasegaluk Lagoon barrier island northwest of Point Lay (USGS 2011). Researchers documented 131 fresh carcasses of juvenile walrus in the vicinity of Icy Cape in September 2009 (Fischbach et al. 2009). The events that lead to the deaths of the animals are unknown. Records indicate the eastern Chukchi Sea continental shelf was free of sea ice for more than 25 days prior to the discovery of the carcasses, and strong winds were recorded for the region in the weeks immediately prior to the discovery of the carcasses (Fischbach et al. 2009). In the absence of sea ice, strong winds result in heavy seas. Walruses cannot remain at sea indefinitely without rest. Telemetry data from walruses in ice-bearing waters of the northern Bering Sea revealed that walruses generally hauled out and rested every day or so, and that 98% of their in-water bouts lasted no longer than 7.5 days, with none exceeding 13 days (Udevitz et al. 2009).

Late summer haulouts of Pacific walrus on the Chukchi coast have continued to occur. In late summer 2011, scientists estimated that approximately 30,000 walruses hauled out along one kilometer of beach near Point Lay, and in late September 2013, approximately 10,000 walruses were hauled out on a small barrier island near Point Lay (NOAA Fisheries 2013).

In response to the recent summertime aggregations of walrus on the Alaskan Chukchi coastline, several conservation partners including The North Slope Borough, the Eskimo Walrus Commission, the Federal Aviation Authority, and the USFWS have developed guidelines for pilots, marine vessels, and land-based viewing to discourage activities that could disturb walrus and cause them to stampede into the water (USFWS September 14, 2010 News Release). The guidelines are communicated to individuals in the communities closest to the haul-outs and others that use the area.

The long-term ability of the prey base to support large numbers of walruses foraging from coastal haul-outs is unknown. The walruses' marine prey base itself is thought to be under-going alterations due to climate change. Grebmeier et al. (2006) and Grebmeier (2012) describes how the benthic productivity of the northern Bering Sea shelf is changing, undergoing a transition from an Arctic to a subarctic ecosystem with a reduction in benthic prey populations that comprise the walrus prey base. Climate-change driven ocean acidification is also predicted to have adverse effects on the calcifying invertebrates (Ray et al. 2006, Sheffield and Grebmeier 2009) that form the basis of the walrus food chain.

Walrus may be sensitive to under water noise related to harbor construction activities. Walrus use airborne and underwater vocalizations for communication (Fay 1982). They likely use underwater sounds to aid in navigation, social communication, and possibly predator avoidance (Garlich-Miller et al. 2011). The communication range for walrus is likely 1-12 kHz [underwater hearing tests at frequencies from 0.125 kHz–32 kHz on one walrus subject found its best hearing ranged from 1–12 kHz with maximum sensitivity occurring at 12 kHz at 67 dB re: 1 μPa, range 63-96 dB re: 1 μPa;(Kastelein et al. 2002)]. Base frequencies for most underwater walrus sounds occur at 400-1200 Hz [or 0.4-1.2 kHz; (Richardson et al. 1995)]. Southall et al. (2007) suggest that auditory injury to pinnipeds in the water may occur at a sound level of 218 db re: 1 μPa. However, exposure to these levels could only occur if a walrus was near (e.g., 1-3 meters) the sound source, and permanent threshold shifts to hearing would only occur if it remained near the source for an extended time.

Kastak et al. (1999) suggested that octave band noise levels below about 60 dB SL (sensation level at center frequency) are unlikely to result in a measurable temporary threshold shift, but found that moderate exposures of 65–75 dB SL reliably produced small amounts of temporary shift in three pinniped species (4.8 dB in a harbor seal, 4.9 dB in a California sea lion, and 4.6 dB in a northern elephant seal). Recovery to baseline threshold levels was observed in test sessions conducted within 24 hours of noise exposure (Kastak et al. 1999). The Pacific walrus, also a pinniped, may experience similar shifts in hearing.

In July 2011 an unusual numbers of sick or dead seals with skin lesions (an ulcerative dermatitis) and hair loss were discovered in the Arctic and Bering Strait of Alaska. Reports of skin lesions in Pacific walruses were also observed in Alaska, with some associated mortality. The disease in walrus tended to be skin lesions generally distributed over the body, and it primarily affected subadult and calf walruses. By December 2011, there were more than 100 cases of affected pinnepeds across a wide geographic area. The National Oceanic and Atmospheric Administration (NOAA) and the USFWS declared an Unusual Mortality Event (UME) in December 2011. This was the first UME involving subsistence species essential to coastal Alaskan communities. Disease surveillance efforts were conducted in 2012 and 2013 with tests for viral, bacterial pathogens, and biotoxins performed. Despite extensive laboratory analysis, no specific infectious disease agent or process has been identified. This suggests that the underlying cause of the disease observed is most likely complex and involves a variety of factors. No new cases have been observed since 2011 and it is thought that pinnepeds reported recently with abnormal hair growth and healing skin ulcers are likely survivors of the initial disease. Future work will continue to investigate a wider range of possible factors in this disease, including immune system-related diseases, fungi, man-made and bio-toxins, radiation exposure, contaminants and other stressors related to sea ice change (NOAA 2014, Stimmelmayr 2014).

3.5. Subsistence Resources

Subsistence harvesting of wild resources for food is an important aspect of Alaska's social and cultural heritage. Archaeological evidence from the Norton Sound – Port Clarence region shows evidence of harvesting subsistence resources dating back to at least about 1500 to 1000 B.C. (Harritt 2010, Smith and Vreeman 1995; in Fall et al. 2013). Many Seward Peninsula residents participate in a mixed subsistence-cash economy where subsistence activities are an important way of life (Fall et al. 2013).

Residents of these small communities rely on wild foods for three fourths of the meat and fish in their diet (possibly more); with wild salmon one of the largest contributors to the local diet (Magdanz et al. 2005). Of 46 subsistence households in Nome surveyed by Magdanz and Olanna (1986), salmon was used by every household (Table 3.5.1). Ahmasuk et al. (2008) found salmon provided over one-third of the subsistence resources harvested by Teller and Brevig Mission residents (Table 3.5.2). The seasonal pattern for harvesting these wild resources is largely influenced by the seasonal availability and accessibility of the resource, and for some resources harvest regulations (Figure 3.5.1). Accessibility is affected by both environmental and technological factors (Ellanna 1983). For example, harvesting a winter-time resource on shore ice usually occurs within the first mile from shore. Harvesting further offshore can be very risky due to the dynamic nature of shore ice. Harvesting this same resource offshore during the summer requires at least a large skiff and possibly additional gear, which requires technology unavailable or too costly for some subsistence users (e.g., skiff, fuel, specialized gear).

Many subsistence users have noticed the weather has become much less predictable than in the past (Raymond-Yakoubian 2013). A change in the timing and in some cases the character of freeze-up and break-up is a major factor influencing both availability and accessibility of subsistence resources. For example, in the Teller and Brevig Mission area spotted and ringed seals are spending more time in Grantley Harbor and Port Clarence because they can maintain their breathing holes in the thinner ice later into the year. These seals are believed to be eating large amounts of fish and forcing the fish into areas not normally fished (Raymond-Yakoubian 2013). In addition, faster breakups of the ice in the spring and later freeze-ups in the fall have made it difficult for people to fish through the ice in cracks that typically form in the spring, and to safely fish from the ice in the fall before the fall fish runs are over (Raymond-Yakoubian 2013).

The Federal Subsistence Management Program is a multi-agency effort to provide the opportunity for a subsistence way of life by rural Alaskans on federal public lands and waters while maintaining healthy populations of fish and wildlife (http://www.doi.gov/subsistence/about/index.cfm). The Program provides for public participation through the Federal Subsistence Board and ten Regional Advisory Councils. The Board is the decision-making body that oversees the program, and is made up of the regional directors of the USFWS, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, U.S. Forest Service, and two appointed public members. The USFWS is responsible for, or shares responsibility for, research and implementing the Board's management policy for subsistence use of fish, migratory birds, sea otters, polar bears and walruses. The NMFS is responsible for managing subsistence use of

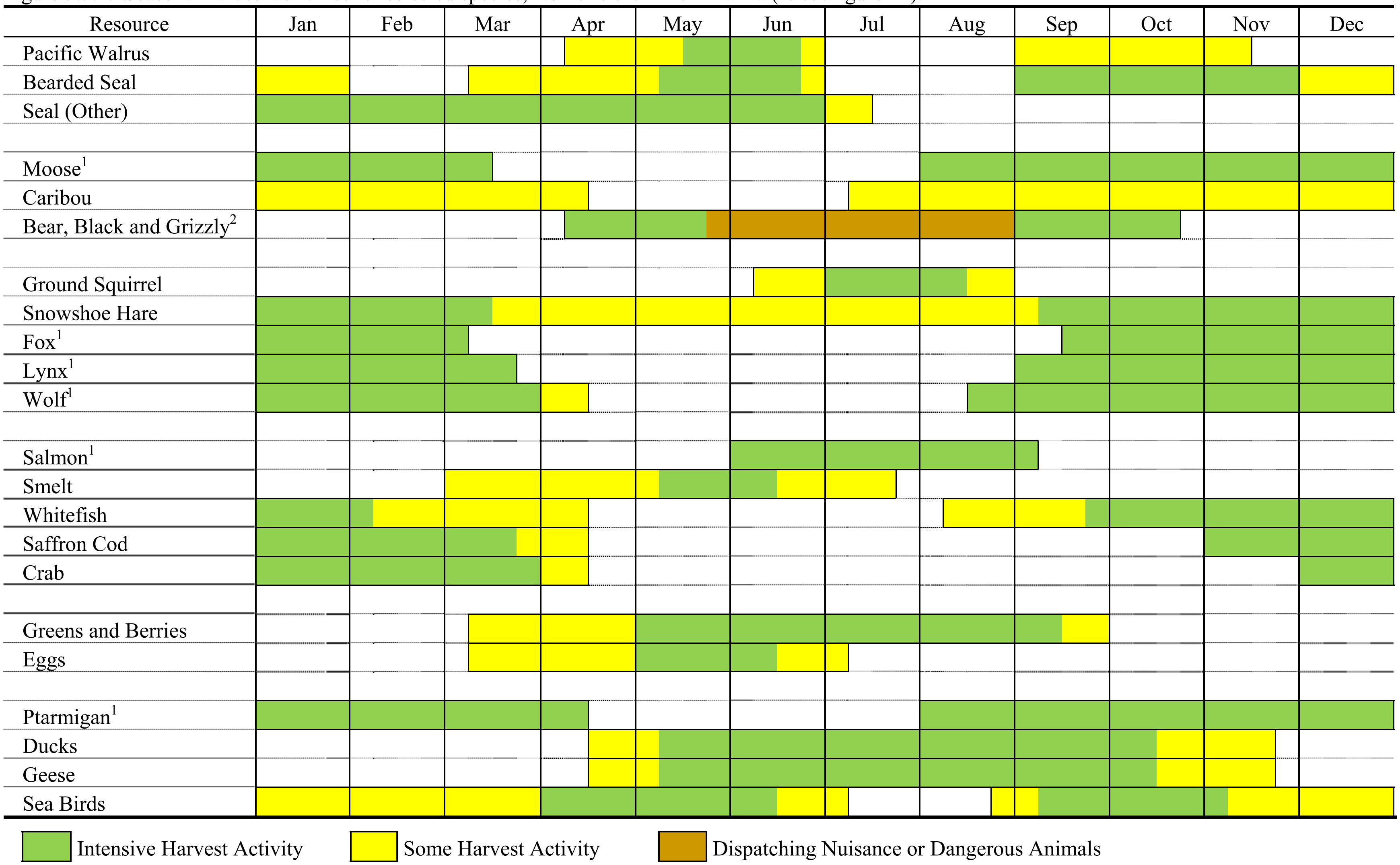
Table 3.5.1. Subsistence resource types used by active Nome subsistence users in 1984. Resources ranked in order of the percent of households surveyed using each resource. After Magdanz and Olanna (1986:Table 1).

Subsistence Resource	Number of Households	Percent of Total Sample (n=46)
Salmon	46	100.0%
Moose	43	93.5%
Plants	43	93.5%
Freshwater Fish	42	91.3%
Shellfish	37	80.4%
Seals	37	80.4%
Marine Fish	36	78.3%
Small Mammals	32	69.6%
Walrus	31	67.4%
Waterfowl	30	65.2%
Wood	26	56.5%
Bear	6	13.0%

Table 3.5.2. Subsistence resource types used by Brevig Mission and Teller residents 2005 to 2006. Resources ranked in order of use by Brevig Mission residents. After Ahmasuk et al. (2008:Table 11-1).

	Estimated Kilograms		Percentage of Total Harvest	
Subsistence Resource	Brevig Mission	Teller	Brevig Mission	Teller
Salmon	9,395	14,676	38.9%	34.1%
Marine Mammals	4,607	21,181	19.1%	49.2%
Plants & Berries	3,740	1,975	15.5%	4.6%
Caribou	2,647	0	10.9%	0.0%
Moose	1,936	1,107	8.0%	2.6%
Non-Salmon Fish	721	3,509	3.0%	8.2%
Other Land Mammals	609	46	2.5%	0.1%
Birds & Eggs	519	540	2.1%	1.3%
Total	24,174	43,033	100.0%	100.0%

Figure 3.5.1. Seasonal harvest activities for selected species, Nome 1982. After Ellanna (1983:Figure 22).



[1] Harvest periods determined by Alaska Department of Fish and Game.
[2] Harvest periods determined by Alaska Department of Fish and Game, occasional taking of nuisance or dangerous bears also occurs in the summer.

halibut, seals, sea lions and whales, while the ADF&G is responsible for managing subsistence use of fish and wildlife on state lands and waters.

Subsistence Use of Fish

Alaska law requires subsistence users to receive priority over other users of fish and wildlife resources. If subsistence harvest increases, commercial fishing and sport fishing may be restricted (Menard et al. 2013). Subsistence harvests are tracked annually for salmon (e.g., Table 3.5.3). Few other species have the same status as salmon in terms of desirability, amount of harvest effort, or actual harvest (Raymond-Yakoubian 2013). As a group, however, "non-salmon fish" approach the importance of salmon as a subsistence resource (Raymond-Yakoubian 2013).

Fall et al. (2013) describe the general approach to subsistence salmon fishing on the Seward Peninsula. In summer, subsistence salmon are harvested with gillnets or seines in the main Seward Peninsula rivers and coastal marine waters. Beach seines are used near the spawning grounds to harvest schooling or spawning salmon and other species of fish. A major portion of fish taken during the summer months is air dried or smoked for later consumption. Chum and pink salmon are the most abundant salmon species for Nome and Port Clarence (e.g., Table 3.5.3). Chinook and coho salmon are present throughout the area, but are more common in eastern and southern Norton Sound. Sockeye salmon are found in only a few Seward Peninsula streams (e.g., Tables 3.3.1 and 3.3.3 in the Fish and Wildlife Resources Section).

Local common names for some species of fish differ from what western fisheries science commonly uses. For example saffron cod (*Eleginus gracilis*) may be called tomcod, Dolly Varden (*Salvinus malma*) may be called trout or char, burbot (*Lota lota*) may be called lingcod, sculpin (Cottidae) may be called bullheads, capelin (*Mallotus villosus*) may be called cigar fish, and Arctic cod (*Boreogadus saida*) may be called blue cod (Magdanz and Olanna 1986, Menard et al. 2013, Raymond-Yakoubian 2013). Commonly used scientific and common names are used here, although some figures from the original source may use the local common name.

Nome, Teller and Brevig Mission have different approaches to their subsistence fishing and areas fished, so subsistence fishing is described below by community.

Nome: Nome's subsistence harvest area is two to three times larger than the harvest areas of other smaller communities in the region (e.g., Table 3.5.4). A well-maintained gravel road

Table 3.5.3. 2011 salmon subsistence harvest by community. Source: Fall et al (2013:Table 2-5).

Community	Households or Permits		Chinook Salmon	Sockeye Salmon	Coho Salmon	Chum Salmon	Pink Salmon	Total
	Total	Returned						
Brevig Mission	46	46	35	900	278	1,908	1,562	4,683
Nome	455	453	29	928	1,797	2,270	2,003	7,027
Teller	43	43	17	316	61	2,185	977	3,556
Total	544	542	81	2,144	2,136	6,363	4,542	15,266

Table 3.5.4. Number of Nome households (n=46) reporting selected use areas for harvesting selected subsistence resources in 1984. After Magdanz and Olanna (1986:Tables 3 and 5)

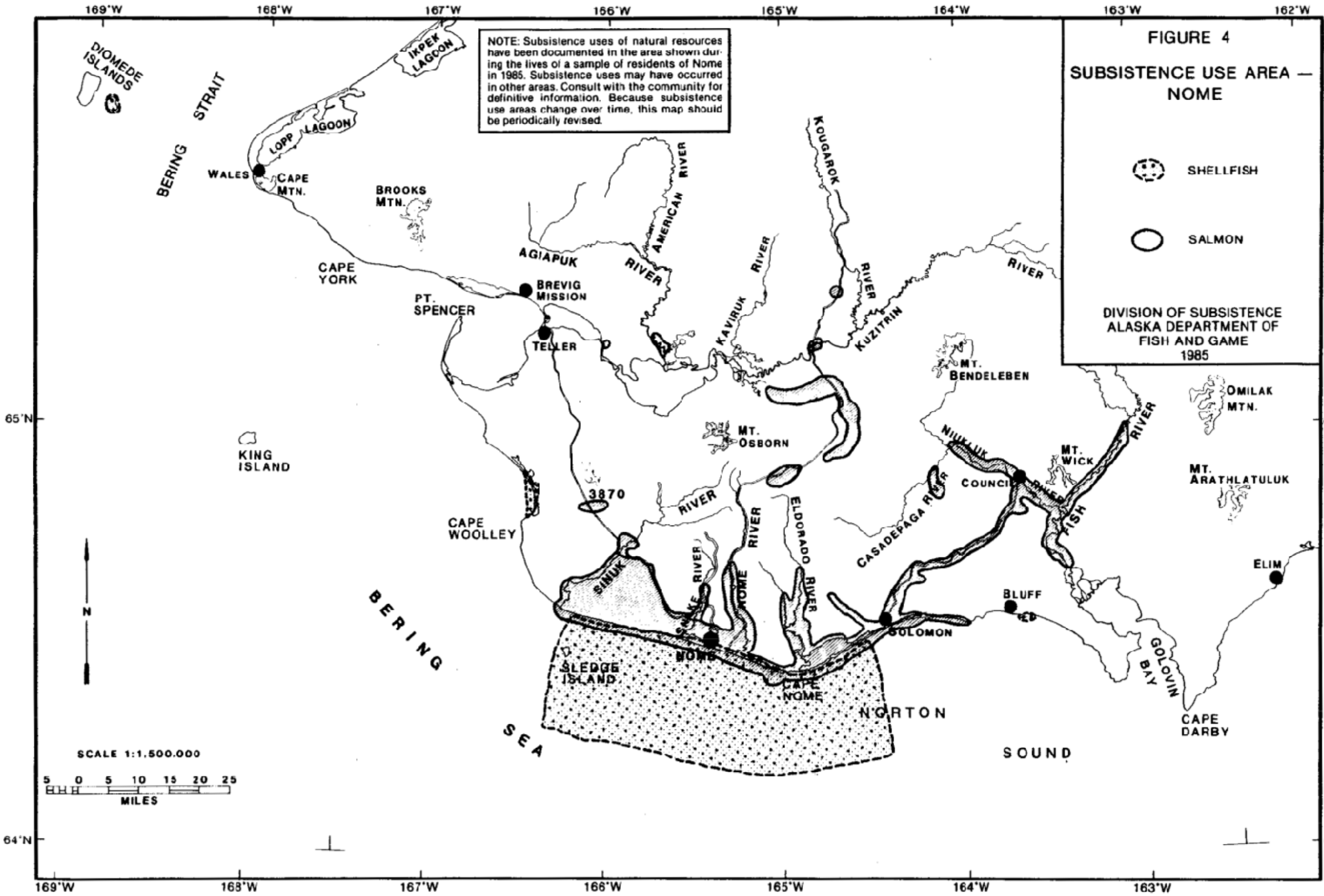
Area Used	Salmon	Shellfish	Marine Fish	Freshwater Fish	Walrus	Seals	Waterfowl
Land Areas							
Nome Townsite	9			6			4
Snake River Watershed	7			12			2
Nome River Watershed	23			15			2
Safety Sound	7	1	17	4		1	11
Greater Teller Coast				2			3
Brevig Mission Coast							1
Other Rivers, Watersheds and Sites (maximum number)	18		4	17			
Road Corridors (maximum number)	11			23			5
Marine Waters							
Nome Nearshore	17	36	30		25	34	10
Nome Offshore		2	1		26	21	1
Port Clarence and Nearshore	2		4		8	5	1
Other Marine Waters (maximum number)	8	3	10		28	30	16
Households Reporting	46	37	36	42	31	37	30

system facilitates easy access to streams within a 75-mile radius of Nome (Magdanz et al 2003). In 1984 only 15 to 20 percent of Nome residents fished for salmon in the Snake River or the Nome Townsite, while 50 percent fished the next closest river; the Nome River (Table 3.5.4, Figure 3.5.2). Nome was among the first communities to be affected by declines in western Alaska salmon stocks (e.g., Figure 3.5.3), and its residents appear to have changed their subsistence salmon fishing patterns in response to increasingly severe restrictions placed on subsistence salmon fishing. The Nome River initially attracted the most salmon fishing effort, but the effort declined after 1986 and the Eldorado and Flambeau Rivers (which flow into Safety Sound) became the most heavily fished rivers in the Nome area.

Magdanz et al (2003) suggested several reasons why Nome residents may be attracted to harvesting subsistence resources outside the Nome area: 1) relatively easy access by road, 2) adjacent watersheds are larger than those near Nome, 3) salmon stocks are more abundant in other rivers, and 4) perhaps most important, competition is less in adjacent areas. Another reason why Nome subsistence users are more likely to travel to more distant areas to harvest resources may be because many of Nome's subsistence families were originally from other villages. Magdanz and Olanna (1986) found that over half of Nome residents born outside Nome, but born in northwest Alaska, returned to their natal communities to hunt, fish and gather.

In addition to Nome residents harvesting all five species of Pacific salmon for subsistence use (Table 3.5.3, Figure 3.5.3), Ellanna (1983:Figure 24) found about 47 percent of Nome

Figure 3.5.2. Salmon subsistence harvesting areas in 1984. The Nome River watershed was most heavily used, followed by the Sinuk River and Norton Sound near Nome (see Table 3.5.4). Source: Magdanz and Olanna (1986: Figure 4).



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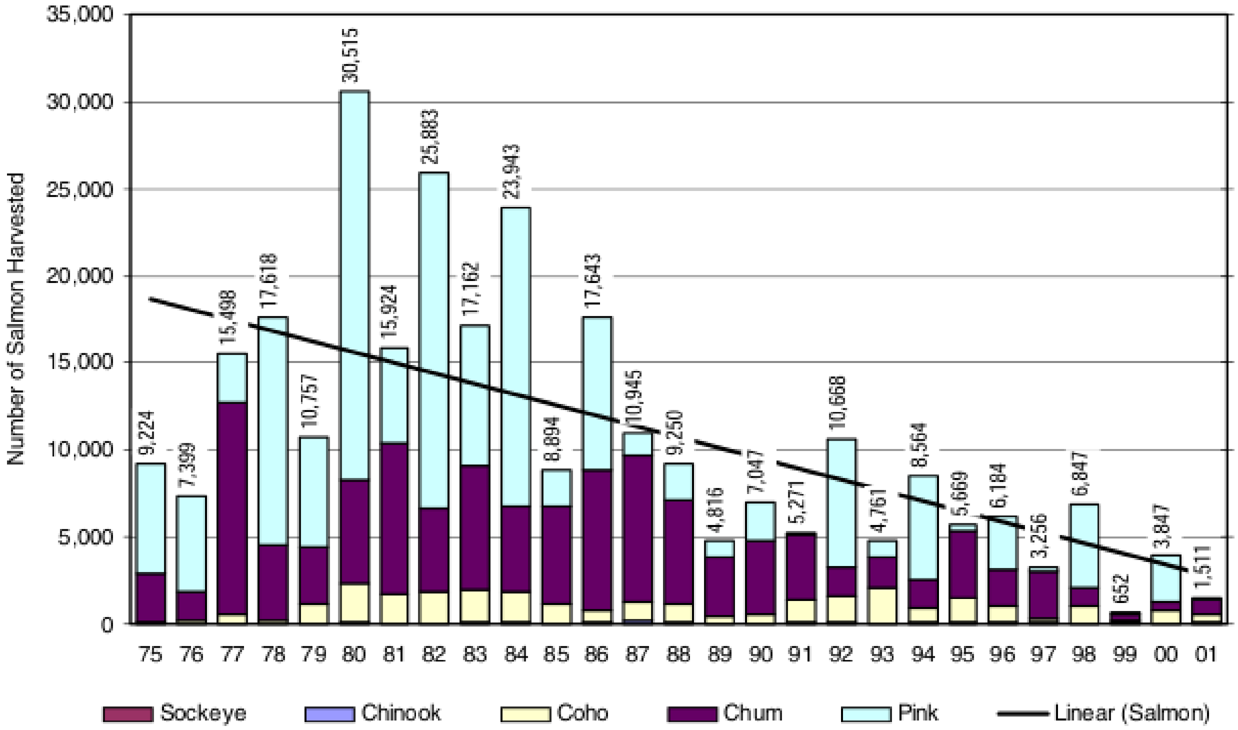


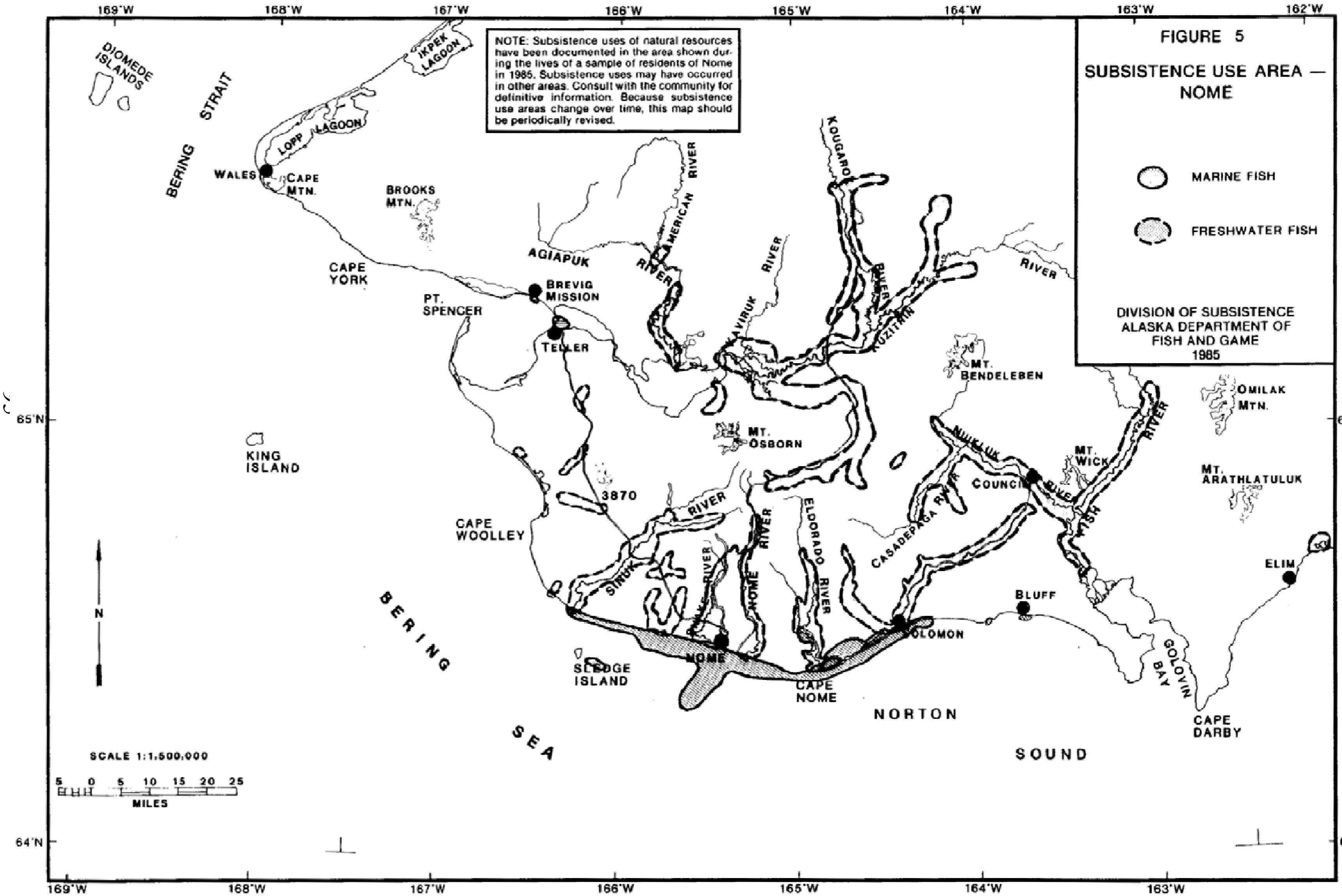
Figure 3.5.3. Nome District subsistence salmon harvests, 1975 to 2001. Harvests declined since 1980 as abundance declined. Widespread closures began in 1991. Source: Magdanz et al. (2003).

subsistence households also harvested Dolly Varden (char), and about 28 percent also harvested whitefish. Most Dolly Varden were harvested in fresh water (Magdanz and Olanna 1986).

In contrast to fishing for salmon outside the Nome area, most Nome subsistence households fished nearshore from Nome for marine fish (Table 3.5.4, Figure 3.5.4). According to Ellanna (1983:Figure 24), the most common marine fish caught by subsistence households were saffron cod (tomcod, about 47%), capelin (about 32%), lingcod/burbot (about 15%), halibut and flounder (about 10%), and herring (about 8%). Nome subsistence user also caught Arctic cod (blue cod) and sculpin (Magdanz and Olanna 1986). Most households reported fishing in Norton Sound between the Solomon River in the east and the Cripple River in the west (Figure 3.5.4). Thirty households (65%) harvested marine fish in the winter through the sea ice south of Nome where they specifically mentioned harvesting saffron cod, sculpin, and Arctic cod (Table 3.5.4).

<u>Teller</u>: The small community Teller is at the end of a well-maintained gravel road, which provides access during the snow-free months to Nome about 72 miles (115.87 kilometers) away. As discussed above, Nome residents range more widely to harvest their subsistence resources, and as a result Teller residents have observed an increase in competition for fishing sites in front of their community (Magdanz et al. 2003). There are a limited number of wage-based employment opportunities in Teller, and many are seasonal (Raymond-Yakoubian 2013). Subsistence hunting, fishing, and gathering are highly valued by residents of Teller. The most

Figure 3.5.4. Marine fish subsistence harvesting areas in 1984 (excludes salmon). Most households reported fishing in Norton Sound between Solomon River in the east and Cripple River in the west. Source: Magdanz and Olanna (1986:Figure 5).



recent research on the harvest of all subsistence resources by Teller residents estimated over 94,800 pounds of subsistence foods for the period of July 2005 to June 2006 (Ahmasuk et al. 2008:289, in Raymond-Yakoubian 2013).

Teller households harvest all five species of salmon for subsistence, although Chinook are not very common (Table 3.5.3, Figure 3.5.5). Magdanz et al (2005) examined these data in Figure 3.5.5 plus an additional two years for both Teller and Brevig Mission (i.e. 1994 to 2003), and concluded the declining trend in large salmon harvests (i.e., pink salmon excluded) was caused entirely from an unusually high chum and sockeye harvest in 1995. If the exceptional chum and sockeye harvests in 1995 were replaced with the nine-year average for the other years, there would be no trend for salmon other than for pink salmon. Pink salmon subsistence harvests in Port Clarence were best described by the odd-year trend, which declined from 1994 to 1999 and then rebounded by 2003. Pink salmon are more abundant in even-numbered years, but less so than in Norton Sound (Magdanz et al 2005). Interestingly, although Teller and Brevig Mission are separated by only five miles (8 kilometers) of water across Port Clarence, Teller had decreasing harvests of large salmon per household, while Brevig Mission had increasing harvests of large salmon per household (Magdanz et al. 2005). In addition, Teller households were more likely than Brevig Mission households to fish the protected waters of Grantley Harbor, Tuksuk Channel, and Imuruk Basin where Teller's success would be expected to be less affected by rough weather (Magdanz et al. 2005). The average large salmon harvest per Teller household was always less than Brevig Mission from 2001 to 2003. This difference between Teller and Brevig Mission may be explained by the distribution of household success within each community. Teller harvests were concentrated in fewer households in some years than others. When the most productive households in Teller did poorly, so did the total subsistence harvest for Teller, and vice versa (Magdanz et al. 2005).

In contrast to salmon, Teller harvested about eight times more non-salmon fish (by number and weight) for subsistence than Brevig Mission during the 2009 to 2010 harvest season (Table 3.5.5). Smelt, herring, cod (saffron and Arctic), and whitefish were the most common species harvested. For the same period, over 35 percent of Teller households surveyed said they did not get enough non-salmon fish to meet their needs, and non-salmon fish continue to be a very important subsistence resource (Raymond-Yakoubian 2013). No herring, grayling, or sculpin were harvested in the 2005 to 2006 harvest season, and there was a six-fold increase in whitefish compared to the 2005 to 2006 harvest season (Raymond-Yakoubian 2013). Teller's harvest of cod increased by about 25 percent, and the harvest of Dolly Varden, northern pike and smelt stayed about the same. Raymond-Yakoubian (2013) also summarized the subsistence fishing effort for a number of other non-salmon species. Some species were no longer targeted, but still common or at least observed near Teller (sculpin, flounder,); some species are only occasionally caught while fishing for other species (sheefish); some species are not harvested, but would be if more available (halibut); some species are not near Teller or there was no information (burbot, pike, blackfish, grayling); and capelin have been seen in the area, but residents are not very familiar with them.

Non-salmon were harvested for subsistence throughout the year, with September, November and April being the most productive (Table 3.5.5). Table 3.5.5 also shows the timing for harvesting non-salmon fish by species for Teller households. Within Port Clarence, Teller households

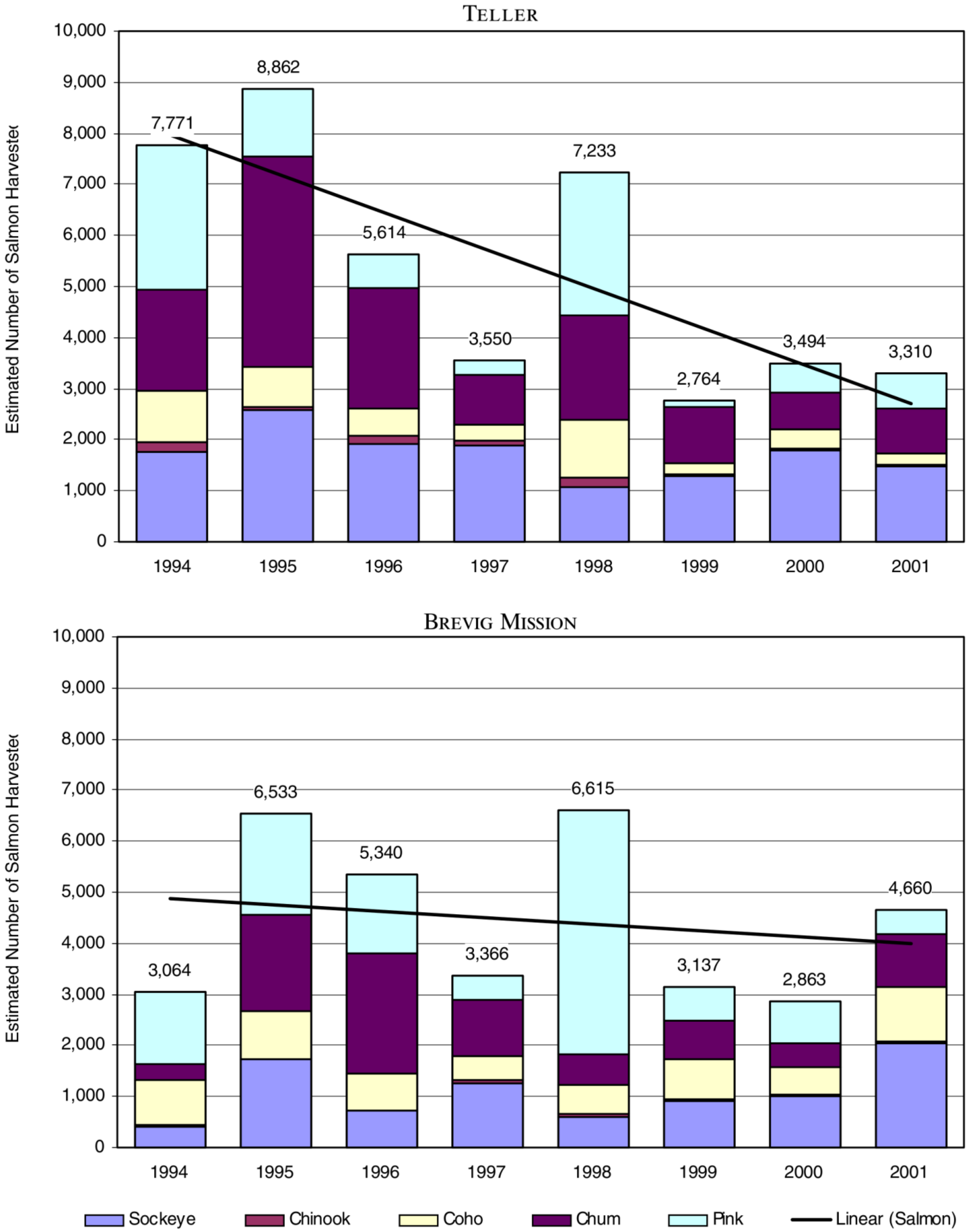


Figure 3.5.5. Estimated subsistence salmon harvests for Teller and Brevig Mission from 1994 to 2001. The substantial sockeye harvest was evident in both Teller and Brevig Mission. Source: Magdanz et al. (2003:Figure 3-11).

Table 3.5.5. Total estimated harvest of non-salmon fish for Teller and Brevig Mission, 2009-2010. Estimated harvest confidence ranged from ±18.9% for cod in Brevig Mission to ±89.7% for lingcod and "other" in Teller. After Raymond-Yakoubian (2013:Tables 25 and 26).

Resource	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total Number	Estimated Pounds
Teller														
Burbot	-	-	2.5	-	-	-	-	6.2	6.2	-	-	-	14.9	62.8
Capelin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cod	979.0	655.3	-	-	-	1,639.0	-	1,145.7	909.1	1,016.2	348.7	468.2	7,161.1	1,503.8
Dolly Varden	-	-	249.2	101.1	119.5	-	-	-	-	-	-	3.7	473.6	1,562.8
Flounder	-	97.1	-	560.4	579.1	610.2	186.8	-	-	-	-	-	2,033.5	2,033.5
Grayling	-	-	-	6.2	21.2	22.4	-	-	-	-	-	-	49.8	34.9
Halibut	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herring	1,383.6	1,643.9	-	-	266.5	1,383.6	1,383.6	1,307.5	-	-	-	-	7,368.9	1,326.4
Lingcod	-	-	24.9	-	-	-	-	-	-	-	-	-	24.9	-
Northern Pike	264.0	31.1	6.2	-	13.7	7.5	18.7	-	-	-	-	54.8	396.0	1,108.8
Other	-	-	373.6	373.6	373.6	-	-	-	-	-	-	-	1,120.8	-
Sculpin	-	-	12.5	12.5	12.5	49.8	12.5	-	-	-	-	-	99.6	149.4
Sheefish	-	-	-	6.2	-	-	-	-	-	-	-	-	6.2	34.2
Smelt	186.8	124.5	-	-	-	1,556.6	-	1,718.5	2,004.9	2,093.3	510.6	249.1	8,444.3	1,182.2
Whitefish	1,534.2	1,357.4	295.1	188.0	155.7	149.4	-	871.7	871.7	-	-	71.0	5,494.2	16,482.6
All Non-salmon	4,347.7	3,909.3	964.0	1,248.0	1,541.7	5,418.6	1,601.6	5,049.6	3,791.9	3,109.5	859.2	846.8	32,687.8	25,481.5
Brevig Mission														
Burbot	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capelin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cod	188.9	147.6	121.6	-	-	-	106.3	318.8	526.5	35.4	0.0	59.0	1,504.0	315.8
Dolly Varden	-	-	14.2	23.6	11.8	9.4	94.4	-	-	-	-	-	153.5	506.5
Flounder	-	-	47.2	-	-	35.4	17.7	-	-	-	-	-	100.3	100.3
Grayling	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Halibut	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herring	-	23.6	47.2	-	-	-	59.0	-	-	-	-	-	129.9	23.4
Lingcod	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	2.4	-	-	-	-	153.5	-	-	-	-	-	-	155.8	436.3
Other	-	-	3.5	-	-	-	-	-	-	-	-	-	3.5	-
Sculpin	-	1.2	-	-	-	-	-	-	-	-	-	-	1.2	1.8
Sheefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smelt	118.1	59.0	-	-	-	35.4	82.6	466.3	696.5	23.6	-	-	1,481.6	207.4
Whitefish	-	336.5	47.2	-	47.2	141.7	-	-	-	-	-	-	572.6	1,717.7
All Non-salmon	309.3	567.8	281.0	23.6	59.0	375.4	360.1	785.1	1,223.1	59.0	0.0	59.0	4,102.4	3,309.3

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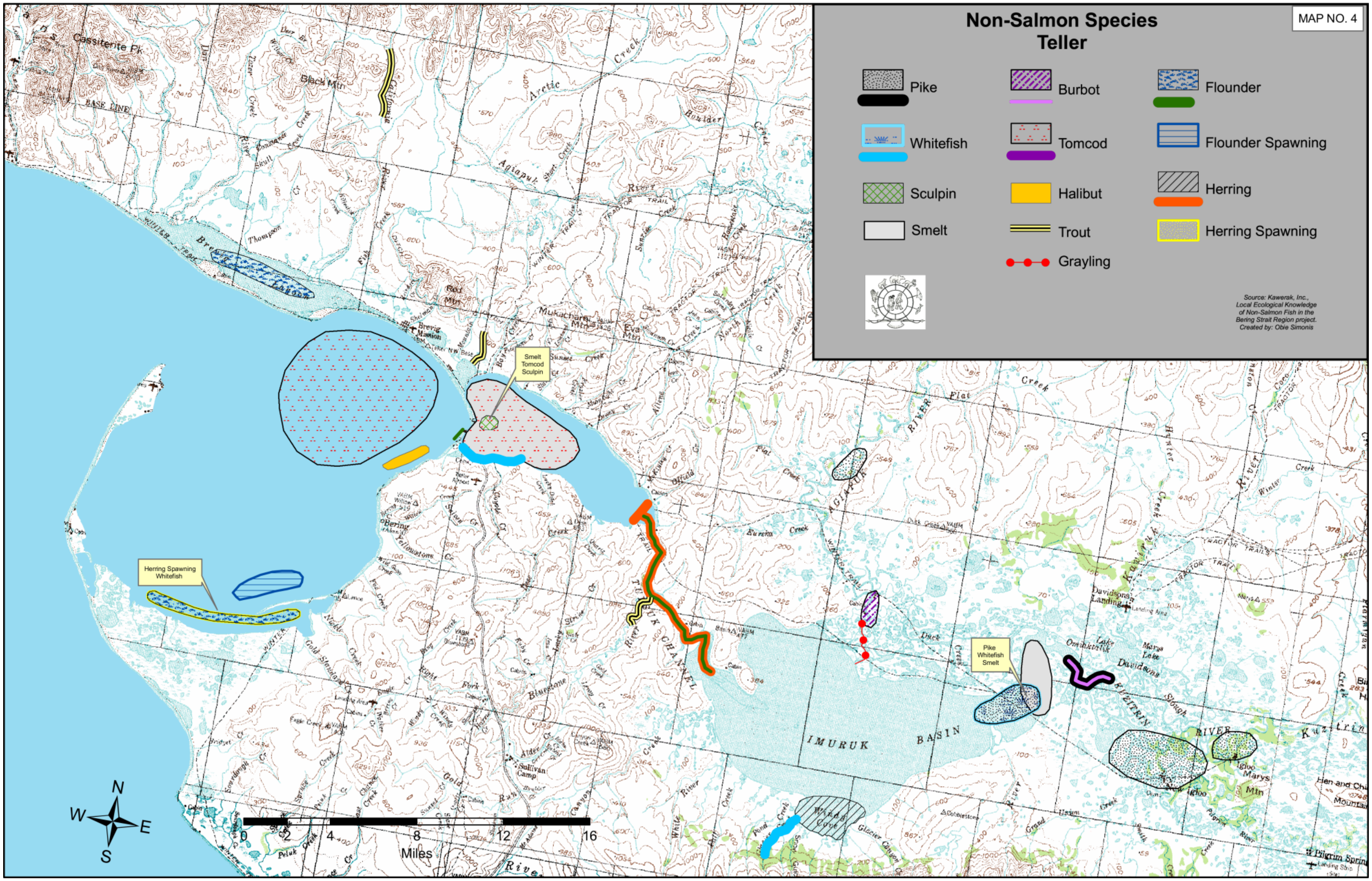

Figure 3.5.6. Locations where Teller residents harvest various non-salmon fish species, and other locations associated with non-salmon fish (e.g., spawning areas). Reproduced by permission from Raymond-Yakoubian (2013:Map 4).

harvested saffron cod (tomcod), whitefish, halibut, and flounder (Figure 3.5.6). Herring and flounder were also observed spawning in southern Port Clarence.

Brevig Mission: The small community of Brevig Mission is located on the north shore of Port Clarence, and is separated from the slightly smaller community of Teller and the road system by a narrow channel between Port Clarence and Grantley Harbor. All travel is by small plane, boat, or in the winter by snowmachine. There are a limited number of wage-based employment opportunities, and many are seasonal (Raymond-Yakoubian 2013). Subsistence hunting, fishing, and gathering remain very important to Brevig Mission residents. The most recent research on the total harvest of all subsistence resources by Brevig Mission residents estimated over 53,200 pounds of subsistence foods for the period of July 2005 to June 2006 (Ahmasuk et al. 2008:289, in Raymond-Yakoubian 2013).

Like Teller, Brevig Mission households harvest all five species of salmon for subsistence, although Chinook are not very common (Table 3.5.3, Figure 3.5.5). In a survey of Brevig Mission households, Raymond-Yakoubian (2009) found the community does not target king salmon when subsistence fishing, and they had not historically targeted king salmon because the fish are "too fatty," making them harder to dry. The trends for salmon in Port Clarence and the differences between Brevig Mission and Teller were described above in the section for Teller.

Brevig Mission harvested fewer species of non-salmon fish and less total non-salmon fish than Teller during the 2009 to 2010 harvest season (Table 3.5.5). Similar to Teller, cod (saffron and Arctic) and smelt were the most frequently harvested non-salmon fish, but Brevig Mission residents harvested far fewer herring. Brevig Mission residents say herring are more difficult to catch in recent years, possibly because seals are staying in the vicinity of the community later in the year. For 2009 to 2010 harvest season, over 76 percent of Brevig Mission households surveyed said they did not get enough non-salmon fish to meet their needs, and non-salmon fish continue to be a critical subsistence resource (Raymond-Yakoubian 2013). Still, their estimated harvest of non-salmon fish during 2009 to 2010 was more than 50 percent more for cod, smelt, pike, herring and whitefish than the estimate for the 2005 to 2006 harvest (Raymond-Yakoubian 2013). Brevig Mission's harvest of Dolly Varden and flounder stayed about the same, and they do not fish for Dolly Varden as often as in the past. Brevig Mission residents also do not fish as intensively as in the past for whitefish (Raymond-Yakoubian 2013). Raymond-Yakoubian (2013) also summarized the subsistence fishing effort for a number of other non-salmon species. Some species were no longer targeted, but still common or at least observed near Brevig Mission (sculpin, burbot, flounder, pike); some species are only occasionally caught while fishing for other species (sheefish); some species have never been caught in the vicinity of Brevig Mission (halibut); some species are not targeted or near Brevig Mission (blackfish, grayling); and capelin have never been eaten or harvested, although seen in the area.

Brevig Mission residents primarily fish for salmon in Port Clarence and Grantley Harbor, and the small creeks and rivers feeding into them (Raymond-Yakoubian 2009). Some Brevig Mission subsistence users believe the sockeye no longer pass along the coastline in front of their community as often as before, and the fish are now taking something of a "short cut" from Point Jackson, across Port Clarence, to Teller at the point where they enter Grantley Harbor (Raymond-Yakoubian 2009). Non-salmon are fished throughout the year, with December,

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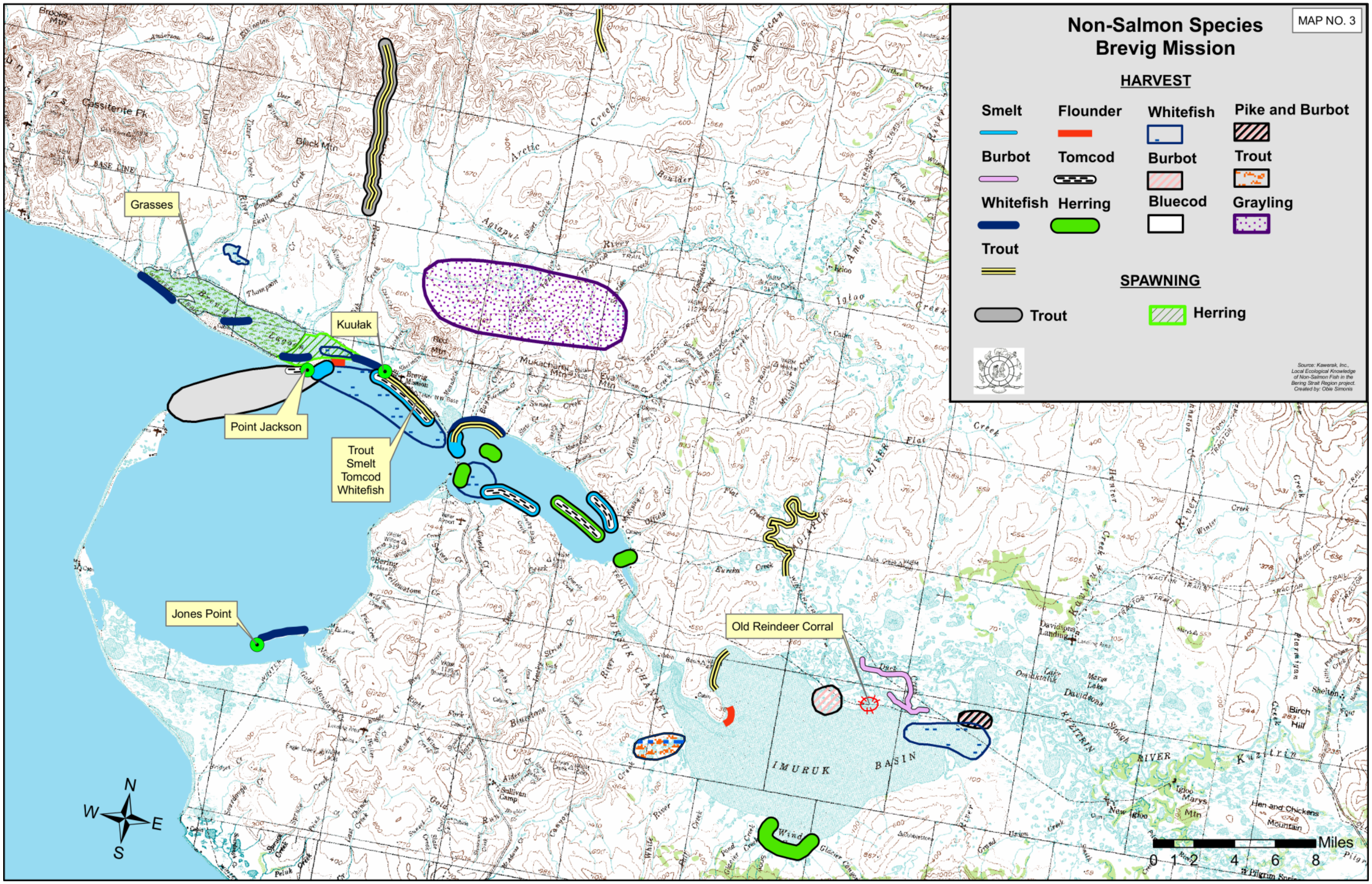

Figure 3.5.7. Locations where Brevig Mission residents harvest various non-salmon fish species, and other locations associated with non-salmon fish (e.g., spawning areas). Reproduced by permission from Raymond-Yakoubian (2013:Map 3).

November and May being the most productive, and no fish caught in February (Table 3.5.5). Table 3.5.5 also shows the timing for harvesting non-salmon fish by species for Brevig Mission residents. Within Port Clarence, Brevig Mission residents primarily fished the north shore near their community, harvesting Dolly Varden (trout), smelt, saffron cod (tomcod), whitefish and flounder (Figure 3.5.7), although some species of fish are not caught as close to Brevig Mission as before. Herring were also observed spawning in the eastern side of Brevig Lagoon adjacent to Port Clarence, and some species of whitefish may overwinter in Brevig Lagoon (Raymond-Yakoubian 2013).

Subsistence Use of Migratory Birds and their Eggs

The most detailed surveys of subsistence migratory bird use is conducted by the Alaska Migratory Bird Co-Management Council (AMBCC). This collaborative group has conducted an assessment program of the subsistence harvest of migratory birds and their eggs in Alaska since 2004. The AMBCC is comprised of representatives of ADF&G, USFWS, and a number of regional Alaska Native organizations.

The survey covers spring, summer, and fall harvests in most regions. Some regions also have a winter survey. Villages with similar harvest patterns are grouped into subregions, and households are interviewed regarding that year's harvest. Villages and regions are surveyed on a rotating schedule. The Bering Strait-Norton Sound region has three subregions: the Bering-Strait Mainland Villages subregion; the Nome subregion; and the St. Lawrence-Diomede Islands subregion. For the purposes of this report, information is presented only from the Bering-Strait-Mainland Villages and the Nome subregions (Figure 3.5.8).

The harvest estimates presented here are from the most recent survey conducted in 2010 (Naves 2012). Harvest estimates for 2004-2007 were reported in Naves (2010a), harvest estimates for 2008 were reported in Naves (2010b), and harvest estimates for 2009 were reported in Naves (2011).

The yearly estimated harvest of migratory birds for the Bering Strait Mainland Villages in the years 2004-2010 was typically in the low tens of thousands of birds (17,195 to 37,482) and eggs (12,240 to 29,321). The yearly estimate harvest for Nome in 2004-2007 has been in the low thousands for migratory birds (2,782 to 6,152 birds) and eggs (2,351 to 8,387 eggs).

The species of birds and bird eggs harvested includes ducks, geese, swans, cranes, ptarmigan and grouse, large numbers of seabirds, shorebirds, and loons and grebes. Eggs collected were largely from a few types of birds including eiders, geese, cranes, gulls, and small shorebirds.

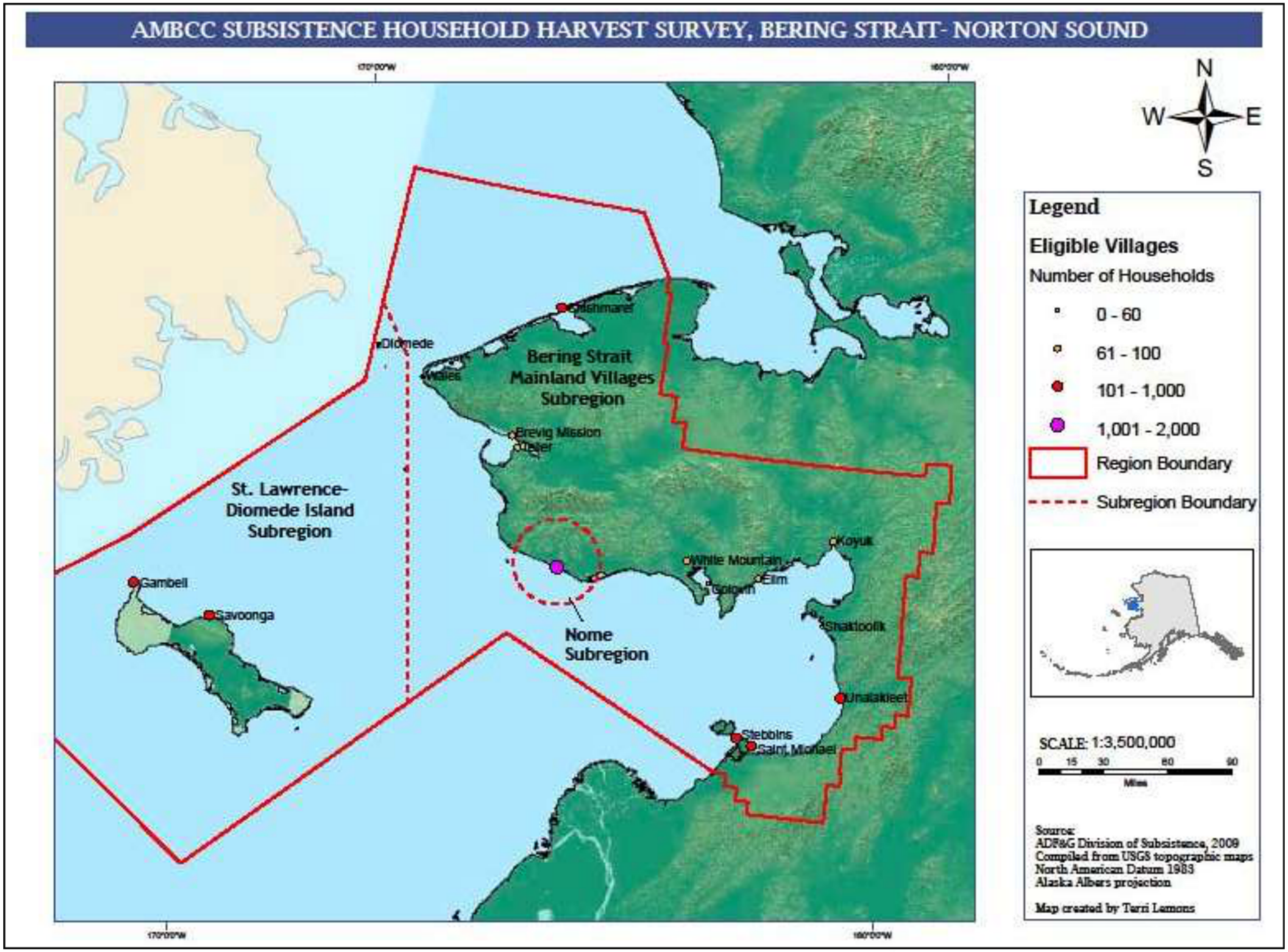

Figure 3.5.8. Map showing Bering Strait – Norton Sound Subsistence Subregions surveyed by the AMBCC (Source: Naves 2012).

Table 3.5.6. Estimated bird harvest 2010, Bering Strait-Norton Sound region, Mainland Villages subregion (Naves 2012: Table 38). This table is presented primarily to indicate the variety of migratory birds harvested.
Table 3.5.7. Estimated egg harvest 2010, Bering Strait-Norton Sound region, Mainland Villages subregion

Species	Annual estimated egg harvest			Seasonal estimated egg harvest					
	Number	Confidence Interval		Spring		Summer		Fall	
		95% CI	Low – High	Number	95% CI	Number	95% CI	Number	95% CI
Ducks									
American wigeon	0	-	-	0	-	0	-	0	-
Teal	169	73%	46 – 292	169	106%	0	-	0	-
Mallard	54	67%	18 – 90	33	96%	21	117%	0	-
Northern pintail	407	32%	278 – 537	360	43%	47	115%	0	-
Northern shoveler	85	73%	23 – 146	85	106%	0	-	0	-
Black scoter	0	-	-	0	-	0	-	0	-
Surf scoter	0	-	-	0	-	0	-	0	-
White-winged scoter	0	-	-	0	-	0	-	0	-
Bufflehead	0	-	-	0	-	0	-	0	-
Goldeneye	0	-	-	0	-	0	-	0	-
Canvasback	0	-	-	0	-	0	-	0	-
Scaup	0	-	-	0	-	0	-	0	-
Common eider	4,689	50%	2,324 – 7,053	4,135	67%	554	54%	0	-
King eider	135	62%	52 – 219	108	109%	27	109%	0	-
Spectacled eider	49	72%	14 – 84	49	88%	0	-	0	-
Steller's eider	0	-	-	0	-	0	-	0	-
Harlequin duck	0	-	-	0	-	0	-	0	-
Long-tailed duck	0	-	-	0	-	0	-	0	-
Merganser	0	-	-	0	-	0	-	0	-
Total ducks	5,588	43%	3,188 – 7,988	4,939	57%	649	49%	0	-
Geese									
Black brant	180	49%	91 – 269	121	74%	59	94%	0	-
Cackling/Canada goose	449	41%	265 – 634	349	54%	100	68%	0	-
Greater white-fronted goose	21	100%	4 – 42	0	-	21	117%	0	-
Emperor goose	0	-	-	0	-	0	-	0	-
Snow goose	151	67%	51 – 252	151	97%	0	-	0	-
Total geese	802	29%	572 – 1,032	622	41%	180	50%	0	-
Swans									
Swan	54	59%	22 – 85	43	86%	11	117%	0	-
Cranes									
Sandhill crane	175	39%	107 – 243	62	64%	113	72%	0	-
Ptarmigans and grouses									
Grouse	0	-	-	0	-	0	-	0	-
Ptarmigan	51	59%	21 – 80	51	79%	0	-	0	-
Total ptarmigans and grouses	51	59%	21 – 80	51	79%	0	-	0	-
Seabirds									
Cormorant	0	-	-	0	-	0	-	0	-
Tern	717	29%	511 – 922	397	45%	320	60%	0	-
Black-legged kittiwake	0	-	-	0	-	0	-	0	-
Bonaparte's/Sabine's gull	0	-	-	0	-	0	-	0	-
Mew gull	124	88%	28 – 233	82	132%	42	117%	0	-
Large gull	3,624	26%	2,685 – 4,562	2,920	36%	703	39%	0	-
Auklet	0	-	-	0	-	0	-	0	-
Murre	786	38%	485 – 1,087	403	62%	384	80%	0	-
Guillemot	0	-	-	0	-	0	-	0	-
Puffin	0	-	-	0	-	0	-	0	-
Total seabirds	5,251	20%	4,175 – 6,327	3,802	30%	1,449	34%	0	-
Shorebirds									
Whimbrel/Curlew	18	95%	3 – 34	18	115%	0	-	0	-
Godwit	0	-	-	0	-	0	-	0	-
Golden/Black-bellied plover	189	50%	94 – 283	165	64%	24	115%	0	-
Turnstone	0	-	-	0	-	0	-	0	-
Phalarope	407	43%	233 – 580	275	75%	132	105%	0	-
Small shorebird	1,187	42%	689 – 1,685	838	66%	349	67%	0	-
Total shorebirds	1,800	33%	1,204 – 2,396	1,296	50%	504	68%	0	-
Loons and grebes									
Common loon	156	45%	86 – 227	156	54%	0	-	0	-
Pacific loon	22	70%	7 – 37	0	-	22	105%	0	-
Red-throated loon	12	95%	2 – 23	0	-	12	115%	0	-
Yellow-billed loon	0	-	-	0	-	0	-	0	-
Grebe	0	-	-	0	-	0	-	0	-
Total loons and grebes	190	39%	117 – 263	156	54%	34	79%	0	-
Total eggs	13,910	24%	10,547 – 17,273	10,970	33%	2,940	32%	0	-

Sampling effort (Bering Strait Mainland Villages subregion, 2010): 5 out of 12 villages in this subregion were included in analysis; 33% of the subregion households were repreented in the sample. -: No reported harvest.

(Naves 2012: Table 39). This table is presented primarily to indicate the variety of bird eggs harvested.

Subsistence Use of Polar Bears and Walruses

Community	Pacific Walrus	Polar Bear
Barrow	24	49
Gambell	3,069	9
Kivalina	4	3
Kotzebue	2	3
Little Diomede	166	14
Nome	24	1
Point Hope	25	51
Point Lay	10	2
Savoonga	2,918	16
Shishmaref	52	6
Wainwright	71	4
Wales	41	5

Table 3.5.8. Reported Pacific walrus and polar bear harvest numbers from 2007 to 2011 in Alaska communities. Walrus harvest numbers are not corrected for the Marine Mammal Marking, Tagging, and Report Rule (50 CFR 18.23) compliance rates or struck-and- loss estimates. From 78 FR 1942: 1956.

Get text from Megan

Some quotes to consider. Hunting area maps like above are available (see Bob):

Thirty [Nome] households in the sample reported areas for harvesting waterfowl or eggs; sixteen of those harvested in Norton Sound west (area 522) which included Sledge Island (Table 5). Coastal hunting predominates, stretching from Topkok Head to Cape Douglas (Fig 8). Waterfowl effort encompassed a wide range of species and habitat. Cranes, Canadian geese, brants, puddle ducks, pond ducks, and sea ducks were all hunted. Canadian geese and eider ducks were the most commonly mentioned species. Eggs were gathered on King Island (only by King Island people), on Sledge Island, between Cape Douglas and Cape Rodney, at Cape Nome, Flambeau River, Topkok Head, and Bluff. Species from which eggs were gathered included. seagulls, murres, aukes, geese, and ducks. [Magdanz and Olanna 1986]

Magdanz and Olanna (1986: Figure 8) has a map of waterfowl and egging areas similar Figure 4.1.5.4 above.

Ahmasuk et al. (2008) surveyed Teller and Brevig Mission residents about their bird use, but no maps

Get text from Jewel

Some quotes to consider. Hunting area maps like above are available (see Bob):

Walrus hunters literally went off the map. When designing the study, researchers underestimated the potential range of walrus hunters hunting. Walrus hunters ranged throughout Norton Sound and through the Bering Strait (Fig. 7). Several hunters reported hunting within sight of the Yukon Delta, 75 miles south of Nome. One hunter sighted St. Lawrence Island, 125 miles southwest. Most walrus hunters in 1985 were using 18-foot aluminum skiffs with 50-90 hp motors. Seventy five miles (not to mention 125 miles) was a long way to travel in such a boat on the open ocean. [Magdanz and Olanna 1986]

Seal hunting areas resembled walrus hunting .areas (Fig. 7). Hunters often hunted seals and walrus simultaneously during spring, but also took seals at other times of the year. Four seal species were available in the Nome area: bearded, ringed, spotted, and ribbon. Thirty-seven households reported areas for hunting seals (Table 5) [Magdanz and Olanna 1986]

Magdanz and Olanna (1986:Figure 8) has a map of walrus and seal subsistence areas similar Figure 4.1.5.4 above.

Ahmasuk et al. (2008) surveyed Teller and Brevig Mission residents about their marine mammals use, but no maps.

3.6 Introduced Species

Rats and Mice

Introduced rodent can have a significant negative impact on local ecosystems, especially where they are an introduced non-native species. Most noticeably, rats are highly effective predators that can decimate local populations of nesting seabirds and also reduce populations of shorebirds (Kurle 2008, Johnson 2008, Fritts 2007). As a result of their significant impacts in seabird colonies, a major nutrient source (guano) is removed from the system (Maron et al. 2006), which may result in reduced biomass and biodiversity at every trophic level. Also as a result of seabird removal from the system, intertidal and marine habitats may become overpopulated with grazers (which are a food resource for seabirds), resulting in denuding of kelp beds (Kurle et al. 2008). Rats are also carriers of diseases, which they can spread to native species (Thompson et al. 2010, Fritts 2007) and to people (Gubler et al. 2001, Fritts 2007). Aside from these direct effects, rats may influence ecosystem dynamics through cascading effects. As opportunistic feeders, they may cause declines in local vertebrate populations by eliminating the prey resources on which these species depend (e.g. insects), or they may graze upon or otherwise damage local vegetation, leading to soil erosion and loss of habitat (Fritts 2007).

Rats can become established on islands and remote coastlines by riding ashore on cargo, escaping during shipwrecks, and even swimming from ships (Ebbert et al. 2007). Increases in shipping, particularly transpolar shipping, will increase the likelihood of rats invading and thriving in rat-free areas of Alaska (Fritts 2007). Projects that will support or encourage increased shipping traffic must take steps to prevent the introduction and spread of rats. The deepwater port proposed for either Nome or Port Clarence in the Norton Sound area introduces the potential for spread of rats to remote areas of western Alaska.

A critical measure for preventing the spread of rats in remote western Alaska is building capacity for rapid response to rat "spills" from disabled vessels to localized reports of non-native rodents (Fritts 2007). Initial rat spill kits are currently staged in several Alaskan locations (e.g. Adak, St. Paul, St. George, Unalaska, Homer, Anchorage, Juneau) (Ebbert et al. 2007, Fritts 2007). In order to increase capacity for response in western Alaska, particularly in light of the likely traffic increase that will result from construction of a deepwater port near Nome or Port Clarence, a rat spill kit should be required at the chosen site of the deepwater port.

Alaska regulations make it illegal to knowingly or unknowingly transport, harbor, release (5 AAC 92.141) or feed (5 AAC 92.230 and 5 AAC 92.990) rats. Project proponents should become familiar with Rat Control for Alaska Waterfront Facilities (Johnson 2008), published by Alaska Sea Grant for the Alaska Department of Fish and Game. The Service would like to see a project-specific Integrated Pest Management (IPM) plan developed for the Norton Sound Deepwater Port project, following the standard operating procedures and other suggestions in these detailed guidelines.

Although control of the existing breeding population (to prevent increase and spread) is the goal for the Nome area in general, prevention should be the goal for all facilities associated with the new port, regardless of the location. Prevention involves eliminating the means of entry or transport of rodents, and eliminating opportunities for reproduction (Fritts 2007). In particular, a project-specific IPM plan should include aggressive prevention and quarantine efforts, with a tiered approach that addresses the port first, then steps down to harbors, individual vessels, and finally to cargo (Fritts 2007).

Mitigation is likely to be required for this project and may include work to eliminate known breeding populations of rats (see Figure 1). Kiska Island may be a good candidate for mitigation through restoration. Although Kiska Island is quite far from either site proposed for the Deepwater Port, some of the shipping traffic at this port will result in risk of rat invasion to this and other Aleutian/Bering Sea Islands. Kiska Island is currently the only island known to support both rats and a significant number of birds. The rats became established on Kiska during WWII, and it is thought to be only a matter of time before the birds are completely decimated. Auklets breeding on Kiska are mostly least auklets (*Aethia pusilla*), but crested auklets (*Aethia cristatella*) are also found in significant numbers. Millions of auklets on the island are at stake, and they are likely experiencing a rapid population decline at present (Major 2004). However, Kiska Island is 70,000 ac, and no island of this size has had successful eradication of rats.

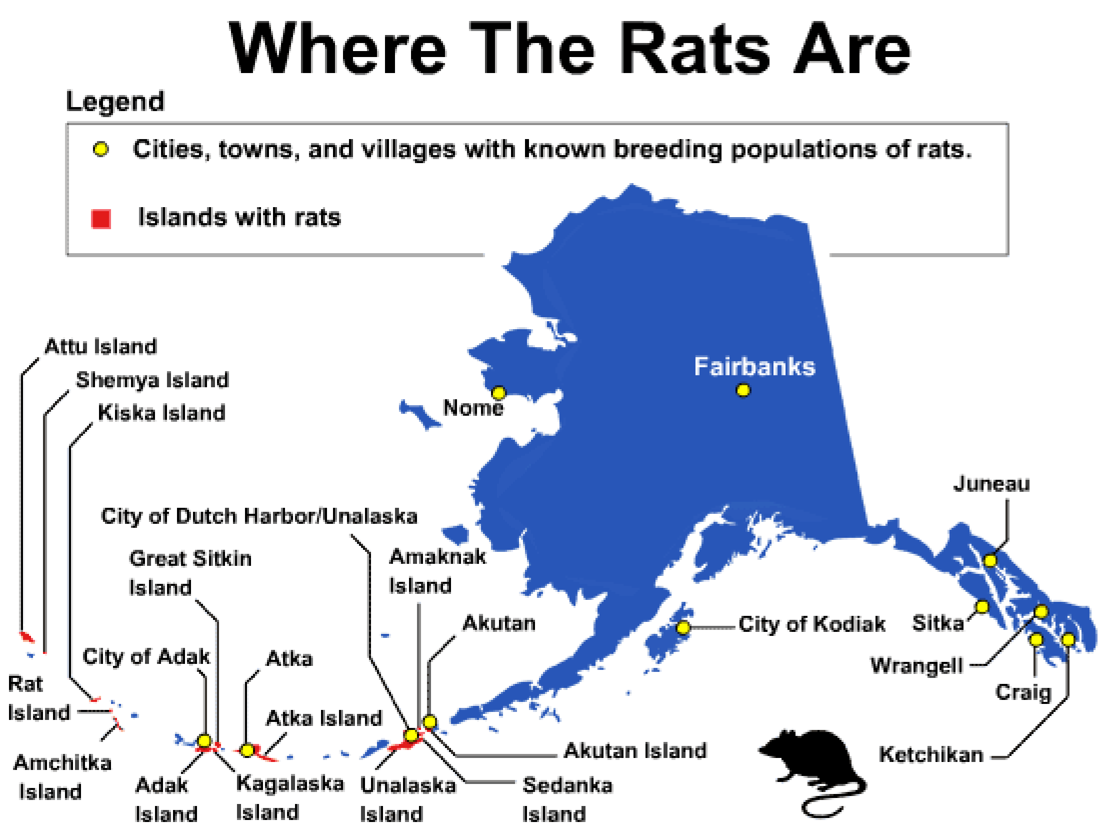

Figure 3.6.1. Known locations of breeding populations of Norway rats. Figure from Johnson (2008).

A recent rapid response effort to control the accidental arrival of mice on St. George Island in the southern Bering Seas was reported (http://www.alaskadispatch.com/article/20140505/killing-invaders-st-george-island-mouse-menace-spreads).

Marine Invasive Species

Sources of marine invasive species include ballast water discharge and hull and anchor fouling. Most marine invasive monitoring in Alaska has been focused on waters in Southeast, as this part of Alaska has been considered a gateway for invasions from the west coast. However as waters warm and Arctic shipping routes open, the potential for spread of invasive species to other parts of Alaska (including the waters of Norton Sound and the Bering Strait) increases.

Alaska is the only West Coast state that has not recently passed ballast water legislation addressing non-indigenous species (ADF&G 2002). Ballast water in ships coming from other countries is largely unregulated if ships do not pass through Vancouver, B.C. or Washington ports before reaching Alaskan ports. Furthermore, ships coming north from the Pacific coast ports may take on ballast from waters already infected with marine invasives, and then discharge that ballast upon reaching Alaskan ports. Ballast water is a particularly problematic vector for the spread of coastal planktonic invasives.

At least thirteen marine invasive species have a documented presence in Alaska, as far north as South Central Alaska (Hines & Ruiz 2001). These marine invasives include colonial tunicates. There is also potential for invasion in Alaskan waters by European green crabs (*Carcinus maenas*), solitary tunicates, and *Undaria seaweed* (Hines & Ruiz 2001).

Presently, the ADF&G monitors for tunicates and green crabs in conjunction with the Smithsonian Environmental Research Center. Green crabs are monitored only as far north as Valdez, and tunicates are monitored as far north as Homer and Seward.

Early detection and rapid response is often the most effective, cost-efficient means of preventing the spread of invasive species. Conducting a Bioblitz in order to detect invasives gets the community involved in recognizing native and invasive species . Successful Bioblitzes have been conducted in Alaska in the communities of Homer, Sitka, Ketchikan, and Juneau. Sitka and Juneau have hosted Bioblitzes focused on detection of marine invasive species.

What is a Bioblitz?

A Bioblitz is simply an intensive survey in which trained volunteers head out en masse to catalog species in a specific area. When resources are limited, a Bioblitz may catalog only a targeted group of species (e.g. invasive species).

Goals of a Bioblitz

- Teach the public about invasive species, including means of transport and prevention.

- Gather baseline data on existing marine environment, including the species present and the vector opportunities for marine invasives.
- Detect newly-arriving invasive species while populations are still small (the key to success of EDRR).
- Keep members of the community engaged: recruit volunteers for future monitoring.
- Culd include removal efforts, if invasive populations are small and expertise is available to make these efforts successful.

Bioblitz Key Ingredients

- Bring in experts. For example, for the Ketchikan Bioblitz, experts on marine invasive species came from the Smithsonian Environmental Research Center Marine Invasions Research Lab, San Francisco State, and the University of Alaska. These experts helped identify species of concern for the area, came up with a survey design, trained volunteers to identify the focal invasive species (plus native species), and then led teams of volunteers in the field.

- Train members of the public as volunteers. Manpower is important to having adequate area coverage to get a good idea of what is, and what is not, present in the area of interest. Perhaps more importantly, Bioblitzes present an opportunity to actively engage the community in a hands-on, fun activity during which volunteers learn about the threats marine invasive species pose to their environment. This is an opportunity to interact with sciences experts and actively participate in marine stewardship.
  The Ketchikan Bioblitz included half a day of lectures and hands-on lab work. Volunteers were trained to identify key species that have recently invaded the West Coast, as well as known Alaskan invaders. Training was immediately followed by the Bioblitz survey.

Bring in Scientific Rigor

Make a "searcher efficiency" game by hiding something the size of a penny in known quantities in searchers' grids. In Ketchikan, Bioblitz leaders glued pennies to pilings and docks, then challenged searchers to see how many they could find while they surveyed for invasives. This kept searchers actively engaged looking for objects that were definitely present, which could be useful where invasives are less likely to be found. It also gave an idea of how efficient searchers were, according to their reported penny counts, and demonstrated how hard it might be to spot a small organism in the marine environment.

Consider setting up long-term monitoring, instead of just a one-time survey. Ask groups to "adopt a dock" to monitor.

Use resources that are already available. For example, Itunicate has established protocols in place for monitoring marine tunicate invaders.

Bioblitz Species Targets

Species known to have invaded Alaskan waters. Possibly also consider West Coast invaders.

Target Bioblitz Habitats

- Shoreline between high and low tide (especially rocky shorelines)
- Docks
- Boat hulls
- Buoys
- Lines

Possible Partners

- Alaska Department of Fish and Game
- NOAA Fisheries
- Alaska Sea Grant Marine Advisory Program
- University of Alaska
  - Northwest Campus Marine Advisory Program (Nome)
  - University of Alaska School of Fisheries and Ocean Sciences
- Alaska SeaLife Center Marine Invasive Species Program
- Plate Watch (i.e. Itunicate, the invasive tunicate network)
- Alaska Invasive Species Working Group
- Local schools

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Appendix A
Nearshore Faunal Assemblages of Nome and Port Clarence, Alaska

Trip Report
September 16-20, 2013

U.S. Army Corps of Engineers
Alaska District
Environmental Resources Section
Anchorage, AK

November 2013

Overview

Fish and invertebrates were sampled in shallow, nearshore waters of Norton Sound and Port Clarence by personnel affiliated with the U.S. Army Corps of Engineers (USACE) Alaska District and the U.S. Fish and Wildlife Service Fairbanks Office from September 16-20, 2013. A 20-foot boat was used to conduct sampling; with sample locations in Nome, Alaska and in Port Clarence based out of Teller, Alaska. Results of the survey provide information on the abundance, frequency of occurrence, and species composition of fauna in marine habitats of the regions sampled.

Objectives

1. To fill information gaps on fish distribution, abundance, and habitat use in nearshore waters near Nome and Port Clarence.

2. To provide tribal entities and government agencies with biological data needed for assessments of potential impacts of marine infrastructure improvements in the project area.

3. Begin a collection of baseline data that will stand as either a pre-project data set or as an indicator of pre-spill conditions should a spill occur one day in the region.

Study Area

Two areas were sampled during this trip; the beach habitat west of Nome and a variety of sites in Port Clarence. Biota were sampled in marine waters with a beach seine at three sites near Nome and each four sites in Port Clarence (Figures 1-3, Table 1).

Methods

Beach seine

At seine sites (<20 m from shore, <5 m deep), fish and invertebrates were captured with a 37-m long variable mesh beach seine that tapers from 5 m wide at the center to 1 m wide at the ends. Outer panels are each 10 m of 32-mm stretch mesh, intermediate panels are each 4 m of

6-mm square mesh, and the bunt is 9 m of 3.2-mm square mesh. We set the seine as a round haul by holding one end on the beach, then backed around in the boat with the other end to the beach about 18 m from the start, and pulled the seine onto shore. The seine has a leadline and a floatline so that the bottom contacts the substrate and the top floats on the surface.

Fauna measurements

After retrieval of either net, the entire catch was sorted, identified to lowest taxon, and counted. A sub-sample (up to 50 individuals) of each fish species was measured to the nearest millimeter total length. Life stage (i.e., larva, young-of-the-year – YOY, juvenile, and adult) was assigned to fish in the field based on ontogenetic characteristics (e.g., jaw development, coloration, and markings) and length. Fish were considered adults when their length exceeded species-specific estimates of length-at-first-maturity (FishBase 2012). Most invertebrates were individually counted, but catch estimates were made routinely for mysids and occasionally for amphipods.

Habitat measurements

Beach slope and substrate composition were visually estimated at each seine site. Upon retrieval of the seine, the presence of debris (e.g., drift vegetation) was noted. All sites were documented with digital photos, and geographic positions were taken with a hand-held GPS.

Data Analysis

Catch data is expressed in absolute numbers (i.e., total catch and species richness), and relative abundance [i.e., catch-per-unit-effort (CPUE), and percent frequency of occurrence (FO)]. Total catch is the total number of individuals captured, and species richness is the total number of species or taxa captured. Individual fish and invertebrates not identified to species were counted in the total catch, but they were only considered a separate species for species richness calculations if no other species from the same taxon-level were captured. Catch-per- unit-effort is the number of each species or taxon captured per seine haul. Percent FO represents the number of hauls in which a species or taxon was captured divided by the total number of hauls made multiplied by 100.

Results

Fish fauna-Nome

A total of 135 fish representing at least 6 species were captured across the three sites at Nome (Table 2). Mean CPUE was 7.5 fish (n = 3) for seine catches. The three most abundant fish caught, accounting for more than 94% of the catch, were saffron cod (CPUE = 34, FO = 67%), longhead dab (CPUE = 5.7, FO = 67%), and Pacific herring (CPUE = 2.7, FO = 33%).

Invertebrate fauna- Nome

An estimated total of 250 invertebrates representing at least 3 species were captured in 3 seine hauls (Table 2). Mean invertebrate CPUE was 27.8 (n = 3) for seine catches.

Habitat - Nome

Substrate and gradient at the West Jetty site were different from the two sites outside the jetty. The gradient at the West Jetty site was nearly flat comprised of 70% sand and 30% large cobble. At the other two sites in Nome, the gradient was moderate with 30% gravel and 70% sand.

Fish fauna - Port Clarence

A total of 73 fish representing at least 12 species were captured across all sites at Port Clarence (Table 3). Mean CPUE was 1.3 fish (n = 4) for seine catches. The four most abundant fish caught, accounting for more than 79% of the catch, were tubenose poacher (CPUE = 7, FO = 50%), shorthorn sculpin (CPUE = 1.8, FO = 100%), three-spine stickleback (CPUE = 1.8, FO = 50%), and Pond smelt (CPUE = 1.3, FO = 25%).

Invertebrate fauna – Port Clarence

An estimated total of 146 invertebrates representing at least 5 species were captured in 4 seine hauls (Table 3). Mean invertebrate CPUE was 7.3 (n = 4) for seine catches.

Habitat – Port Clarence

The gradient was similar at beach seine sites in Port Clarence, but the substrate differed between most sites. Substrate at Willow Creek was composed of 40% gravel, 20% sand, and 40% small cobble. Substrate at the Jones Point site was composed of 30% gravel and 70% sand. The substrate at both sites on Point Spencer was similar; averaging 70% gravel and 30% sand.

Summary

The composition of nearshore fish catches were distinctly between Nome and Port Clarence. The dominant fishes in Nome, accounting for nearly 90% of the total catch, were Saffron cod and longhead dab. The dominant fishes in Port Clarence, accounting for nearly 80% of the total catch, were tubenose poacher, shorthorn sculpin, three-spine stickleback, and pond smelt.

Catches were highly variable in both locations; the West Jetty site in Nome, set inside the jetty, produced no catch despite a decent set and haul on the flat gradient. All of the catch in Nome therefore came from the two hauls outside the jetty. In Port Clarence, the sites on the east side (Willow Creek and Jones Point) were far more productive. Less than 10% of the catch in Port Clarence came from the two sites on Point Spencer.

Our sampling represents only a temporal and spatial “snapshot” of faunal distribution and relative abundance of nearshore fish and invertebrates. Indeed, the patchy distribution of some fish species and differences in water temperature, salinity, life stage, sampling effort, time of sampling, and gear types can determine the occurrence of any given species at any given time.

Additional sampling could provide a more complete description of species distribution and abundance in the nearshore habitats near Nome and Port Clarence.

Acknowledgements

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Figure 1. Seven sites sampled with a beach seine for nearshore fauna near Nome and in Port Clarence from September 16-20, 2013. Latitude and longitude of each site are listed in Table 1.

Figure 2. Close up of three sites sampled with a beach seine for nearshore fauna near Nome from September 16-20, 2013. Latitude and longitude of each site are listed in Table 1.

Figure 3. Close up of four sites sampled with a beach seine for nearshore fauna in Port Clarence from September 16-20, 2013. Latitude and longitude of each site are listed in Table 1.

Table 1. Latitude and longitude (decimal degrees) of 7 sites sampled for nearshore fauna in Nome and Port Clarence during September 16-20, 2013. Site locations are shown on Figure 1.

Gear	Location	Site	Latitude (N)	Longitude (W)
Seine	Nome	West Jetty	64.50010	165.43329
	Nome	Near West	64.50130	165.44691
	Nome	Far West	64.50455	165.47580
	Port Clarence	Willow Creek (PC1)	65.19897	166.46585
	Port Clarence	Jones Point (PC 2)	65.12917	166.62193
	Port Clarence	Pt. Spence N (PC3)	65.27553	166.84607
	Port Clarence	Pt. Spencer S (PC4)	65.26688	166.84608

Table 2. Total catch, mean catch-per-unit-effort (CPUE, unit = beach seine) and percent frequency of occurrence (FO) by taxa in Nome, Alaska, September 16-20, 2013. Fish and invertebrates were captured with a beach seine in marine waters at three sites, one haul per site. Site locations are shown in Figure 1 and listed in Table 1. Taxa are listed in decreasing order of abundance based on total catch among all tows.

Taxa	Total	CPUE	FO
Fish - **Nome Sites**			
Saffron cod, *Eleginus gracilis*	102	34	67
Long head dab, *Limanda proboscidea*	17	5.7	67
Pacific herring, *Clupea pallasii*	8	2.7	33
Pond smelt, *Hypomesus olidus*	3	1	33
Arctic flounder, *Pleuronectes glacialis*	3	1	67
Unidentified larval fish	2	0.7	33
Total catch	135		
Number of species	6		
Mean CPUE	7.5		
Invertebrates - Nome Sites			
Myisds - neomysis spp.	215	71.7	100
Shrimp- Crangon spp.	32	10.7	33
Unidentified jellyfish	3	1	67
Total catch	250		
Number of species	3		
Mean CPUE	27.8		

Table 3. Total catch, mean catch-per-unit-effort (CPUE, unit = beach seine) and percent frequency of occurrence (FO) by taxa in Port Clarence, Alaska, September 16-20, 2013. Fish and invertebrates were

captured with a beach seine in marine waters at four sites, one haul per site. Site locations are shown in Figures 1 and 2 and listed in Table 1. Taxa are listed in decreasing order of abundance based on total catch among all tows.

Taxa	Total	CPUE	FO
Fish - Port Clarence Sites			
Tubenose poacher, *Pallasina barbata*	28	7	50
Shorthorn sculpin, *Myoxocephalus scorpius*	17	1.8	100
Three-spine stickleback, *Gasterosteus aculeatus*	7	1.8	50
Pond smelt, *Hypomesus olidus*	5	1.3	25
Arctic flounder, *Liopsetta glacialis*	3	0.8	25
Saffron cod, *Eleginus gracilis*	3	0.8	25
Great sculpin, *Myoxocephalus polyacanthocephalus*	3	0.8	25
Rainbow smelt, *Osmerus mordax*	2	0.5	25
Pacific herring, *Clupea pallasii*	1	0.3	25
Pacific sandlance, *Ammodytes hexapterus*	1	0.3	25
Slender eelblenny, *Lumpenus fabricii*	1	0.3	25
Unidentified stickleback	1	0.3	25
Total catch	72		
Number of species	12		
Mean CPUE	1.3		
Invertebrates - Port Clarence Sites			
Myisds - neomysis spp.	100	25	50
Shrimp- Crangon spp.	25	6.3	100
Unidentified jellyfish	15	3.75	25
North Pacific seastar, *Asterias amurensis*	4	1	50
Helmet crab, *Telmessus cheiragonus*	2	0.5	50
Total catch	146		
Number of species	5		
Mean CPUE	7.3		

Appendix B

Additional Information of the Birds of the Southern Seward Peninsula

Table 1. Birds found in coastal and marine habitats of the Southern Seward Peninsula, Port Clarence, and northern Norton Sound. Bird list compiled from MMS 1980, Gill & Handel 1981, MMS 1990, ADF&G 2012.

Species	Season
Seabirds	
Arctic Tern (*Sterna paradisaea*)	spring-fall
Aleutian Tern (*Onychoprion aleuticus*)	spring- fall*
Glaucous Gull (*Larus hyperboreus*)	spring-fall, winter*
Mew Gull (*Larus canus*)	spring-fall
Sabine's Gull (*Xema sabini*)	spring-fall*
Bonaparte's Gull (*Larus philadelphia*)	spring-fall*
Glaucous-winged Gull (*Larus glaucescens*)	spring-fall
Herring/Vega Gull (*Larus argentatus*)	spring-fall*
Slaty-backed Gull (*Larus schistisagus*)	spring-fall*
Parasitic Jaeger (*Stercorarius parasiticus*)	spring-fall
Pomarine Jaeger (*Stercorarius pomarinus*)	spring-fall*
Long-tailed Jaeger (*Stercorarius longicaudus*)	spring-fall
Northern Fulmar (*Fulmarus glacialis*)	spring-fall*
Pelagic Cormorant* (*Phalacrocorax pelagicus*)	no information available
Common Murre (*Uria aalge*)	no information available
Thick-billed Murre (*Uria lomvia*)	no information available
Pigeon Guillemot * (*Cepphus columba*)	no information available
Kittlitz's Murrelet (*Brachyramphus brevirostris*)	no information available
Parakeet Auklet (*Aethia psittacula*)	no information available
Horned Puffin (*Fratercula corniculata*)	no information available
Shorebirds	
Dunlin (*Calidris alpina*)	spring-fall
Semipalmated Sandpiper (*Calidris pusilla*)	spring-fall
Western Sandpiper (*Calidris mauri*)	spring-fall
Red-necked Phalarope (*Phalaropus lobatus*)	spring-fall
Sanderling (*Calidris alba*)	spring-fall*
Red-necked Stint (*Calidris ruficollis*)	spring- fall*
Least Sandpiper (*Calidris minutilla*)	spring-fall*
Baird's Sandpiper (*Calidris bairdii*)	spring-fall*
Pectoral Sandpiper (*Calidris melanotos*)	spring-summer*, fall
Red Phalarope (*Phalaropus lobatus*)	spring- fall*
Semipalmated Plover (*Charadrius semipalmatus*)	spring-fall
American Golden Plover (*Pluvialis dominica*)	late summer-fall
Pacific Golden Plover (*Pluvialis fulva*)	fall*
Black-bellied Plover (*Pluvialis squatarola*)	spring-fall*
Bar-tailed Godwit (*Limosa lapponica*)	spring- fall

Species	Season
Whimbrel (*Numenius phaeopus*)	spring-fall
Bristle-thighed Curlew (*Numenius tahitiensis*)	spring-fall*
Lesser Yellowlegs (*Tringa flavipes*)	fall*
Ruddy Turnstone (*Arenaria interpres*)	spring-fall
Black Turnstone (*Arenaria melanocephala*)	spring-fall*
Common Snipe (*Gallinago gallinago*)	spring*
Long-billed Dowitcher (*Limnodromus scolopaceus*)	spring-fall
Wilson's Snipe (*Gallinago delicata*)	spring-fall
Red Knot (*Calidris canutus*)	spring-fall*
Sharp-tailed Sandpiper (*Calidris acuminata*)	fall*
Rock Sandpiper (*Calidris ptilocnemis*)	spring-fall*
Stilt Sandpiper (*Micropalama himantopus*)	spring- fall*
Spotted Sandpiper (*Actitis macularius*)	spring-fall
Surfbird (*Calidris virgata*)	spring-fall*
Wandering Tattler (*Tringa incana*)	spring-summer, fall*
Lesser Sandplover (*Charadrius mongolus*)	spring-summer*
Raptors and Other Birds of Prey	
Golden Eagle (*Aquila chrysaetos*)	spring-fall, winter*
Bald Eagle (*Haliaeetus leucocephalus)*	spring-fall*
Peregrine Falcon (*Falco peregrinus*)	spring-fall*
Gyrfalcon (*Falco rusticolus*)	year-round
Rough-legged Hawk (*Buteo lagopus)*	spring-fall
Northern Harrier (*Circus cyaneus)*	spring-summer, fall*
Merlin (*Falco columbarius*)	spring-fall*
Osprey (*Pandion haliaetus*)	spring-fall*
Snowy Owl (*Bubo scandiacus*)	year-round*
Short-eared Owl (*Asio flammeus*)	spring*, summer-fall
Common Raven (*Corvus corax)*	year-round
Waterfowl	
Northern Pintail (*Anas acuta*)	spring-fall
American Wigeon (*Anas americana*)	spring-fall
Eurasian Wigeon (*Anas penelope*)	spring-fall*
Greater Scaup (*Aythya marila*)	spring-fall
Lesser Scaup (*Aythya affinis*)	spring-fall*
Green-winged Teal (*Anas crecca*)	spring-fall
Mallard (*Anas platyrhynchos*)	spring-fall*
Lesser Scaup (*Aythya affinis*)	no information available
Northern Shoveler (*Anas clypeata*)	spring-fall*
Canvasback (*Aythya valisineria*)	spring-fall*
Long-tailed Duck (*Clangula hyemalis*)	spring-fall, winter*
Red-breasted Merganser (*Mergus serrator*)	spring-fall
Common Merganser (*Mergus merganser*)	spring-fall*
Common Goldeneye (*Bucephala clangula*)	spring*, summer*
Gadwall (*Anas strepera*)	spring-fall*
Surf Scoter (*Melanitta perspicillata*)	spring-fall
White-winged Scoter (*Melanitta fusca*)	spring-fall
Black Scoter (*Melanitta americana*)	no information available

Species	Season
Common Eider (*Somateria mollissima*)	spring-fall, winter*
King Eider (*Somateria spectabilis*)	year-round*
Spectacled Eider (*Somateria fischeri*)	spring-fall*
Steller's Eider (*Polysticta stelleri*)	spring-fall*
Harlequin Duck (*Histrionicus histrionicus*)	spring-fall
Brant (*Branta bernicla*)	spring-fall
Canada Goose (*Branta canadensis*)	no information available
Cackling Goose (*Branta hutchinsii*)	spring*, summer, fall*
Snow Goose (*Chen caerulescens*)	spring-fall
Greater White-fronted Goose (*Anser albifrons*)	spring-fall
Emperor Goose (*Chen canagica*)	spring-fall*
Tundra Swan (*Cygnus columbianus*)	spring-fall
Common Loon (*Gavia immer*)	spring-fall*
Pacific Loon (*Gavia pacifica*)	spring-fall
Arctic Loon (*Gavia arctica*)	spring-fall*
Red-throated Loon (*Gavia stellata*)	spring-fall
Yellow-billed Loon (*Gavia adamsii*)	spring-fall*
Horned Grebe (*Podiceps auritus*)	spring-fall*
Red-necked Grebe (*Podiceps grisegena*)	spring*, summer, fall*
Other	
Sandhill Crane (*Grus canadensis*)	spring-fall
Willow Ptarmigan (*Lagopus lagopus*)	year-round
Rock Ptarmigan (*Lagopus muta*)	year-round
Belted Kingfisher (*Megaceryle alcyon*)	spring-fall*
Say's Phoebe (*Sayornis saya*)	spring*, summer, fall
Horned Lark (*Eremophila alpestris*)	spring-fall*
Arctic Warbler (*Phylloscopus borealis*)	spring*, summer, fall
Bluethroat (*Luscinia svecica*)	spring-fall*
Northern Wheatear (*Oenanthe oenanthe*)	spring*, summer, fall
Lapland Longspur (*Calcarius lapponicus*)	spring, summer, fall
Savannah Sparrow (*Passerculus sandwichensis*)	spring*, summer, fall
Eastern Yellow Wagtail (*Motacilla tschutschensis*)	spring*, summer, fall
White Wagtail (*Motacilla alba*)	spring-fall*
Snow Bunting (*Plectrophenax nivalis*)	year-round
McKay's Bunting (*Plectrophenax hyperboreus*)	spring, fall, winter
Red-throated Pipit (*Anthus cervinus*)	spring-fall*
American Pipit (*Anthus rubescens*)	spring-fall

*Species is uncommon or rare.

Table 2. Seabirds possibly nesting in Port Clarence and Grantley Harbor area. Data from Denlinger (2006) and AKNHP (2010).

Species	Conservation Status		
	Alaska	North America	Global
Pelagic Cormorant[ϕ]	High	High Risk	Least Concern
Parasitic Jaeger	Low – Moderate	Low Concern	Least Concern
Long-tailed Jaeger	Not at Risk	Low Concern	Least Concern
Glaucous Gull	Not at Risk	Not Currently at Risk	Least Concern
Sabine's Gull	Low	Low Concern	Least Concern
Black-legged Kittiwake	Moderate	Not Currently at Risk	Least Concern
Arctic Tern	High	High Concern	Least Concern
Aleutian Tern	Moderate	High Concern	Least Concern
Common Murre	Low	Moderate Concern	Least Concern
Thick-billed Murre	Not at Risk	Moderate Concern	Least Concern
Pigeon Guillemot	Moderate	Moderate Concern	Least Concern
Kittlitz's Murrelet	High	High Risk	Critically Endangered
Parakeet Auklet	Low	Low Concern	Least Concern
Horned Puffin	Moderate	Moderate Concern	Least Concern

ϕ Species has year-round presence.

Table 3. Seabirds possibly nesting at the Bluff Colony. Data from Denlinger (2006) and AKNHP (2010).

Species	Conservation Status		
	Alaska	North America	Global
Pelagic Cormorant[ϕ]	High	High Risk	Least Concern
Parasitic Jaeger	Low – Moderate	Low Concern	Least Concern
Long-tailed Jaeger	Not at Risk	Low Concern	Least Concern
Glaucous Gull	Not at Risk	Not Currently at Risk	Least Concern
Sabine's Gull	Low	Low Concern	Least Concern
Mew Gull	Not at Risk	Not Currently at Risk	Least Concern
Black-legged Kittiwake	Moderate	Not Currently at Risk	Least Concern
Arctic Tern	High	High Concern	Least Concern
Aleutian Tern	Moderate	High Concern	Least Concern
Common Murre	Low	Moderate Concern	Least Concern
Thick-billed Murre	Not at Risk	Moderate Concern	Least Concern
Pigeon Guillemot[ϕ]	Moderate	Moderate Concern	Least Concern
Kittlitz's Murrelet	High	High Risk	Critically Endangered
Parakeet Auklet	Low	Low Concern	Least Concern
Horned Puffin	Moderate	Moderate Concern	Least Concern
Tufted Puffin	Not at Risk	Moderate Concern	Least Concern

ϕ Species has year-round presence.