SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL CHARACTERISTICS OF THE BEAUFORT SEA PLANNING AREA

1. Geology
- a. Physiography and Bathymetry
- b. Surficial Sediments
- c. Seafloor Stability
- d. Gas-Charged Sediments
- e. Faults and Earthquakes
- f. Shorelines
  - (1) Coastal Erosion
  - (2) Environmental Sensitivity Index
- g. Permafrost
- h. Natural Gas Hydrates

2. Climate, Meteorology, and Air Quality
- a. Climate and Meteorology
- b. Air Quality

3. Oceanography
- a. Circulation
- b. Temperature and Salinity
- c. Tides
- d. Waves and Swells
- e. Storm Surges
- f. Sea Ice
  - (1) Landfast-Ice Zone
  - (2) Stamukhi Zone
  - (3) Pack-Ice Zone

4. Chemical Oceanography and Water Quality
- a. Turbidity
- b. Dissolved Oxygen
- c. Trace Metals
- d. Hydrocarbons
- e. Long-Range Redistribution of Contaminants in the Arctic Ocean

B. BIOLOGICAL RESOURCES

1. LowerTrophic-Level Organisms
- a. Planktonic Communities
- b. Epontic Communities
- c. Benthic Communities

2. Fishes
- a. Freshwater Species
- b. Anadromous and Amphidromous Species
- c. Marine Species

3. Endangered and Threatened Species
- a. Bowhead Whale
- b. Arctic Peregrine Falcon
- c. Spectacled Eider
- d. Steller's Eider

4. Marine and Coastal Birds

5. Pinnipeds, Polar Bears, and Belukha Whales
- a. Pinnipeds
  - (1) Ringed Seals
  - (2) Bearded Seals
  - (3) Spotted Seals
  - (4) Walruses
- b. Polar Bears
- c. Belukha Whales

6. Caribou

C. SOCIAL SYSTEMS

1. Economy of the North Slope Borough
- a. NSB Revenues and Expenditures
- b. Employment

2. Subsistence-Harvest Patterns
- a. Characteristics of Harvest Patterns
- b. Annual Cycle of Harvest Activities
- c. Community Subsistence-Harvest Patterns
  - (1) Barrow
  - (2) Nuiqsut
    - (a) Bowhead Whales
    - (b) Belukha Whales
    - (c) Seals
    - (d) Walruses
    - (e) Polar Bears
    - (f) Caribou
    - (g) Fishes
    - (h) Marine and Coastal Birds
    - (i) Moose
  - (3) Kaktovik

3. Sociocultural Systems
- a. Characteristics of the Population
- b. Social Characteristics of the Communities
  - (1) Barrow
  - (2) Nuiqsut
  - (3) Kaktovik
- c. Social Organization
- d. Cultural Values
- e. Institutional Organization of the Communities
- f. Other Issues

4. Archaeological Resources
- a. Prehistoric Resources
  - (1) Review of the Baseline Study
  - (2) Review of Existing Geologic and Cultural Resource Reports
  - (3) Review of Sea-Level History
  - (4) Review of Geological/Geophysical Data to Determine Survivability and Detectability of Archaeological Resource Sites
- b. Historic Resources

5. Land Use Plans and Coastal Management Programs
- a. Land Status and Use
- b. Land Use Planning Documents
  - (1) NSB Comprehensive Plan and Land Management Regulations
  - (2) National Wildlife Refuge System Administration Act
  - (3) Alaska National Interest Lands Conservation Act (ANILCA)
  - (4) Comprehensive Conservation Plan (CCP)
- c. Coastal Management
  - (1) Statewide Coastal Management Standards
    - (a) Coastal Habitats
    - (b) Coastal Resources
    - (c) Uses and Activities
  - (2) NSB District CMP

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL CHARACTERISTICS OF THE BEAUFORT SEA PLANNING AREA:

The physical descriptions of the Beaufort Sea Planning Area in Sections III.A, B, and C of the Sales 97, 124, and 144 Final Environmental Impact Statements (FEIS's) (U.S. Dept. of the Interior [USDOI], MMS, 1987a, 1990a, and 1996a, respectively) are incorporated by reference in the following Sections III.A, Physical Characteristics; III.B, Biological Resources; and III.C, Social Systems. Summaries of these descriptions, augmented by additional material, as cited, follow.

1. Geology:

For information on the petroleum geology of the Sale 170 area and regional petroleum exploration history, see Appendix A of this EIS and the Sale 144 FEIS (USDOI, MMS, 1996a).

a. Physiography and Bathymetry: The Beaufort Sea Sale 170 area includes the continental shelf of the Alaskan Beaufort Sea. Water depths within the sale area range from about 1 meter (m) (approximately 3 feet [ft]) to slightly less than 40 m (120 ft). The major Beaufort Sea shelf bathymetric features are the barrier islands and shoals. Shoals rise 5 to 10 m (16-33 ft) above the surrounding seafloor and are found in water depths of 10 to 20 m (33-65 ft).

b. Surficial Sediments: The Alaskan Beaufort Sea shelf surficial sediments consist predominantly of mud (clay- and silt-size particles). Sediment erosion is more dominant than deposition out to a depth of 30 m. Coarse-grained sediments (sand- and gravel-size particles) are, for the most part, relict deposits found in the nearshore areas, in the vicinity of the offshore barrier islands, and on shoals and along the shelf break. Overconsolidated sediments are widespread on the Beaufort Sea shelf.

c. Seafloor Stability: Downslope movement of large, tabular sediment blocks occurs seaward of the 50- to 65-m isobath. These water depths are outside of the Sale 170 area.

d. Gas-Charged Sediments: Two areas of shallow gas are indicated by the acoustic anomalies of the seismic-reflection profiles. One is nearshore Camden Bay and the other is parallel to the shore from Bullen Point to the Colville River Delta. The Kaktovik Basin contains numerous diapirs that disturb the Tertiary sediments along the continental shelf east of 146° W. longitude. The occurrence of abnormal pressure probably is confined to areas of thick Cenozoic strata as in the Kaktovik, Camden, and Nuwuk basins.

e. Faults and Earthquakes: In the Sale 170 region, 73 earthquakes have been recorded from 1937 to 1992. These earthquakes range in magnitude from less than (<) 1.0 to 5.3 on the Richter scale; most of the earthquakes recorded since 1968 range in magnitude from 3.0 to 4.0. Earthquakes indicate active movement along the faults in the Camden Bay area and tend to occur along the axes of anticlines and synclines.

f. Shorelines:

(1) Coastal Erosion: The rates of coastal retreat vary from year to year. Most of the erosion occurs in late summer and autumn. Coastal erosion rates from Oliktok Point to the Hulahula River range from 1.3 to 3.7 m per year (m/yr). Some islands are migrating westward at rates of 19 to 30 m/yr (60-100 ft/yr) and landward 3 to 7 m/yr (10 to 23 ft/yr).

(2) Environmental Sensitivity Index: The environmental sensitivity index (ESI) of shorelines adjacent to the Sale 170 area ranges from 1 to 8 (Table III.A.1-1). Figure III.A.1-1 shows the percent frequency of ESI types from Oliktok Point to Barter Island.

g. Permafrost: Shallow zones of the bonded permafrost occur locally in the Beaufort Sea. A large area of permafrost occurs off the Sagavanirktok River, where ice-bonded sediments are commonly found <10 m below the surface. Also, seismic data indicate that some nearshore areas in Harrison Bay may be underlain by ice-bonded permafrost. Other areas of ice-bonded permafrost occur (1) in adjacent zones landward of the 2-m isobath that are overlain by bottomfast ice in the winter, (2) at highly variable depths up to several hundred meters beneath the seafloor, (3) in areas between the barrier islands and the shore, and (4) onshore and on some of the barrier islands. Based on seismic studies, permafrost also may exist on the Beaufort Shelf at depths that range from 100 to 1,900 m.

h. Natural Gas Hydrates: The presence of natural gas hydrates occurs in water depths exceeding 400 m. Natural gas hydrates are not anticipated in the Sale 170 area.

2. Climate, Meteorology, and Air Quality:

a. Climate and Meteorology: The Sale 170 area is in the Arctic climate zone. Mean annual temperature is about -12 degrees Celsius (°C). Precipitation ranges from 13 centimeters (cm) at Barrow to 18 cm at Barter Island and occurs mostly as summer rain. Fog frequently reduces visibility along the coast in the open-water season. Mean annual wind speed is 5 m per second (m/sec) at Barrow and 6 m/sec at Barter Island. Winds usually are easterly but shift to westerly from January through April. Part of this

Table III.A.1-1 Environmental Sensitivity Index for the Beaufort Sea Shorelines

Shoreline Type	ESI	Morphology	Persistence
Steep Cliffs	1	Shoreline exposures of ice-bonded permafrost	Oil is rapidly removed except in crevices or spray on top of cliffs
Steep Beaches and Bluffs	2	In front of unconsolidated cliffs of tundra	Oil is estimated to persist 1 or more years
Exposed, Non-vegetated Barriers	3	Gravelly or of mixed sand and gravel, frequent overwash	Oil is estimated to last for more than 1 year
Vegetated Low Barriers	4	Same as above with vegetative mat of mosses and grasses	Oil persistence increased over nonvegetative barriers
Lagoon Facing Mainland Shores	5	Range of shorelines all exposed to moderate wave action	Oil is estimated to persist for years
Peat Shores	6	Peat detritus is mixed in with inorganic sediment in the tundra bluffs	Oil is estimated to persist for many years
Sheltered Tidal Flats	7	Distal margin of major river deltas, fine sand and mud drapes.	Oil is estimated to persist for years
Marshes	8	Vegetated low-lying coastal areas subject to saltwater inundation	Oil is estimated to persist greater than 10 years

Source: Nummendal, 1980

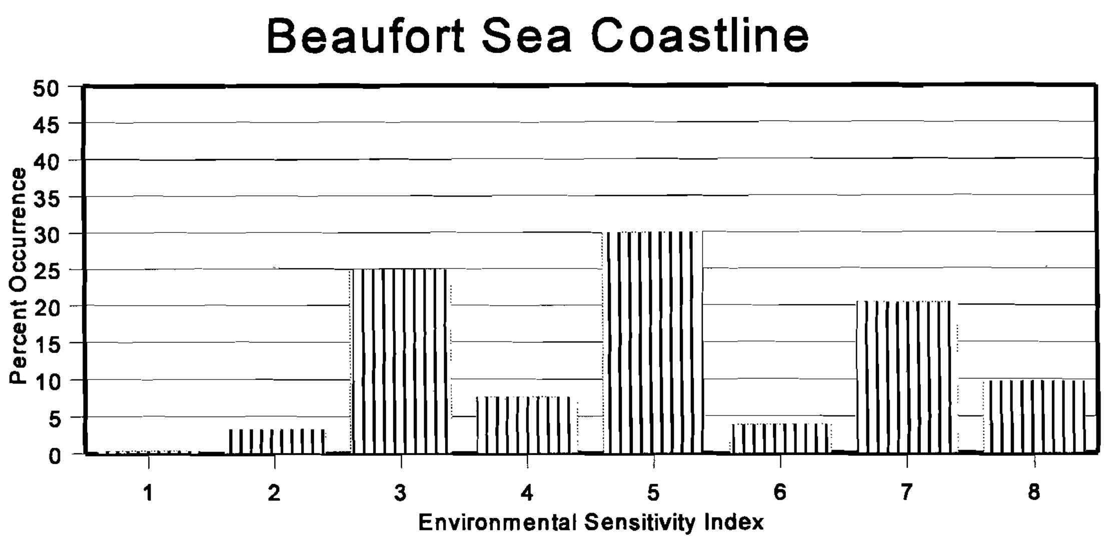


Figure III.A.1-1 Percent Frequency of Environmental Sensitivity Index 1 Through 8 Shorelines Adjacent to the Sale 170 Area from Oliktok Point to Barter Island. Source: Nummendal, 1980.

shift in winter, particularly along the eastern shores of the proposed sale area, is caused by air piling up against the Brooks Range. Sea breezes occur during about 25 percent of the summer and extend to at least 20 kilometers (km) offshore.

In the Sale 124 Public Hearing in Kaktovik, Mr. Ningeok stated that "without any notice at all this storm would come upon us. No matter how beautiful a day, these sudden storms can come upon you. We were unloading the plane, at that moment, the plane did not leave, nor did we get done unloading the plane, and all the supplies for the DEW line were frozen out there because of this sudden snow storm which no one was able to do anything at all" (USDOI, MMS, 1990b).

b. Air Quality: The existing onshore air quality for most areas adjacent to the Beaufort Sea sale area is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards (national standards) and State air-quality statutes and regulations (U.S. Environmental Protection Agency [USEPA], 1978). These standards are designed to protect human health. Areas where national standards are attained are referred to as attainment areas; others are nonattainment areas. The entire North Slope of Alaska is an attainment area. Under provisions of the Prevention of Significant Deterioration Program (PSD) of the Clean Air Act, existing air quality superior to the national standards is protected by additional limitations on nitrogen dioxide, sulfur dioxide, and total-suspended-particulate matter. Areas in Alaska currently are designated as PSD Class I or II. Class I air-quality designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. There are no Class I areas in or near the proposed sale area. The entire onshore area adjacent to the sale area is designated Class II. The applicable standards and PSD Class II increments are listed in Table III.A.2-1.

Over most of the onshore area adjacent to the sale area, there are only a few small, scattered emissions from widely scattered sources, principally from diesel-electric generators in small villages. The only major local sources of industrial emissions near the sale area are in the Prudhoe Bay/Kuparuk/Endicott oil-production complex. This area was the subject of two monitoring programs during 1986 to 1987 (ERT, 1987; Environmental Science and Engineering, Inc., 1987). In each case, two monitoring sites were selected—one deemed subject to maximum air-pollutant concentrations, and one site to be more representative of the air quality of the general Prudhoe Bay area. The 1-hour maximum-value standard for ozone at site C (Table III.A.2-2) apparently was exceeded; however, it was determined that the high ozone level may have been caused by arc welding within 150 m of the monitoring site. However, the results demonstrate that generally, most ambient-pollutant concentrations, even for sites deemed subject to maximum concentrations, meet the ambient-air-pollution standards. This is true even if the baseline PSD concentrations (which must be determined on a site-specific basis) are assumed to be zero, limiting the allowable increase in concentrations.

During the winter and spring, pollutants are transported to arctic Alaska across the Arctic Ocean from industrial Europe and Asia (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze. Pollutant sulfate due to arctic haze in the air in Barrow—that in excess of natural background—averages 1.5 micrograms per cubic meter. The concentration of vanadium, a combustion product of fossil fuels, averages up to 20 times the background levels in the air and snowpack. Recent observations of the chemistry of the snowpack in the Canadian Arctic also provide evidence of long-range transport of small concentrations of organochlorine pesticides (Gregor and Gummer, 1989). Concentrations of arctic haze during winter and spring at Barrow are similar to those over large portions of the continental U.S. (see Fig. III.A.2), but they are considerably higher than levels south of the Brooks Range of Alaska. Any ground-level effects of arctic haze on the concentrations of regulated air pollutants in the Prudhoe Bay area are included in the monitoring data given in Table III.A.2-2. Model calculations indicate that <10 percent of the pollutants emitted in the major source regions is deposited in the Arctic (Pacyna, 1995). Maximum concentrations of some pollutants, sulfates and fine particles, were observed during the early 1980's and decreases were measured at select stations at the end of the 1980's (Pacyna, 1995). Despite this seasonal, long-distance transport of pollutants into the Arctic, regional air quality still is far better than specified by standards.

3. Oceanography:

a. Circulation: The Sale 170 area is on the inner shelf. The inner shelf is <50 m and includes the nearshore barrier islands, open bays, lagoons, and river deltas. Inner-shelf circulation primarily is wind driven; other factors controlling circulation include tides, river discharge, ice melt, bathymetry, and coastal geomorphology. The generalized circulation is shown in Figure III.A.3-1.

During open water, the prevailing winds are easterly, which move surface water to the west from Barter Island to Oliktok Point. The circulation changes rapidly to changes in wind direction such that under westerly winds, common in the fall and winter, surface water moves to the east. The year-round mean surface-current direction is to the west.

The current speed is approximately 3 to 4 percent of the wind speed. The nearshore surface water responds quickly, within 1 to 3 hours, to changes in the wind direction from sustained easterly (or westerly) to sustained westerly (or easterly). Natural shelf circulation generally is parallel to

Table III.A.2-1. Ambient-Air-Quality Standards Relevant to Beaufort Sea Lease Sale 170
(Measured in $\mu g/m^3$; an asterisk [*] indicates that no standards have been established.)

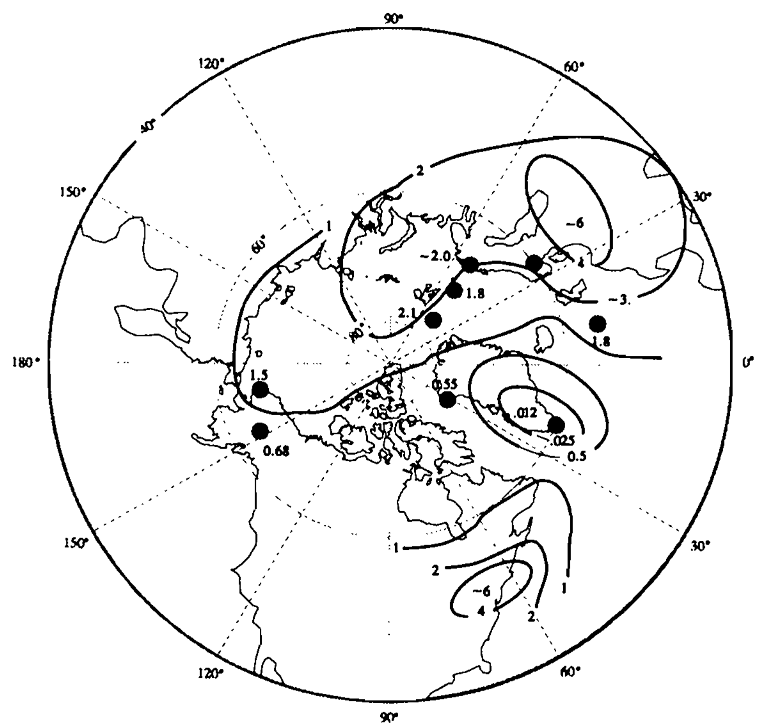
	Averaging Time Criteria					
Pollutant[1]	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Total Suspended Particulates[2]	60[3]	150	*	*	*	*
Class II[4]	19[3]	37	*	*	*	*
Carbon Monoxide	*	*	10,000	*	40,000	*
Ozone[5]	*	*	*	*	235[6]	*
Nitrogen Dioxide	100[7]	*	*	*	*	*
Class II[4]	25[7]	*	*	*	*	*
Inhalable Particulate Matter (PM10)[8]	50[9]	150[10]	*	*	*	*
Class II[4]	17	30	*	*	*	*
Lead	1.5[11]	*	*	*	*	*
Sulfur Dioxide	80[7]	365	*	1,300	*	*
Class II[4]	20[7]	91	*	512	*	*
Reduced Sulfur Compounds[2]	*	*	*	*	*	50

Source: State of Alaska, Dept. of Environmental Conservation, 1982, 80, 18, AAC, 50.010, 18 AAC 50.020; 40 CFR 52.21 (43 FR 26388); 40 CFR 50.6 (52 FR 24663); 40 CFR 51.166 (53 FR 40671).
Footnotes: [1] All-year averaging times not to be exceeded more than once each year, except that annual means may not be exceeded. [2] State of Alaska air-quality standard (not national standard). [3] Annual geometric mean. [4] Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations. [5] The State ozone standard compares with national standards for photochemical oxidants; which are measured as ozone. [6] The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an "expected exceedance during a year." [7] Annual arithmetic mean. [8] PM10 is the particulate matter less than 10 micrometers in aerodynamic diameter. [9] Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 $\mu g/m^3$. [10] Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$, as determined in accordance with 40 CFR 50, subpart K, is equal to or less than 1. [11] Maximum arithmetic mean averaged over a calendar quarter.

Table III.A.2-2. Measured-Air-Pollutant Concentrations at Prudhoe Bay, Alaska 1986-1987
(Measured in $\mu g/m^3$; absence of data is indicated by asterisks [**].)

	Monitor Sites					
Pollutant[1]	A[2]	B[3]	C[4]	D[5]	National Standards[6]	Class II Increments[7]
Total Suspended Particulates						
Annual	8.4	**	14.8	**	60	19
Annual Max. 24 hr	79.7	**	104[8]	**	150	37
Ozone						
Annual Max. 1 hr	92.1	170.5	265[9]	67	235	
Nitrogen Dioxide						
Annual	15.8	7.5	16	4	100	25
Inhalable Particulate Matter (PM10)						
Annual	**	**	10.5	**	50	17
Annual Max. 24 hr	**	**	25[8]	**	150	30
Sulfur Dioxide						
Annual	7.9	**	3	**	80	20
Annual Max. 24 hr	15.7	**	80.5[8]	**	365	91
Annual Max. 3 hr	21.0	**	**	**	1,300	512
Carbon Monoxide						
Annual Max. 8 hr	**	**	1,400	**	10,000	
Annual Max. 1 hr	**	**	2,500[8]	**	40,000	

Sources: ERT, 1987, and Environmental Science and Engineering, 1987.
[1] Lead was not monitored. [2] Site CCP (Central Compressor Plant), Prudhoe Bay monitoring program, selected for maximum pollutant concentrations. [3] Site Pad A (Drill Pad A), Prudhoe Bay monitoring program, site of previous monitoring, selected to be more representative of the general area or neighborhood. [4] Site CPF-1 (Central Processing Facility), Kuparuk monitoring program, selected for maximum pollutant concentrations. [5] Site DS-1F, Kuparuk monitoring program site selected to be representative of the general area or neighborhood. [6] Applicable National Ambient Air Quality Standards. Please refer to Table III.A.2-1 for more specific definitions of air-quality standards. [7] Class II PSD Standard Increments. [8] Second highest observed value (in accordance with approved procedures for determining ambient-air quality). [9] The highest value for ozone at site C (CPF-1) may have been atypical due to field operations using arc welding within 150 m of the site. Otherwise, the highest value at the site was 174.7 $\mu g/m^3$.



Source: After Rahn, 1982.

Figure III.A.2 Mean Winter Concentrations of Pollutant Sulphate ($\mu g/m^3$) in Surface Aerosol of Arctic and Environs

the shelf with large zonal variations across the shelf. Herman Aishana stated that at "Brownlow Point - the currents, I found out, were pretty strong in that area down there. There were no currents on top, but there were a lot of currents down (below). Around Flaxman I've seen stronger currents over there" (University of Alaska [UAA], Institute for Social and Economic Research [ISER], 1983). Mr. Ningeok of Kaktovik stated during the Sale 124 public hearings, ". . .even if there's no wind, the ocean current can be so swift that no matter how thick the ice is, even without any wind, it really can do something because the current, ocean currents, are so swift in this part of the country (USDOI, MMS, 1990b)."

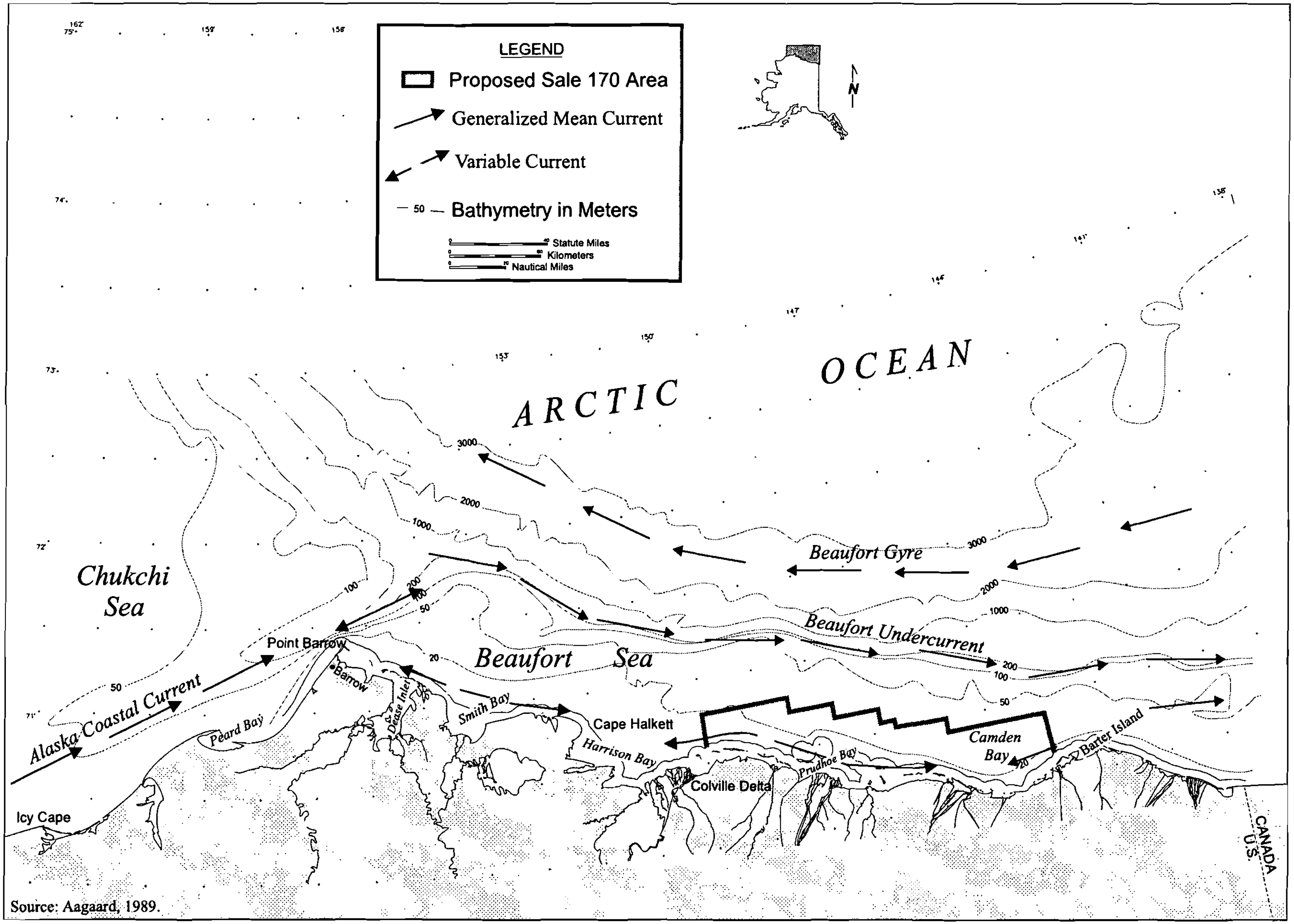
In addition to the wind causing water movement to the east or west, the wind moves some water onshore or offshore. Easterly winds cause nearshore, warm, less saline surface waters to move offshore and cooler, more saline marine waters to flow onshore. Westerly winds result in warmer water replacing the cooler, more saline marine water that encroaches along the coast during easterly winds. During westerly winds, when the dominant flow direction is to the east, the water column tends to become more vertically homogeneous.

In the spring and summer warm, freshwater runoff accumulates in the surface layer on and adjacent to the deltas. As water spreads seaward across the shelf, there is an accompanying onshore flow of cooler, more saline marine water in a subsurface layer (similar to estuarine flow, except it occurs along the entire coastline). This estuarine-type circulation probably is most important during the period of high runoff in late spring-early summer and continues to a lesser extent throughout the summer. The residence time of this fresh- or low-salinity water in the nearshore environments largely depends on the frequency and direction of the easterly and westerly winds. Persistent easterly winds cause the water to move offshore; however, persistent westerly winds keep these waters nearshore.

Transverse flow also occurs in the winter. As seawater freezes, dense brine forms and flows offshore in the lower layer; this offshore flow probably is accompanied by an onshore flow in the upper layer. Brine flow is most important during the early freezeup, especially in the shallow, nearshore water, and probably continues throughout the winter.

The circulation and water-exchange patterns of lagoons adjacent to the Sale 170 area between Oliktok Point and Barter Island are classified as open lagoons. Open lagoons are open to alongshore transport as well as cross-shelf exchange through the multiple large openings between the barrier islands.

The West Dock and Endicott causeways are manmade structures that act as geomorphological features affecting



Source: Aagaard, 1989.

Figure III.A.3-1. Generalized Schematic of the Offshore Circulation in the Beaufort Sea the circulation and mixing of watermasses. Both causeways generally are orientated perpendicular to the bathymetry. This orientation deflects the east-west transport of water along the inner shelf offshore and causes changes in the hydrographic conditions downstream from the causeways; these changes are indicated by temperature and salinity gradients between the areas east and west of the causeways. The effects of the Endicott Causeway are to reduce the amount of warm, low-salinity water that flows into Foggy Island Bay during westerly winds.

b. Temperature and Salinity: Near Barrow, the Alaska Coastal Water has temperatures of 5 to 10 °C and salinities <31.5 parts per thousand ($^{o}/_{oo}$); the Bering Sea Water temperatures are near 0 °C and have salinities of 32.2 to 33$^{o}/_{oo}$. These watermasses move into the Beaufort Sea through the Barrow Canyon. The Alaska Coastal Water mixes rapidly with the surface water in the Beaufort Sea and is not clearly identifiable east of Prudhoe Bay. The Bering Sea Water has been traced as far east as Barter Island. Depending on the season, amount of freshwater, and proximity to shore and rivers, temperatures can range from 0 to 15 °C, and salinities can range from <5$^{o}/_{oo}$ to >30.5$^{o}/_{oo}$.

c. Tides: Tides in the Beaufort Sea are very small and generally are mixed semidiurnal, with mean ranges from 10 to 30 cm. Tide height increases slightly west to east along stations on the Beaufort Sea coast.

d. Waves and Swells: The Sale 170 area is a low-wave-energy environment. Waves, which generally are from the northeast and east, are limited to the open-water season due to the ice pack. Wave heights greater than (>) 0.5 m occur in <20 percent of the observations; wave heights >5.5 m are not reported.

e. Storm Surges: Summer and fall storms frequently generate storm surges increasing sea level 1 to 3 m. Storm surges also occur during the period from December through February, but changes in sea-level elevation are less than in summer and fall. Decreases in sea-level elevation also occur and appear to be more frequent in the winter months.

f. Sea Ice: The Sale 170 area is covered by sea ice for three-quarters of the year. There are wide-ranging spatial and temporal variations, but during an "average year," the September arctic pack-ice edge ranges from 20 to 110 km offshore. In mid-October, the edge moves south of the sale area, and >50 percent of the area is covered with ice; from November through May, the ice covers >90 percent of the sale area. By mid-July, much of the lagoonal and open-shelf fast ice inside the 10-m isobath has melted, and there is ice movement. After the first openings and ice movement in late June to early July, the areas of open water with few icefloes expand along the coast and away from the shore, and there is a seaward migration of the pack-ice zone. The concentration of icefloes generally increases seaward and, as the pack retreats, the width of the bands that define percentage of sea-ice cover also increases. East and northeast winds drive the ice offshore; westerly winds move the ice onshore.

The sale area's sea ice consists of a landfast-ice zone, the stamukhi (or shear) zone, and the pack-ice zone.

(1) Landfast-Ice Zone: The landfast-ice zone extends from shore to the zone of grounded ridges. Grounded ridges first form in about 8 to 15 m of water but, by late winter, may extend beyond the 20-m isobath. Ice movements in later winter usually are on the order of tens of meters, but larger movements up to several hundred meters occur. Deformations take the form of pileups and rideups on the coastal and island beaches and rubble fields and small ridges offshore. As the winter progresses, extensive deformation within the landfast-ice zone generally decreases as the ice in the landfast zone thickens and strengthens and becomes more resistant to deformation. By late winter, first-year sea ice in the landfast-ice zone generally is about 2 m thick; out to a depth of about 2 m, it is frozen to the bottom forming the bottomfast-ice subzone. The remaining ice in the landfast zone is floating, forming the floating fast-ice subzone.

The onshore movement of sea ice in the landfast-ice zone is a relatively common event that generates pileups and rideups along the coast and on offshore and barrier islands. The onshore pileups frequently extend up to 20 m inland from the shoreline over both gently sloping terrain and up onto steep coastal bluffs. Ice rideups, where the whole ice sheet slides in a relatively unbroken manner over the ground surface for >50 m, are not very frequent; rideups that extend >100 m are relatively infrequent.

During public hearings, the local residents of Nuiqsut and Kaktovik described numerous incidents where the ice has come onshore and has come up over cliffs as high as 20 to 40 ft. Mr. Isaak Akootchook of Kaktovik stated that ". . .the current is pretty strong. It can push (ice) all the way (up on) the shore, about 20 to 30 feet high. But we haven't seen this (for) about 50 years now." During the Beaufort Sea (BF) Public Hearing in Nuiqsut, Mr. Neil Allen wrote:

> "I have seen how strong the ice can be. In 1929 or 1930 I was living with my brother. In December, just before Christmas a very strong west wind came up. When the weather cleared, we went over to Icy Reef and we saw that the ice had pushed up on the island. My brother measured how thick the ice was. It was as thick as the length of the pole he carried which was 5-1/2 feet long. That thick sheet of ice had pushed over

the island. In those days the island was about 20 feet high and 200 feet wide" (USDOI, MMS, 1979a).

Mr. Phillip Tikluk of Kaktovik stated during the BF public hearings:

"But they don't know how strong the ice movements are. I have seen the ocean when it piles up and when it moves. With a little help of wind I have seen here in Barter Island when it piles up and when it hit the beach. We have a cliff out here which is maybe thirty or forty feet high and during the month of June if I remember right the ice moved and that ice maybe five to six feet thick climbs up over the cliff that's how strong it is. The ice five feet or six feet thick right on top of the thirty or forty foot cliff. I have seen the ice move right across from the ocean side to the lagoon, blocking the airport road. The ice starts to move, it doesn't stop at anything" (USDOI, MMS 1979b).

(2) **Stamukhi Zone:** Seaward of the landfast-ice zone is the stamukhi, or shear, zone. This is a region of dynamic interaction between the relatively stable ice of the landfast-ice zone and the mobile ice of the pack-ice zone that results in the formation of ridges and leads. In the Beaufort Sea, the region of most intense ridging occurs in waters that are 15 to 45 m deep. During the BF Public Hearings in Nuiqsut, Mrs. Bessie Ericklook describes what happens when a pressure ridge meets a barrier island:

"I have seen how a sodhouse was covered up by a pressure ridge in the wintertime. The wind was so strong that it covered one end of this island. The ice is very dangerous and unpredictable in Oct./Nov. During one December on one of the islands, another sodhouse was completely covered by pressure ridge. The ice had cracked and the ice turbulent and it took two of Tookak's kids. Another movement and his wife was taken away. You cannot talk of the ice so easily. You cannot control nature, the wind. The wind is the greatest factor" (USDOI, MMS, 1979a).

The dominant ice-gouge orientation in waters 10 to 50 m deep generally is parallel to the coast. Gouge densities >100 gouges per square kilometer (km^2) are found in waters 20 to 40 m deep with average depths of >1 m. Dense gouging also occurs on the seaward side of the shoals. The lowest gouge densities are located in waters that are <5 m deep and >45 m deep.

(3) **Pack-Ice Zone:** The pack-ice zone lies seaward of the stamukhi zone and includes first-year ice, multiyear undeformed and deformed ice, and ice islands. The first-year ice that forms in the fractures, leads, and polynyas (large areas of open water) within the pack-ice zone varies in thickness from a few centimeters to more than a meter. Multiyear ice is simply defined as ice that has survived one or more melt seasons; undeformed multiyear ice is believed to reach a steady-state thickness of 3 to 5 m. Undeformed icefloes with diameters >500 m occupy about 60 percent of the pack-ice zone; some floes may have diameters up to 10 km.

Ridges are a prominent indicator of deformed ice. The height of most ridges appears to be about 1 to 2 m; ridge heights up to 6.4 m have been observed. The relationship between ridge sail height and keel depths suggests a sail-to-keel ratio of about 1:4.5 for first-year ice ridges and 1:3.3 for multiyear ridges. Multiyear composite maps of major ridges indicate that (1) in the nearshore region, there is a pronounced increase in ridge density in the vicinity of shoals and large promontories; (2) massive ridges occur shoreward of the 20-m isobath; and (3) in the eastern Beaufort Sea 30 to 40 km from the coast, there is an increase in ridging from east to west.

During the winter, movement in the pack-ice zone of the Beaufort Sea generally is small and tends to occur with strong winds of several days' duration. The long-term direction of ice movement is from east to west in response to the Beaufort Gyre; however, there may be short-term perturbations from the general trend due to the passage of low- and high-pressure weather systems across the Arctic. The velocity of the pack ice has been reported variously as having (1) a mean annual net drift of 1.4 to 4.8 km per day and (2) an actual rate of 2.2 to 7.4 km per day, with extreme events up to 32 km per day.

4. Chemical Oceanography and Water Quality:

The description of the chemical oceanography and water quality contained in the Sale 144 FEIS (USDOI, MMS, 1996a) is summarized herein and incorporated by reference. This description is augmented by additional material.

The marine waters of the Beaufort Sea Planning Area provide an environment for (1) many species of pelagic and benthic plants and animals and (2) a variety of human commercial, industrial, and subsistence activities.

The quality of the Beaufort Sea aquatic environment is determined by water's physical (Sec. III.A.3, Physical Oceanography) and chemical characteristics. The constituents of the waters mainly are composed of naturally occurring substances but may include manmade substances—pollutants. The naturally occurring substances are derived from the atmospheric, terrestrial, and other aquatic (fresh and marine) environments. The waterborne and airborne substances entering the Beaufort Sea may include pollutants.

Because of little or no industrial activity, most contaminants occur at low levels in the Beaufort Sea

Planning Area. However, turbidity, trace metals, and hydrocarbons are introduced into the marine environment through river runoff, coastal erosion, atmospheric deposition, and natural seeps. The rivers (Colville, Kuparuk, Sagavanirktok, and Canning) that flow into the Alaskan Beaufort Sea remain relatively unpolluted by human activities.

a. Turbidity: Satellite imagery and suspended-particulate-matter data suggest that in general, turbid waters are confined to depths within the 5-m isobath and do not extend seaward of the barrier islands. In mid-June through early July, the shallow inshore waters generally carry more suspended material, because runoff from the rivers produces very high turbidity adjacent to the river mouths. The resulting turbidity from the floods, along with other factors, blocks light and measurably reduces primary productivity of waters inshore of about the 13-m isobath. Wave action resulting from prevailing winds and storms during the open-water season resuspends unconsolidated river-delta sediments, which increases the turbidity in shallow inshore areas. Any ice cover in summer limits wave action and decreases turbidity.

b. Dissolved Oxygen: Dissolved oxygen levels in the Beaufort Sea Planning Area usually are high, about 8 milliliters (ml) of oxygen per liter. In deeper waters, there is an oxygen minimum of 6 ml per liter at about 150- to 200-m depth. Under winter ice cover, respiration of oxygen continues, but atmospheric exchange and photosynthetic production of oxygen cease. Some oxygen is excluded into underlying water from thickening ice. Over the ice-covered period, areas with unrestricted circulation seldom drop below 6 ml of oxygen per liter. In areas of reduced circulation or high respiration, further depletion occurs. In 1975, a basin of the Colville River Delta containing overwintering fish contained only 2 ml of oxygen per liter underneath the ice. Such basins sometimes turn anoxic before spring breakup.

c. Trace Metals: Beaufort Sea trace-metal levels are elevated relative to the eastern Arctic Ocean due to high trace-metal levels in Bering Sea waters entering the Arctic Ocean through Bering Strait. Trace metal concentrations in the Beaufort Sea Planning Area generally are considerably lower than USEPA criteria and show no indication of pollution (Table III.A.5-1, USDOI, MMS, 1996a).

Studies to date have not found any evidence of trace-metal contamination of sediments. Observed geographic variation in the trace-metal concentration were attributed to grain-size distribution and organic content, with higher trace-metal concentrations in finer sediments. The major rivers—Canning (except for mercury), Sagavanirktok, Kuparuk, and Colville—are thought to be major sources for the trace metals in the Beaufort Sea coastal sediments.

d. Hydrocarbons: Background water hydrocarbon concentrations are low, generally equal to or less than ($\leq$)1 parts per billion (ppb) (ppb $\approx$ nanogram/gram) and appear to be biogenic. Sediment aliphatic and aromatic hydrocarbon levels are relatively high in comparison with other undeveloped outer continental shelf (OCS) areas. The hydrocarbon composition differs from most other areas because they are largely fossil derived. The hydrocarbon sources primarily are the onshore coal and shale outcrops and natural petroleum seeps that are drained by rivers into the Beaufort Sea.

Most of these aliphatic hydrocarbons—80 to 85 percent—found in Harrison Bay are higher molecular-weight alkanes (n-C21 to n-C34) characterized by odd-carbon dominance, indicating a biogenic source from terrestrial plant materials. The presence of significant quantities of lower molecular-weight alkanes, 0.3 to 1.2 parts per million (ppm) (15-20% of the total aliphatic hydrocarbons), also suggests widespread presence of petroleum hydrocarbons in the sediments. The highest concentrations were found offshore of the Colville River (Harrison Bay) and offshore of the Kuparuk River.

The total aromatic hydrocarbons (TAH) range between 8 and 16 ppm and appear to be derived mostly from nonindustrial, abiotic source materials. The subportion of TAH constituting two-to-five-ring polynuclear aromatic hydrocarbons (PAH) range from 0.2 ppm in Camden Bay and the Endicott Field area to 0.65 in the Kuparuk River Delta and to 1.0 ppm in Harrison Bay. The predominance of two-to-three-ring PAH over most four-to-five-ring PAH (with the exception of perylene) indicates that the PAH is derived from petrogenic (e.g., crude oil or coal) rather than pyrolytic sources. This derivation requires local marine or local terrestrial sources rather than a long-distance, atmospheric source. The rivers, particularly the Colville and Kuparuk, appear to be important sources of PAH; however, marine-sediment concentrations range higher than riverine-sediment concentrations, suggesting the possibility of additional contributions from marine seeps.

There is no evidence that the hydrocarbon concentrations in Beaufort Sea sediments are derived from oil-industry activities.

e. Long-Range Redistribution of Contaminants in the Arctic Ocean: Drifting sea ice may play a role in the long-range redistribution of contaminants in the Arctic Ocean; however very little data are available to permit an assessment of its relative contribution to pollutant dispersal in this region (Pfirman et al., 1995). Sea ice contains fine-grained particulate matter and organic material, and contaminants tend to sorb onto these particles and/or organic material. The contaminants may be associated with (1) riverborne particulate matter that may be deposited on or near the deltas or dissolved substances that mix with the seawater, (2) wind-blown particulate matter that may be deposited on the surface of the open water or sea ice, and (3) particulate matter associated with the arctic haze, which also may be deposited on the surface of the open water or sea ice. Pollutants of concern include radionuclides, pesticides, oil, heavy metals, and other agricultural and industrial byproducts.

The central Arctic ice cover includes ice that initially formed during winter on the shallow parts of the Arctic Ocean continental shelves, especially the Siberian shelf. The Siberian rivers discharging into the Kara, Laptev, and East Siberian seas drain an area of about 9 million km^2, which extends far to the south and encompasses many industrial and agricultural regions (Alaska contains about 1.5 million km^2; the drainage area of the Yukon River at Pilot Station is about 0.8 million km^2). The ice formed in the shallow regions of the continental shelves contains large amounts of fine-grained particles deposited on the seafloor or suspended in the water column or on the surface. Shelf ice, which has survived summer melting, is transported into the central part of the Arctic Ocean and becomes part of the drifting pack ice.

During the summer, some of the ice in the drifting pack ice is transported into the shallow waters of the continental shelves. When melting occurs, the particulate matter in the ice escapes into the water column, where the particles may remain suspended on the surface or in the water column or be deposited on the ocean floor. The formation, transport, and melting sea ice contribute to the dispersal of particulate matter, and any associated contaminants, in the Arctic Ocean.

A relatively large amount of the drifting pack ice exits the Arctic Ocean through Fram Strait located east of Greenland; the amount is estimated to be about 2,600 km^2 annually. Ice that forms on the Eurasian shelves is incorporated into the Transpolar Drift Stream, which moves westward towards the Fram Strait; the transport of ice from the Laptev Sea typically takes about 3 years. Ice from the Beaufort, Chukchi, and East Siberian seas becomes part of the Beaufort Gyre and may circulate for 5 or more years before exiting the Arctic Ocean.

B. BIOLOGICAL RESOURCES:

1. Lower Trophic-Level Organisms:

The following section summarizes the lower trophics information contained in former Beaufort Sea EIS's, which are herein incorporated by reference. Lower trophic-level organisms in the Beaufort Sea can be categorized as planktonic (living in the water column), epontic (living on the underside of sea ice), or benthic (living on or in the sea bottom). Due to the annual predominance of shorefast ice, the intertidal zone of the Beaufort Sea (0-10 m in depth) is highly disturbed and supports no marine flora and few fauna. Hence, in the traditional sense, there is little or no intertidal zone in the Beaufort Sea. Rather, it is a disturbed shoreline area that is seasonally recolonized by a small number of fauna during the summer months.

a. Planktonic Communities: Annual primary production in the Alaskan Beaufort Sea is low compared to that of other oceans. Recent estimates of annual primary production in this area indicate that up to 30 grams of carbon per year per square meter ($gC/yr/m^2$) can be produced in the shelf and coastal environments. This is roughly the same as that produced in the central gyres of the Atlantic and Pacific oceans (Schell, 1988; Cooney, 1988). In the Beaufort Sea, there is no real evidence of a major spring phytoplankton bloom occurring; instead, there is a modest phytoplankton increase during and after ice breakup. The most productive areas of the Alaskan Beaufort Sea appear to be the areas near Barrow in the west and Barter Island in the east. Annual primary production in the area just east of Barrow could be as high as 50 $gC/yr/m^2$ (Schell et al., 1982). The abundance of phytoplankton appears to be greatest in nearshore waters at depths <5 m, with decreasing numbers farther offshore. Peak abundance occurs in late July and early August due to increased light intensity during this period. Sources of primary production include epontic algae, phytoplankton, benthic microalgae, benthic macroalgae, and peat entering into the system from terrestrial areas. The contribution of ice algae to annual productivity is small, but it provides a source of food in early spring when food is in short supply. Benthic macroscopic algae, although limited in their occurrence in the Beaufort Sea, can provide as much as 56 percent of the annual primary production in an area (Dunton, 1984).

Due to the small amount of primary production in the Alaskan Beaufort Sea, the zooplankton communities of this area also are impoverished and are characterized by low diversity, low biomass, and slow growth (Cooney, 1988). More than 100 species of zooplankton have been identified in the Beaufort Sea. They are (1) species that occur throughout the Arctic Basin; (2) species that are swept into the Alaskan Beaufort Sea to varying extent from the Bering and Chukchi seas; (3) species characteristic of nearshore, less saline environments; and (4) species that are the larval forms of animals that live in the benthos (meroplankton) (USDOC, National Oceanographic and Atmospheric Administration, 1978). Richardson (1986), in a study of the eastern Beaufort Sea, found that copepods represented 87 percent of the individual zooplankters and 78 percent of the wet-weight zooplankton biomass. Distribution of zooplankton in the eastern Beaufort Sea was patchy, with patches being very extensive in the horizontal plane (e.g., hundreds to thousands of meters across), but usually only 5 to 10 m thick. Off of Kaktovik, patches of zooplankton were more abundant in nearshore and inner-shelf waters, and biomass was greater than in more offshore waters (Richardson, 1986).

b. Epontic Communities: Epontic communities are composed of those plants and animals living on or in the undersurface of sea ice. Microalgae in the ice consist primarily of pennate diatoms and microflagellates. Although approximately 200 diatom species have been identified from arctic sea ice, only a few species predominate. Microalgae are found in sea ice as it forms in the fall, but the origin of the cells is not known (Horner and Schrader, 1982). Light appears to be the major factor controlling the distribution, development, and production of the ice-algal assemblage. The total amount of epontic algal primary production was estimated by Schell and Horner (1981) to constitute about one-twentieth of the annual total primary production of the nearshore zone. Dunton (1984) found that ice algae beneath clear ice contributed about 25 percent of the carbon produced in the area of the Stefansson Sound Boulder Patch. Although the contribution of ice algae to annual productivity may be relatively small, its importance lies in its input during early spring.

c. Benthic Communities: The benthic communities in the Alaskan Beaufort Sea contain macrophytic algae (large kelps), benthic microalgae and bacteria, and benthic invertebrates. Although most substrates in the Beaufort Sea consist of silty sediments that are unsuitable for the settlement and growth of macrophytes, hard substrates in the form of cobbles and boulders are suitable and are known to exist. The largest kelp community thus far described occurs in Stefansson Sound (commonly known as the Boulder Patch) (see Dunton and Schonberg, 1981; Dunton, Reimnitz, and Schonberg, 1982; and Dunton, 1984). Other beds occur near the Stockton Islands, Flaxman Island, and Demarcation Bay (Thorsteinson, 1983). The Boulder Patch community, although predominated by the brown alga *Laminaria solidungula,* also contains red algae and benthic invertebrates. Approximately 98 percent of the carbon produced annually in the Boulder Patch is derived from kelp and phytoplankton. Dunton (1984) estimates that benthic microalgae contribute about 2 percent of the annual carbon produced in the Stefansson Sound Boulder Patch.

Benthic invertebrates typically are divided into epifauna and infauna, based on their relationship with the bottom substrate. The organisms comprising these groups, as well as the general patterns of their distribution and abundance, have been described in the FEIS's for Sales 97, 109, 124, and 144 and in Thorsteinson (1983). In nearshore waters with depths ≤2 m, relatively few species are found. Biomass and diversity in the inshore zone generally increase with depth, except in the shear zone at approximately 15 to 25 m in depth. Intensive ice gouging occurs in this zone between the landfast ice and the moving polar pack ice, which generally disturbs the sediments where infaunal organisms live. Polychaetes, bivalves, and gammarid amphipods predominate in this area. The coastal lagoons of the Beaufort Sea support a nearshore benthic environment that is used as a feeding ground in the late summer by many vertebrate consumers (Thorsteinson, 1983). Predominant benthic invertebrates include amphipods, mysids, copepods, and other motile crustaceans. These invertebrates are fed on heavily by some fishes, birds, and marine mammals (Envirosphere, 1985). Other invertebrates, such as bivalves, snails, crabs, and shrimp, are fed on heavily by some marine mammals (e.g., walruses and bearded and ringed seals; see Frost and Lowry, 1983). In general, the food habits of marine invertebrates vary depending on habitat, season, preferences, etc., but they typically rely on marine plants, other invertebrates, detritus, or carrion.

2. Fishes: The description of fishes in the Beaufort Sea Planning Area, as contained in Section III.B.3 of the Sale 144 FEIS (USDOI, MMS, 1996a), is herein incorporated by reference. A summary of this description, using different categories and augmented by additional material, as cited, follows.

The physical environment in the Sale 170 affected area significantly influences fish dynamics. The nearshore area has extended ice coverage between October and June. Fish can be found in the nearshore coastal area during the ice-free months of July, August, and September. Water movement predominantly is wind driven. The nearshore coastal water movement is in an east-to- west direction. The winds are predominantly in a northeasterly to southwesterly direction in July and August, but can be variable (Wilson, 1996, p.c.). A nearshore coastal band forms when freshwater from coastal river systems decreases the marine salinity, and water temperatures are elevated as a result of riverine input into the marine shallow-water system. This band provides the major feeding area during the ice-free months.

The three categories for fish classification used in this EIS are (1) freshwater species, (2) anadromous and amphidromous species, and (3) marine species. Freshwater species are those species that either spend their entire life in freshwater or are found almost exclusively associated with fresh- or brackish waters extending offshore from major river deltas. Anadromous species are those species that spawn in freshwater, migrate to the sea where they spend most of their lives, and return to freshwater to spawn. Amphidromous fishes are those species that migrate from freshwater to the sea, or vice versa, for purposes other than spawning, such as feeding. This occurs on a regular basis at some definite point in their life cycle. When in the sea, these species remain in nearshore (estuarine) coastal waters and generally avoid the true marine water. Marine fishes complete their entire lifecycle in the marine environment. Following are brief summaries of the species and environment of these three types of fishes in the Sale 170 area.

a. Freshwater Species: Freshwater fishes may enter coastal areas near major river deltas, where freshwater extends offshore or the water is brackish. This usually occurs sporadically and briefly, most often during or immediately following spring breakup. The freshwater species found in the Sale 170 area include arctic grayling, round whitefish, slimy sculpin, northern pike, lake trout, and burbot. Some populations of least cisco, ninespine stickleback, and Dolly Varden char are migratory and do not remain in freshwater for their entire lifecycle. Arctic char may be found in lacustrine areas.

The freshwater-fishing-subsistence activities of the people of Nuiqsut consist of jigging for burbot and catching arctic grayling by jigging and by rod and reel fishing. The people of Kaktovik often combine ice fishing and hunting trips in the winter and spring at inland sites. They jig for char, arctic grayling, and northern pike. The majority of the Barrow subsistence fishery occurs between May and October in local river systems. Freshwater species caught by netting include arctic grayling, round whitefish, and burbot.

b. Anadromous and Amphidromous Species: The availability of overwintering habitat is likely to be the most important factor in the survival of amphidromous and anadromous fishes in the affected area. The two largest rivers in the affected area, the Colville and the Sagavanirktok, do not flow from late winter until spring breakup. The Colville River Delta area provides the largest amount of potential overwintering habitat in the affected area. It is a large area with brackish waters in the winter, due to saltwater intrusion. The Sagavanirktok River Delta also has some brackish water intrusion in the winter. With spring breakup in June, amphidromous and young anadromous fishes, which have overwintered in under-ice pools and river perennial springs, move from upriver areas and disperse into coastal waters where they feed primarily on epibenthic invertebrates. The summer, nearshore coastal band of low salinity and warmer water is important habitat to anadromous, amphidromous, and marine fishes for feeding and rearing during the open-water season. The food habits of the species using the nearshore brackish waters as a feeding ground are similar.

Anadromous fishes found in the Beaufort Sea area are chum and pink salmon, ninespine stickleback, and rainbow smelt. These species will return to freshwater when they mature for spawning.

Many more species in this area are amphidromous fishes. These species include broad whitefish; humpback whitefish (*Coregonus pidschian*); inconnu (sheefish); Dolly Varden char (migratory form); and Bering, least (migratory form), and arctic ciscoes, which originate in Canada's Mackenzie River and migrate in the wind-driven coastal, nearshore band mentioned above. Arctic cisco could be considered an anadromous species, because they spend approximately 85 percent of their lives at sea (Craig, 1989). The taxonomic classification of lake and humpback whitefish is confused. As presented in this document, humpback whitefish—*C. pidschianis*—is the species found in the Alaskan Beaufort Sea drainages, whereas the lake whitefish—*C. clupeaformis*—is found in the Mackenzie River area in Canada (Scott and Crossman, 1973). Whitefishes and least ciscoes do not disperse far from their rivers of origin, whereas arctic ciscoes and some Dolly Varden char disperse widely and are found along the entire Beaufort Sea coastline. Amphidromous fishes return to rivers and lakes in late summer or fall.

The entire Sale 170 area is within the Nuiqsut traditional subsistence-harvest area. However, the subsistence fishing occurs in the Colville River Delta area. Amphidromous fishes are the basis for a small but important subsistence fishery. Unless otherwise noted, the following information was obtained from *Subsistence Resource Harvest Patterns: Nuiqsut* (Impact Assessment, Inc., 1990). Fishing is one of the most important and common subsistence activities in Nuiqsut. Most, if not all, of the subsistence fishing occurs in and near the Colville River Delta area, which shows no signs of overfishing. Mr. Isaac Nukapigak, a Nuiqsut citizen and whaling captain, stated that all kinds of fish are in the Colville River Delta area, but that cisco are not spawning out near the delta anymore (Burwell, 1995). The majority of the fishing occurs between June and July through mid-November. The most productive fishery is the fall/winter net fishery. A Native informant estimated that 3,000 pounds (lb) of fish could be caught in 2 weeks. Informants stated that they sometimes fish for whitefish that are full of roe, which is considered a delicacy. Summer setnet fishing is conducted in a limited number of localities in the Colville River Delta area and Fish Creek, just west of the Colville River.

The eastern part of the delta is not fished for mainly to avoid contact with the operators of the commercial fishery located there. This commercial operation has existed for approximately 40 years. The commercial catch over the previous 10 years accounted for 46 percent of the total area catch of arctic cisco and 59 percent of the total area catch of least cisco.

The Kaktovik subsistence fish-harvest area ranges from just east of the Colville River Delta eastward to near the U.S./Canada border. The summer fishing is the most productive fishery. Most of the amphidromous fishery occurs in the summer using gillnets of varying mesh size. The predominantly caught species are arctic cisco and Dolly Varden char. Broad whitefish also are caught. Summer fishing peaks in July and August, with Dolly Varden char being caught early in the season and arctic ciscoes being caught later. The anadromous pink salmon also are caught near Arey Island.

The Beaufort Sea area of the Barrow subsistence-fishing area ranges from just east of Pogik Bay to Point Barrow. Subsistence fishing occurs exclusively in the rivers and lakes, with no fishing in the ocean areas. However, most of the anadromous pink and chum salmon caught are from either lagoons or near river mouths. Rarely, a few anadromous rainbow smelt are caught. Most of the harvested fishes are amphidromous species and are netted primarily in local rivers between May and October. Species caught include humpback and broad whitefish (from both lakes and rivers); least, arctic, and Bering ciscoes; and Dolly Varden char.

c. Marine Species: Forty-three species of marine fishes have been reported in the Beaufort Sea. Generally, these species are widely distributed in fairly low densities. Some of these species are found primarily in the brackish, nearshore waters and others in the marine, offshore waters (Irvine and Meyer, 1990). Species diversity in the arctic marine environment can be attributed to low temperatures, low productivity, and ice conditions that prevent extensive use of coastal habitats during the winter.

Marine fish species found in the sale area include arctic flounder, fourhorn sculpin, kelp snailfish, leatherfin lumpsucker, arctic cod, saffron cod, capelin, and Canadian eelpout.

Marine fishes are not harvested commercially in the Sale 170 area. However, they are of limited subsistence value to Alaskan Natives and are important in marine food webs (Houghton, 1984).

Kaktovik subsistence fishers occasionally net arctic flounder when fishing in the brackish water/marine areas. Barrow subsistence fishers have caught arctic cod and capelin, but these species make up an insignificant percentage of the yearly subsistence-fish harvest.

3. Endangered and Threatened Species: The Endangered Species Act (ESA) of 1973 defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range. The act defines a threatened species as one that is likely to become endangered within the foreseeable future. The endangered bowhead whale, the threatened spectacled and Steller's eiders, and the delisted arctic peregrine falcon (considered here as a candidate species) occur seasonally in the Beaufort Sea Planning Area. The descriptions of these species, as contained in Section III of the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a), are herein incorporated by reference. The descriptions of additional species along the southern transportation route from Alaskan ports such as Valdez or Cook Inlet to U. S. ports along the Pacific coast, referenced by the USDOI, Fish and Wildlife Service (FWS) as contained in Section III of the following document, also are herein incorporated by reference: Cook Inlet Planning Area Oil and Gas Lease Sale 149 FEIS (USDOI, MMS, 1996b) the Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 DEIS (USDOI, MMS, 1995), and the Biological Evaluations prepared for the ESA Section 7 consultations for both those sales. A summary of these descriptions, supplemented by additional material, as cited, follows.

a. **Bowhead Whale:** The Bering Sea or western arctic stock of bowhead whales was estimated to number from 7,200 to 9,400 individuals in 1993, with 8,200 as the best estimate of the population. An alternative method for estimating population size estimated the 1993 population to number from 6,800 to 8,900 individuals, with 7,800 as the best estimate of the population. Te western arctic stock is estimated to have increased at a rate of 3.2 percent/year from 1978 to 1993 (Zeh, Raftery, and Schaffner, 1996). The historic population has been estimated from 10,400 to 23,000 whales in 1848 prior to commercial exploitation, compared to an estimate of between 1,000 to 3,000 animals in 1914 near the end of the commercial-whaling period.

Bowhead whales migrate through the proposed sale area semiannually between wintering areas in the Bering Sea and summer-feeding grounds located in the Canadian Beaufort Sea. During the winter, they are associated with the marginal ice zone, regardless of where the zone is located, and with polynyas in the Bering Sea along the northern Gulf of Anadyr, south of St. Matthew Island, and near St. Lawrence Island.

The bowheads' northward spring migration appears to be timed with the ice breakup. They pass through the Bering Strait and eastern Chukchi Sea from late March to mid-June through, or relatively near, newly opened leads in the shear zone between the shorefast ice and the offshore pack ice. After passing Barrow from April through mid-June, they move through or near offshore leads in an easterly direction. Bowheads arrive on their summer-feeding grounds near Banks Island from mid-May through June and remain in the Canadian Beaufort Sea and Amundsen Gulf until late August or early September. Some whales regularly may occur in the Chukchi Sea along the northwestern Alaskan coast in late summer, but it is unclear whether these are "early autumn" migrants or whales that have summered nearby.

After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward into Alaskan waters in August and September. Typically, the major portion of the migration occurs between early to mid-September and mid-October. The median water depth over which the greatest number of whales appears to migrate is from 20 to 50 m (22-55 yard [yd]). An analysis of median water depths of bowheads sighted during fall aerial surveys from 1982 through 1995 provides an overall median depth of 37 m (40 yd) for all years combined (Treacy, 1996). Miller, Elliott, and Richardson (1996) observed that whales within the Northstar region (147°-150° W long.) migrate closer to shore in light and moderate ice years and farther offshore in heavy ice years, with median distances offshore of 30 to 40 km (19-25 miles [mi]), 30 to 40 km (19-25 mi) and 60 to 70 km (37-43 mi), respectively.

Data are limited on the bowhead fall migration through the Chukchi Sea. After moving south through the Chukchi Sea, bowheads pass through the Bering Strait in late October through early November on their way to overwintering areas in the Bering Sea.

Bowheads apparently feed throughout the water column, including bottom or nearbottom feeding as well as surface feeding. Carbon-isotope analysis of bowhead baleen indicates that a significant amount of feeding may occur in wintering areas. Bowheads may feed opportunistically where food is available as they migrate across the Alaskan Beaufort Sea. Although MMS conducted a feeding study in the eastern Beaufort Sea (Richardson, 1987, as cited in MMS, USDOI, 1996a), there remains a question regarding the importance of that area as a feeding area. That study indicated that, for the population as a whole, food resources consumed in the eastern Beaufort Sea did not contribute significantly to the whales' annual energy needs. The North Slope Borough Science Advisory Committee (1987) reviewed the report but did not accept the conclusion in the report that the study area is unimportant as a feeding area for bowhead whales. The Committee believed there were problems in study design and that the duration of the study was too short. As a result of these concerns and to help determine and quantify the importance of the eastern Alaskan Beaufort Sea as a feeding area for bowhead whales, the Alaska OCS Region Environmental Studies Section, is procuring a study entitled *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information* (USDOI, MMS, Alaska OCS Region, **Alaska Environmental Studies Strategic Plan**, 1997). The study will emphasize cooperation between the MMS, local government, subsistence-whale hunters, and scientists in its planning and execution. Food items most commonly found in the stomachs of harvested bowheads include euphausiids, copepods, mysids, and amphipods, with euphausiids and copepods being the primary prey species.

Bowhead whale-mating season is not known with certainty, although most bowhead mating and calving appear to occur from April through mid-June, coinciding with the spring migration.

b. **Arctic Peregrine Falcon:** The arctic peregrine falcon was removed from the list of endangered and threatened wildlife on October 5, 1994 (59 *Federal Register* [*FR*] 50796); however, the FWS will monitor this species for 5 years. Based on 1993 surveys, the population of arctic peregrine falcons now stands at about 200 to 250 pairs; annual recruitment into the breeding population is about 12 percent (Ambrose, 1995, pers. comm.).

Arctic peregrine falcon-nest sites nearest the Beaufort coast occur about 32 km (20 mi) inland. The major nesting areas occur along the Colville and Sagavanirktok rivers, with scattered nest sites along other Arctic Slope rivers. Peregrine falcons usually are present in Alaska from about mid-April to mid-September. Egg laying begins in mid-May on the Arctic Slope (USDOI, FWS, 1982). Immature arctic peregrines are known to use coastal habitats east of the Colville River on a transient basis from mid-August to mid-September.

c. **Spectacled Eider:** An estimated minimum 7,000 to 9,000 (uncorrected for density variation) threatened spectacled eiders seasonally occupy arctic Alaska. They are most abundant westward from the Sagavanirktok River, although density is lower in the vicinity of Prudhoe Bay than other areas of the coastal plain (Anderson and Cooper, 1994; Balogh and Larned, 1994, 1995; Larned and Balogh, 1993; TERA, 1993). Eiders nest at low density (0.13-0.20 pairs/km^2) on coastal tundra and major river deltas such as the Colville (Larned, 1996, pers. comm.; Meehan and Jennings, 1988; USDOI, FWS, 1996; TERA, 1993; 58 *FR* 27474). Probably 90 percent of the world population nests in arctic Russia. Nesting populations declined substantially at Prudhoe Bay in the 1980's (apparently about 80% between 1981-1991; Warnock and Troy, 1992), and Native elders from Wainwright and Barrow residents observed evidence of local population declines elsewhere on the Arctic Slope (USDOI, FWS, 1994; Suydam, 1996, pers. comm.). Recent surveys in the Prudhoe Bay area suggest a trend of increasing abundance occurred there from 1991 to 1994 but noted a decline from 1994 to 1995 (TERA, 1995, 1996).

Spring migration of eiders eastward past Barrow occurs in late May and early June; part of the population may arrive on the Arctic Slope following inland routes (Myres, 1958). Males depart the nesting area in late June or July shortly after breeding. Large flocks of departing individuals stage in nearshore waters or offshore, depending on the extent of ice coverage, for 1 to 2 weeks prior to moving west and south to molting areas (Petersen, 1995, pers. comm.; Napageak, 1995, pers. comm., as cited in USDOI, MMS, 1995b). Females and young move from freshwater to marine habitats after the young fledge, and young have been observed migrating westward past Barrow in August and September. Female spectacled eiders are present in the Beaufort Sea/Arctic Slope area from late May through September. Thus, although whatever proportion of the spectacled eider population use the Beaufort Sea during migration and nesting seasons, one or more segments of the Arctic Slope population occur there from late May through September. Nest success typically ranges from 10 to 80 percent; average success is relatively high in most areas, suggesting the population decline is due to factors outside the nesting period.

Satellite-tagged postbreeding birds have been relocated in Ledyard Bay, the primary Alaskan molting area, and several other coastal areas from the Beaufort Sea to the Yukon-Kuskokwim Delta and Russian Far East and scattered localities near St. Lawrence Island (Petersen, Douglas, and Mulcahy, 1995). A large proportion of the world spectacled eider population (about 140,000) was observed wintering in pack ice between St. Matthew and St. Lawrence islands in the central Bering Sea in April 1995; this is assumed to be the previously undocumented wintering area (Larned and Balogh, 1995, unpublished data).

d. **Steller's Eider:** An estimated 50-percent decline in the threatened Steller's eider population, currently estimated at 150,000 to 200,000 individuals, has occurred since the early 1970's (59 *FR* 35896). The majority of the population nests along the northern coast of Siberia. Although relatively few have been observed between Barrow and the Colville River, about 1,000 pairs may nest at extremely low density in northwestern Alaska, and numbers may be higher (Brackney and King, 1993). Native residents reported that the Steller's eider was a common breeder on the Colville River Delta and eastern Arctic Slope in the 1930's (Patkotak, 1993, pers. comm., cited in 59 *FR* 35896), but Anderson (cited by Bailey, 1948) considered it rare east of Barrow. Currently, the only confirmed Alaskan nesting area is south of Barrow, where several dozen pairs nest in most years.

Alaskan Steller's eiders are coastal migrants through the western Beaufort, Chukchi, and Bering seas, although exact routes are unknown. They occupy nearshore marine waters most of the year. Pairs arrive on the nesting grounds in early June. Males depart the nesting areas in late June, while females are incubating. Limited observation suggests that females with broods remain until late August or early September. Most of the world population molts in the southeastern Bering Sea and winters from the eastern Aleutian Islands to lower Cook Inlet.

4. Marine and Coastal Birds: Several million birds representing about 75 regularly occurring species seasonally occupy Arctic Slope/Beaufort Sea habitats in or adjacent to the Sale 170 area. Nearly all these species, which include seabirds, waterfowl, shorebirds, passerines, and raptors, are migratory, inhabiting the Beaufort Sea area within the period May to October. Species that are abundant or commonly observed in nearshore coastal waters (≤20 m depth) include oldsquaw, red phalarope, glaucous gull, and common eider.

Within or adjacent to the proposed sale area, major concentrations of birds occur, especially in lagoons and bays in coastal areas such as Pitt Point-Cape Halkett, Colville River Delta, and Simpson Lagoon (Fig. III.B.4). Concentration areas more distant from the proposed sale area include the Plover Islands-Elson Lagoon area to the west and Beaufort Lagoon to the east. Lagoons may support 50 to 100 birds/km^2 in August, with feeding flocks of thousands of birds/km^2 occurring when abundant food sources are available. As many as 50,000 oldsquaw have been recorded in Simpson Lagoon in late July (Johnson and Herter, 1989). Although lower densities of birds generally characterize pelagic waters (greater than or equal to [≥]20 m), high densities seasonally occur offshore of Pt. Barrow (38.1 birds/km^2). During a recent spring migration, an estimated 373,000 king eiders and 71,000 common eiders passed Point Barrow; lower numbers were observed in fall (Suydam et al., 1997). Though substantial, these counts of eiders represent declines from estimates made in previous decades.

Barrier islands provide important breeding habitat for several species, such as common eider, black guillemot, and glaucous gull. The Teshekpuk Lake Special Area and the Colville, Sagavanirktok, and Canning river deltas provide wet-tundra habitat important for nesting waterfowl, including the yellow-billed loon, tundra swan, brant and snow geese, and numerous shorebird species.

In early July, brant broodrearing groups move from the nesting areas to coastal meadows. Beginning in mid-July, large concentrations of ≥10,000 oldsquaw and eider occur in lagoons, where the birds feed intensively and oldsquaw molt before fall migration. In late July, large numbers of molting and staging phalaropes and other shorebird species begin to concentrate along the coast. They feed intensively on both outer barrier island beaches and along lagoon shorelines, marshes, and mudflats. Use of lagoons and other coastal habitats by migrants peaks in August to late September. During the migration period, tens of thousands of birds may pass through a local habitat area. In addition to the above habitats, coastal tundra lakes, ponds, and river deltas are very important for waterfowl and shorebird molting and staging before and during fall migration. Major areas include Teshekpuk Lake and the Fish Creek and Colville River deltas; in the Arctic National Wildlife Refuge (ANWR), the Hulahula River Delta is important for snow geese and tundra swans. From late September to mid-October, 20,000 to 40,000 Ross' gulls, representing a major proportion of the world population, usually occur offshore of Point Barrow and eastward to the Plover Islands (Divoky, Hatch, and Haney, 1988).

5. Pinnipeds, Polar Bears, and Belukha Whales: The description of these nonendangered marine mammals in the Beaufort Sea Planning Area, as contained in Section III.B.4 of the Sale 87 FEIS (USDOI, MMS, 1984), is herein incorporated by reference. A summary of this description, augmented by additional material, as cited, follows. This account emphasizes species of marine mammals, other than endangered whales, commonly occurring in the Alaskan Beaufort Sea habitats that may be affected by the proposed sale—the ringed seal, bearded seal, spotted seal, walrus, polar bear, and belukha whale. Other species that are uncommon or rare in the sale area but that occasionally occur in small numbers (<10) include the gray whale, harbor porpoise, killer whale, narwhal, and hooded seal. The gray whale was discussed in detail in previous Beaufort Sea lease-sale EIS's, because these sales included tracts within the Chukchi Sea comprising part of the feeding area of this species. However, Sale 170 does not include any tracts west of Cape Halkett or within the Chukchi Sea (see Fig. II.A.1); therefore, gray whales are not expected to be exposed to or affected by any activities associated with Alternative I. Although the Pacific walrus generally occurs far to the west of the sale area, ocean currents are expected to drive any potential oil spills that may be associated with Alternative I into walrus summer habitats just west of the sale; thus, the walrus is included in the list of marine mammal populations that could be affected. Because of the relative numerical insignificance of the latter species (including gray whales) in the Beaufort Sea (<100-<10 individuals of any of these species have been recorded in the Beaufort Sea), they are not expected to be exposed to or affected by any activities associated with Alternative I and, therefore, are not discussed further.

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act (MMPA) of 1972. In the act, it was the declared intent of Congress that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem." General habitat areas of marine mammals are shown on Figure III.B.5.

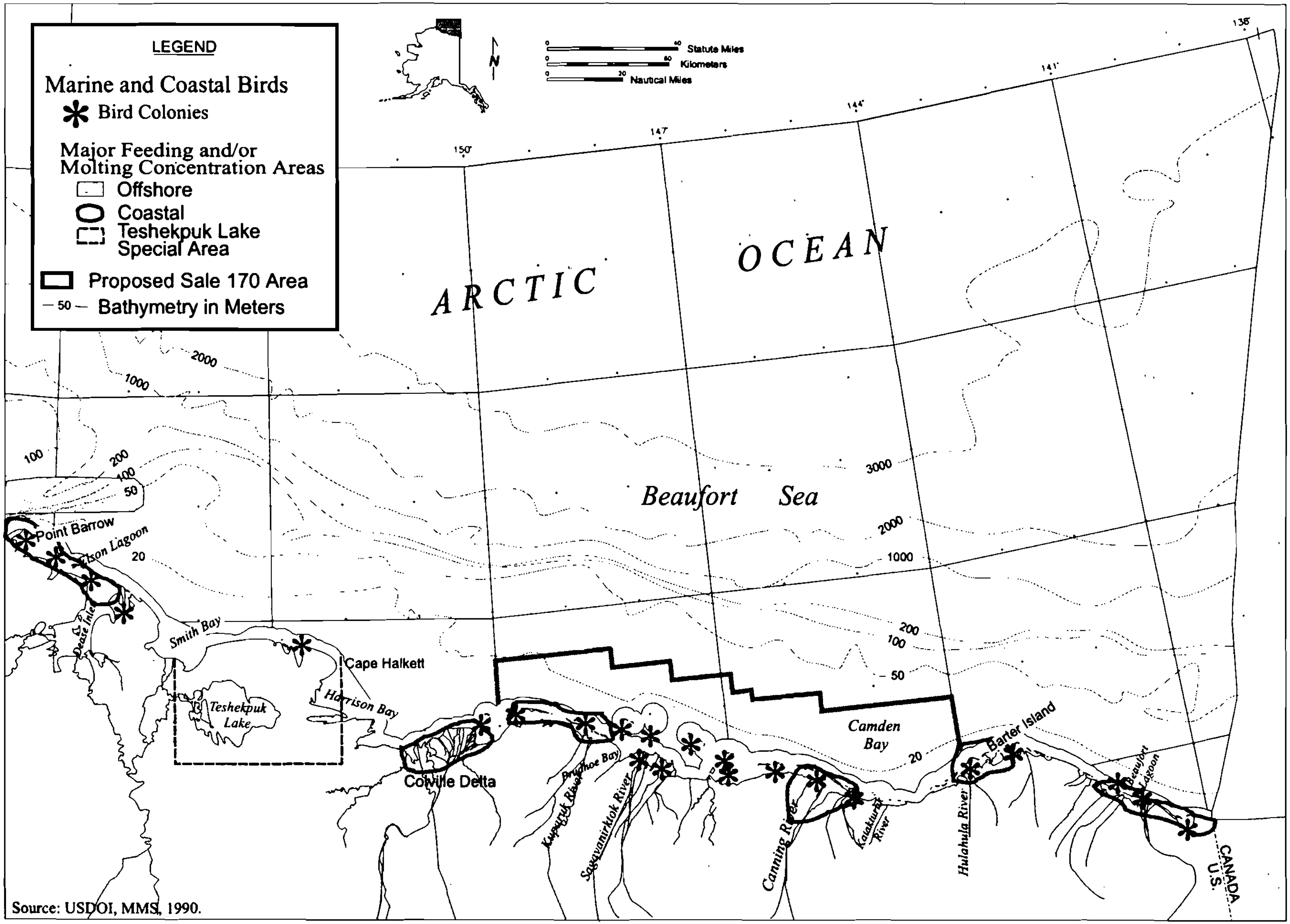


Figure III.B-4. Marine and Coastal Bird Habitats

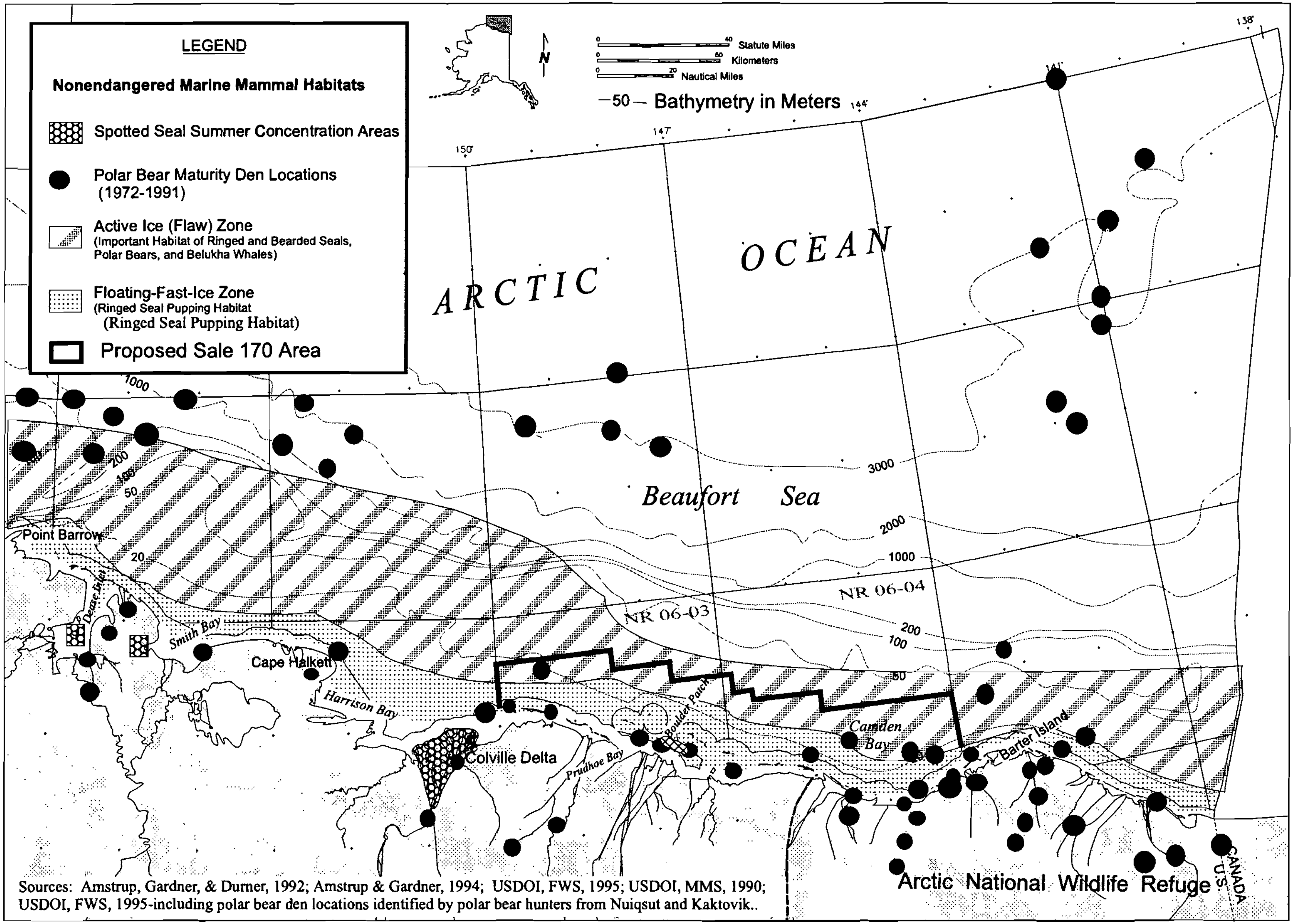


Figure III.B.5. Nonendangered Marine Mammal Habitats

a. Pinnipeds:

(1) Ringed Seals: This species is the most abundant seal in the Beaufort Sea. It is widely distributed throughout the Arctic, with an estimated population of 80,000 seals during the summer and 40,000 seals during the winter in the Alaskan Beaufort Sea (Frost and Lowry, 1981). Ringed seal densities within the proposed sale area depend on a variety of factors such as food availability, water depth, ice stability, and proximity to human disturbance. Ringed seal densities reflect the overall productivity of the ecosystem in different areas and can be used to monitor changes in ecosystem productivity (Stirling and Oritsland, 1995). Densities of ringed seals in the floating shorefast-ice zone of the Beaufort Sea generally range from 1.5 to 2.4 seals to 1 square nautical mile (Frost, Lowry, and Burns, 1988a). Surveys in May 1996 recorded densities of 0.30 to 0.62 seals per square kilometer in the fast-ice habitat of the Beaufort Sea (Frost et al., 1997).

Probably a polygamous species, ringed seals, when sexually mature, establish territories during the fall that they maintain during the pupping season. Pups are born in late March and April in lairs that are excavated in snowdrifts and pressure ridges. During the pupping and breeding season, adults on shorefast ice (floating fast-ice zone, see Fig. III.B.5) generally are less mobile than individuals in other habitats; they depend on a relatively small number of holes and cracks in the ice for breathing and foraging. During nursing (4-6 weeks), pups generally are confined to the birth lair. This species is a major subsistence resource harvested by subsistence hunters in Alaska (see Sec. III.C.2, Subsistence-Harvest Patterns).

(2) Bearded Seals: This species is found throughout the Arctic and generally prefers areas of less stable or broken sea ice, where breakup occurs early (Cleator and Stirling, 1990). The majority of the bearded seal population in Alaskan OCS areas are in the Bering and Chukchi seas, where an estimated 300,000 to 450,000 individuals occur. The bearded seal primarily is restricted to the moving ice in the Beaufort Sea. Densities of bearded seals in the western Beaufort Sea and throughout the sale area are greatest during the summer and lowest during the winter. The most important winter and spring habitat area is the active ice zone shown in Figure III.B.5.

Pupping occurs on top of the ice from late March through May primarily in the Bering and Chukchi seas, although some pupping occurs in the Beaufort Sea. The nursing period is very short (12-18 days); most pups reach approximately 63 percent of their adult length when they are weaned. These seals do not form herds, although loose aggregations of animals do occur. The bearded seal-ugruk is a primary subsistence-resource species and favorite food of subsistence hunters (Residents of Barrow, as cited in S.R. Braund and Assocs. and UAA, ISER, 1993).

(3) Spotted Seals: This species is a seasonal visitor to the Beaufort Sea from populations in the Bering/Chukchi seas, as indicated from satellite-tagged animals (Lowry et al., 1994). Spotted seals appear along the coast in July-August in low numbers (about 1,000 total for the Alaskan Beaufort Sea coast) hauling out on beaches, barrier islands, and remote sandbars on the river deltas. Beaufort Sea coastal haulout and concentration areas include the Colville River Delta, Peard Bay, and Oarlock Island in Dease Inlet/Admiralty Bay (Fig. III.B.5). Recently, these seals also have frequented Smith Bay at the mouth of the Piasuk River. Spotted seals frequently enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Spotted seals migrate out of the Beaufort Sea in the fall (September to mid-October) as the shorefast ice re-forms and the pack ice advances southward. They spend the winter and spring periods along the ice front throughout the Bering Sea where pupping, breeding, and molting occur.

(4) Walruses: The North Pacific walrus population was estimated at about 201,000 animals in 1990 (Seagars, 1992; Gilbert et al., 1992; USDOI, FWS, 1995a), comprising about 80 percent of the world population. In general, most of this population is associated with the moving pack ice year-round. Walruses spend the winter in the Bering Sea; and the majority of the population summers throughout the Chukchi Sea, including the westernmost part of the Beaufort Sea. Although a few walruses may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open-water season, the majority of the Pacific population occurs west of 155° W. longitude north and west of Barrow, with the highest seasonal abundance along the pack-ice front.

Nearly all the adult females with dependent young migrate into the Chukchi Sea during the summer, while a substantial number of adult males remain in the Bering Sea. Spring migration usually begins in April, and most of the walruses move north through the Bering Strait by late June. Females with calves comprise most of the early spring migrants. During the summer, two large Arctic areas are occupied—from the Bering Strait west to Wrangell Island and along the northwest coast of Alaska from about Point Hope to north of Point Barrow. With the southern advance of the pack ice in the Chukchi Sea during the fall (October-December), most of the walrus population migrates south of the Bering Strait. Solitary animals occasionally may overwinter in the Chukchi Sea and in the eastern Beaufort Sea.

Walrus calves are born from mid-April to mid-June during the northward migration; mating takes place from January to March. The gross reproductive rate of walruses is considerably lower than that of seals. Prime reproductive females produce one calf every 2 years rather than one every year as do other pinnipeds. Although bivalve mollusks-clams are the primary food of walruses, seals also are eaten. In Barrow, walruses are a very important cultural and subsistence resource comprising the third most important species by weight of harvestable meat (Residents of Barrow, as cited in S.R. Braund, Assocs. and UAA, ISER, 1993).

b. Polar Bears: Polar bears are found throughout the Arctic. The Beaufort Sea population (from Point Barrow to Cape Bathurst, Northwest Territories) is estimated to be 1,300 to 2,500 bears; this population has increased over the past 20 to 30 years at ≥2 percent per year and is believed to be increasing slightly or stabilizing near its carrying capacity (Amstrup, 1995; USDOI, FWS, 1995b). There is substantial annual variation in the seasonal distribution and local abundance of polar bears in the Alaskan Beaufort Sea. Average density was estimated to be one bear every 78 to 130 km^2 (30-50 mi^2), with much lower densities occurring farther than 100 mi offshore, and higher densities occurring near ice leads where seals are concentrated (Amstrup, 1983). The overall density from Point Barrow and Cape Bathurst was estimated at one bear every 141 to 269 km^2 (54-103 mi^2) (Amstrup, Stirling, and Lentfer, 1986). There is substantial annual variation in the seasonal distribution and density of polar bears in the Alaskan Beaufort Sea. The two most important natural factors affecting polar bear distributions are sea ice and food availability.

Drifting pack ice off the coast of the Alaskan Beaufort Sea probably supports greater numbers of polar bears than either shorefast ice or polar pack ice, probably due to the abundance and availability of subadult seals in this habitat. Polar bears prefer rough sea ice, floe-edge ice, and moving ice over smooth ice for hunting and resting (Martin and Jonkel, 1983; Stirling, Andriashek, and Calvert, 1993). Local concentrations of polar bears may occur along the coast of Alaska when pack ice drifts close to the shoreline and shorefast ice forms early in the fall. Polar bears are capable of swimming long distances and are very curious animals (Adams, 1986, pers. comm., as cited in USDOI, MMS, 1986a).

Pregnant and lactating females and newborn cubs are the only polar bears that occupy winter dens for extended periods. Polar bears may concentrate such denning on offshore islands and certain portions of the mainland. Typically, dens are more sparsely distributed in the Alaskan coastal zone than areas receiving consistent use such as Wrangell Island, Russia, and in Hudson Bay and James Bay, Canada. Pregnant females come to coastal areas in late October or early November to construct maternity dens. Most terrestrial dens are located close to the seacoast, usually not more than 8 to 10 km inland, but some dens have been located >100 mi inland in Canada (Kolenosky and Prevett, 1983). Offspring are born from early December to late January, and females and cubs break out from dens in late March or early April. Polar bear dens have been located along river banks in northeast Alaska and on shorefast ice close to islands east of the mouth of the Colville River. Recently recorded denning areas have been found along the coast of the ANWR. These and other recorded den locations from 1972 to 1991 are indicated on Figure III.B.5. Of the 35 recorded polar bears that den along the mainland coast of the Beaufort Sea in Alaska and Canada, 80 percent den between 137'00" W. longitude—Mackenzie Bay, Canada and 146'59" W. longitude—west ANWR boundary (Amstrup and Garner, 1994). This clumped distribution may in part be related to the greater topographic relief on the eastern part of the Arctic Coastal Plain (137'00"-146'59" W. long. compared to the flat relief of the coastal plain west of 146'59" W. long.). Topographic relief provides areas where snow will accumulate in drifts on the leeward side of banks and other topographic features adequate for den construction by the bears. Several of the coastal den sites shown in Figure III.B.5 from the Colville River Delta east to Barter Island were identified by polar bear hunters from Nuiqsut and Kaktovik (USDOI, FWS, 1995b).

Female polar bears generally do not use the same den-site location (Ramsay and Stirling, 1990; Amstrup, Garner, and Durner, 1992). Polar bears repeatedly use the same geographic areas for maternity denning (Amstrup, Garner, and Durner, 1992), but shifts in the distribution of den locations have been reported in Canada and might be related to changes in sea-ice conditions (Ramsay and Stirling, 1990).

Polar bears have been reported to bear young in maternity dens far offshore on the pack ice (Lentfer and Hensel, 1980; Amstrup, 1986). The majority of polar bear maternity dens located recently (1983-1991) in the Beaufort Sea area were found on sea ice scattered throughout the planning area (Amstrup, 1986; see Fig. III.B.5).

In addition to being covered by the MMPA of 1972, polar bears and their habitats are protected by the International Agreement on the Conservation of Polar Bears of 1976 between Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States. This agreement addresses the protection of "habitat components such as denning and feeding sites and migration patterns." Also, a bilateral agreement between the U.S. and Russia for the conservation of polar bears in the Chukchi/Bering Seas has been proposed (USDOI, FWS, 1997).

The North Slope Borough/Inuvailuit Game Council management on polar bears for the southern Beaufort Sea includes sustainable harvest quotas based on estimated population size, sustainable harvest rates for female polar bears, and information regarding the sex ratio of the subsistence harvest. These quotas are believed to be

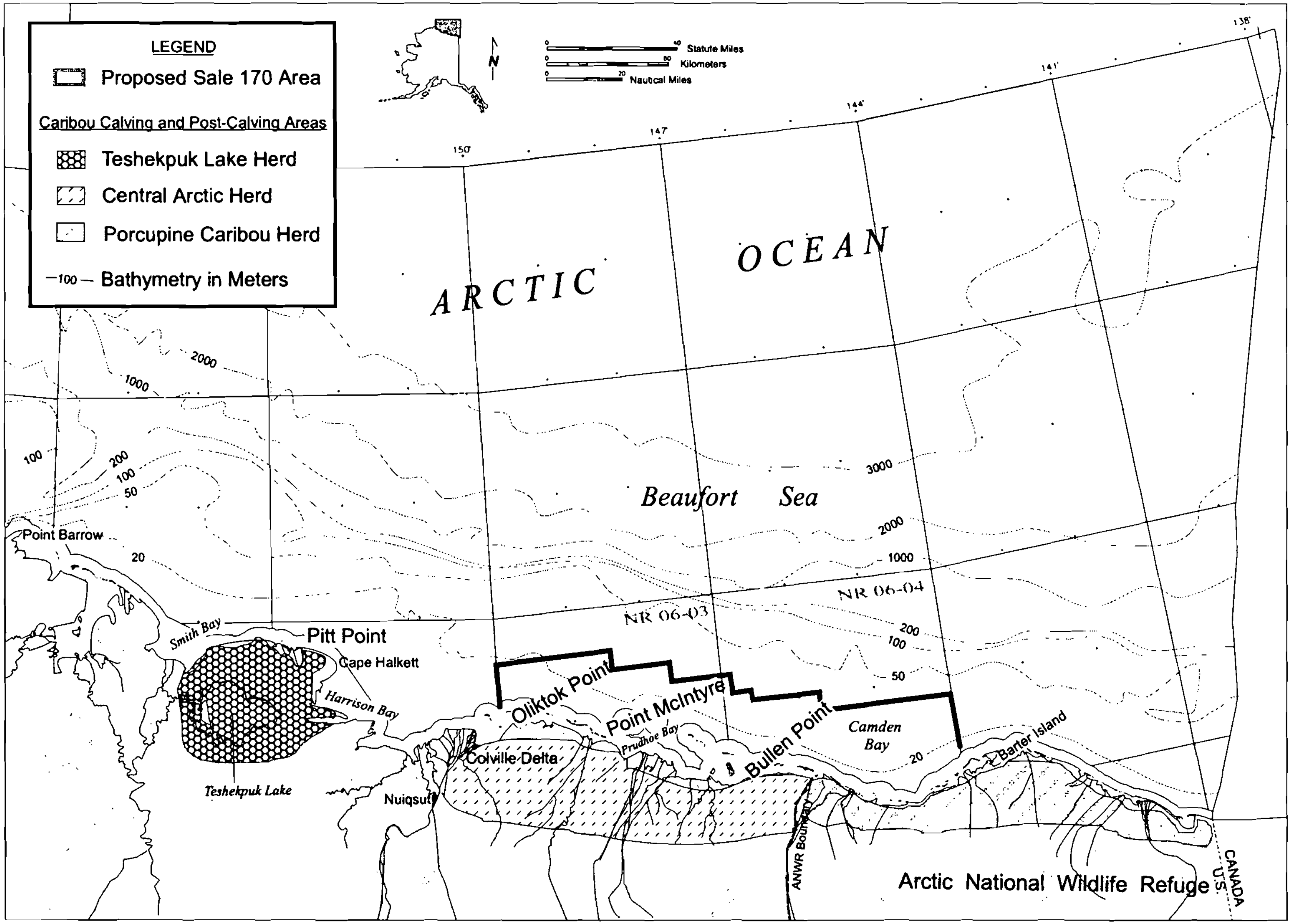


Figure III.B.6. Caribou Calving Areas

sustainable; however, any potential significant increase in mortality that may be associated with the proposed activities could push removal rates beyond the sustainable level.

c. Belukha Whales: The belukha whale, a subarctic and arctic species, is a summer seasonal visitor throughout offshore habitats of the Alaskan portion of the Beaufort Sea. The Beaufort population may be in excess of 42,500 whales (Hill, DeMaster, and Small, 1996). Most of the latter population migrate from the Bering Sea into the Beaufort Sea in April or May. However, some whales may pass Point Barrow as early as late March and as late as July. The spring-migration routes through ice leads are similar to those of the bowhead whale. A major portion of the Beaufort Sea population concentrates in the Mackenzie River estuary during July and August (Fig. III.B.5). An estimated 2,500 to 3,000 belukhas summer in the western Beaufort and northwestern Chukchi seas, with some using coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost, Lowry, and Burns, 1988b; Frost, Lowry, and Carroll, 1993).

Fall migration through the western Beaufort Sea and the Sale 170 area is in September or October. Although small numbers of whales have been observed migrating along the coast (Johnson, 1979), surveys of fall distribution strongly indicate that most belukhas migrate offshore along the pack-ice front (Frost, Lowry, and Burns, 1988b; Treacy, 1996). Belukha whales are an important subsistence resource of Inuit Natives in Canada and also are important locally to Inupiat Natives in Alaska (see Sec. III.C.3, Subsistence-Harvest Patterns).

6. Caribou: The description of caribou in the Beaufort Sea Planning Area, as contained in Section III.B.6 of the Sale 87 FEIS (USDOI, MMS, 1984), is incorporated herein by reference. A summary of this description, supplemented by additional material, as cited, follows. Among the terrestrial mammals that occur along the coast of the Beaufort Sea, barren-ground caribou is the species that could be affected most by proposed OCS oil and gas activities in the Sale 170 area. Other terrestrial mammal species such as muskoxen, moose, brown bears, and the arctic fox are not expected to be affected significantly by Alternative I because of their sparse distribution adjacent to the sale area.

One large caribou herd and two smaller caribou herds use coastal habitats adjacent to or near the sale area—the Porcupine, the Central Arctic, and the Teshekpuk Lake herds (PCH, CAH, and TLH respectively). The PCH, estimated to be about 178,000 to 180,000 animals in 1989, declined to 160,000 animals in 1992 and to 152,000 animals in 1994 (Whitten, 1992; Whitten, 1995, pers. comm.); the PCH ranges south from the Beaufort Sea coast, from the Canning River of Alaska in the west, eastward through the northern Yukon and portions of the Northwest Territories in Canada, and south to the Brooks Range (Fig. III.B.6). The CAH was estimated at about 23,000 animals (Abbott, 1993), but has declined to about 18,100 animals in 1994 (Whitten, 1995, pers. comm.). Its range extends from the Itkillik River east to the Canning River and from the Beaufort coast south into the Brooks Range.

The calving and wintering range for the TLH, comprising more than 27,600 animals (Machida, 1994), is around Teshekpuk Lake and near Cape Halkett adjacent to Harrison Bay (see Fig. III.B.6). The PCH calving range encompasses an area along the Beaufort Sea coast from the Canning River in Alaska to the Babbage River in Canada and south to the northern foothills of the Brooks Range (Fig. III.B.6). Major concentrations of calving cows occur within this range between the Canning and Sadlerochit rivers on the west and east, respectively, and between Camden Bay on the north and the Sadlerochit Mountains on the south. Recently, most of the CAH have calved within 30 km of the Beaufort Sea, including the Prudhoe Bay area (see Fig. III.B.6). Calving generally takes place from late May to late June.

During the postcalving period in July through August, caribou generally attain their highest degree of aggregation with continuous masses of animals in herds, such as the PCH, in excess of tens of thousands. Cow/calf groups are most sensitive to human disturbance during this period. During the summer months caribou, for relief from insect pests, use various coastal habitats of the Beaufort Sea in Alaska, such as sandbars, spits, river deltas, and some barrier islands.

The need for caribou to migrate appears to be a behavioral adaptation that prevents destruction of forage habitat and avoids predators. If movements are greatly restricted, caribou are likely to overgraze their habitat, leading to perhaps a drastic, long-term population decline. Migrating caribou often follow well-defined routes between winter and summer ranges. The caribou diet shifts from season to season and depends on the availability of forage. The winter diet has been characterized as consisting predominantly of lichens and mosses, with a shift to vascular plants during the spring (Thompson and McCourt, 1981). Eriophorum-tussock-sedge buds (cotton grass) appear to be very important in the diet of lactating caribou cows during the calving season (Lent, 1966; Thompson and McCourt, 1981; Eastland, Bowyer, and Fancy, 1989; Fancy and Whitten, 1991), while orthophyll shrubs (especially willows) are the predominant forage during the postcalving period (Thompson and McCourt, 1981). The availability of sedges during the spring—which apparently depends on temperature and snow cover—probably affects specific calving locations and calving success. Cow caribou tend to select areas with the highest rate of plant biomass accumulation during the 2 weeks immediately following calving (Griffith et al., 1995).

C. SOCIAL SYSTEMS:

1. Economy of the North Slope Borough:

The most important economic effects of proposed Sale 170 are anticipated to fall on the North Slope Borough (NSB). The NSB government employs a significant numbers of people directly and finances construction projects under its Capital Improvement Program (CIP) which, by itself, has employed a significant number of people. The NSB expenditures have been funded in large part with property-tax revenues based on the oil facilities at and near Prudhoe Bay. With these revenues, the NSB government has provided greatly improved educational, health, and other government services and capital improvements. Effects of Sale 170 potentially are to continue the use of these facilities and expand the facilities from which NSB property-tax revenues are derived. In the past, most workers at North Slope oil facilities centered at Prudhoe Bay commuted between worker enclaves on the North Slope and permanent residences in regions of the State outside of the NSB. However, only a small number of North Slope Native residents have worked at oil facilities at and near Prudhoe Bay, and this is very likely to be true in the future. Some workers are anticipated to commute between the enclaves and permanent residences outside of Alaska, especially during the exploration phase. Because economic effects on parts of Alaska outside the NSB are anticipated to be relatively insignificant compared to the larger employment and population of the rest of the State, only employment data for the NSB are presented below.

The NSB includes the entire northern coast of Alaska and encompasses 88,281 mi^2 of territory, equal to 15 percent of the land area of Alaska. The predominately Inupiat residents traditionally have relied on subsistence activities. Subsistence activities and sociocultural aspects of the economy are discussed in Sections III.C.2 (Subsistence) and III.C.3 (Sociocultural), respectively, of this EIS.

a. NSB Revenues and Expenditures:

The tax base that has allowed the recent high levels of local-government expenditures consists primarily of the enormously high-valued petroleum-industry-related property in the Prudhoe Bay area. In Fiscal Year (FY) 1995, more than 95 percent of revenues were generated by property tax according to the FEIS for Sale 144 (USDOI, MMS, 1996a, Sec. III.C.1).

Assessed property value for the NSB for FY 1986 through FY 1991 was approximately $12 to $13 billion. For FY 1991, all assessed property value was $13,103,000, whereas industrial-property assessed value at Prudhoe Bay was $12,425,000, or 95 percent of the total. Between 1982 and 1991, total NSB taxes collected peaked in FY 1987 at $249 million and declined in FY 1991 to $221 million (*NSB 1992 Economic Profile, Volume VI*, NSB, 1993).

The FY 1994 mill rate applied by the NSB to assessed property was 18.5 mills. This rate is the sum of a rate of 4.78 mills for operations and 13.72 mills for debt service. Although the mill rate for operations is at the limit allowed by State statutes, the NSB's mill rate is well under the limit and, therefore, the NSB administration is not now facing any legal constraints to raising the rate (USDOI, MMS, 1996a, Sec. III.C.1).

b. Employment:

Civilian employment in the NSB grew from 1,600 persons in 1975 to a peak of about 2,000 persons in 1978 during the pipeline boom, dropped to 1,400 in 1980, climbed to 2,700 in 1986, and has been in the range of 2,800 to 3,000 persons between 1987 and 1995 (see Fig. III.C.1-1). The definition of employment for these data is for those employed who reside in the NSB. The definition used for the employment data in Figure III.C.1-2 is the number of persons in who work in the NSB; in the case of the NSB, this definition includes the oil workers in and near Prudhoe Bay. Residency is a basic difference between the two sets of employment numbers, but there are other more technical differences in definitions. The State of Alaska, Dept. of Labor (ADOL) cautions against comparing the two sets of numbers (Windisch-Cole, 1996, pers. comm.). The annual average nonagricultural employment for the NSB Census Area was approximately 9,400 persons in 1985, which dropped to 6,600 in 1987 and 1987, and rose to 7,600 in 1993 and 8,243 in 1994 (Fig. III.C.1-2). Mining employment fluctuated approximately between approximately 3,400 persons in 1991, dropped to 2,800 in 1993, and rose to 3,300 in 1994 (Fig. III.C.1-3). "Mining" is a category of the U.S. Dept. of Labor (USDOL), Bureau of Labor Statistics (BLS) which, in the case of the NSB, primarily reflects the employment of oil workers at Prudhoe Bay and adjoining areas. Construction employment fluctuated from approximately 500 persons in 1991 to a peak of 600 in 1994 (Fig. III.C.1-3), and local-government employment rose from approximately 1,800 persons in 1991 to 2,200 in 1994, reflecting the large number of employees of the NSB government itself.

Oil development at Prudhoe Bay and nearby areas, including the Trans-Alaska Pipeline System, is the main driving force of employment in the NSB. Property taxes collected by the NSB from the oil development at Prudhoe Bay has enabled significant employment by the NSB and Native corporations. The NSB is the largest employer of North Slope residents in the region. The NSB employs more than 45 percent of all working residents who provide a wide range of services, many of which are not found in other regions of the State. The NSB School District employs another 17 percent of the resident-employed workforce. The majority of the remainder of the workforce is employed by the Arctic Slope Regional Corporation (ASRC), the Ukpeagvik Corporation, the other Alaska Native Claims Settlement Act (ANCSA) village

Figure III.C.1-1. North Slope Borough Labor Force, 1975–1995: Workers Residing Permanently in the North Slope Borough. Source: U.S. Department of Labor, Bureau of Labor Statistics, "Historical Report on Labor Force and Employment," provided by ADOL.

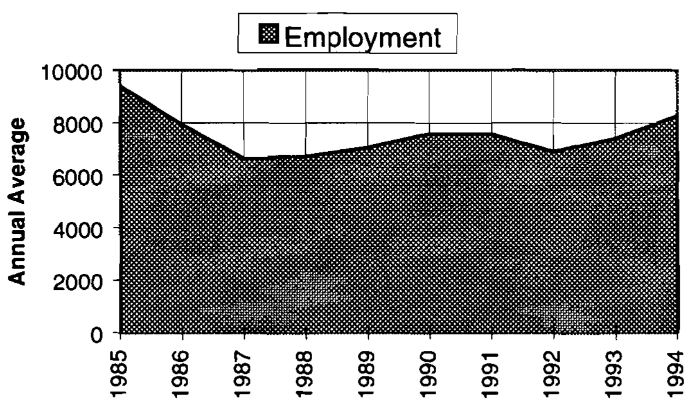


Figure III.C.1-2. North Slope Borough Nonagricultural Employment, 1985–1995: Workers Working in the North Slope Borough. Source: Nonagricultural Wage and Salary Employment and Earnings by Census Area, 1985–1990; Employment and Earnings Summary Reports, 1991–1994.

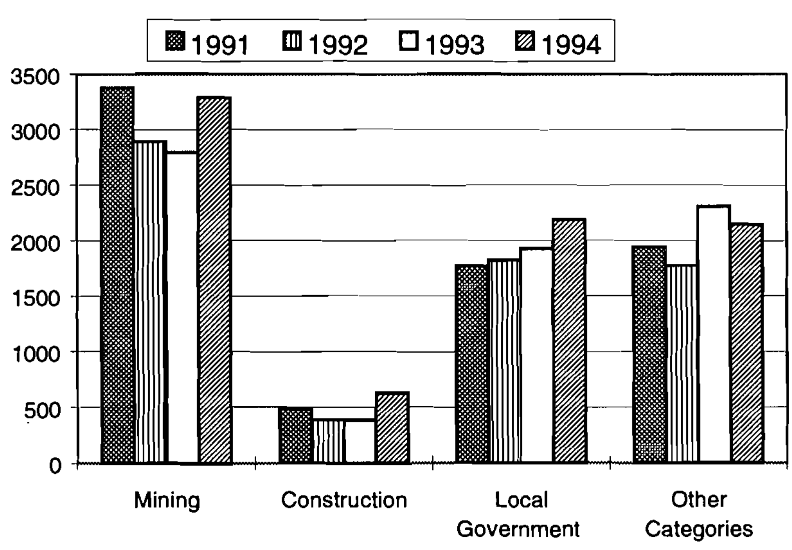


Figure III.C.1-3. North Slope Borough Nonagricultural Employment by Selected Industry Type, 1991–1994. Source: Employment and Earnings Summary Report, 1991–1994, ADOL.

corporations, and their subsidiaries and joint ventures. Over 1975 to 1995 period, the NSB CIP has expended many millions of dollars and employed a substantial number of North Slope residents. Construction workers on all CIP projects in the 1989 to 1994 period were comprised of 68 percent NSB residents; also of the total 59 percent were Inupiat residents. However, on any given CIP project, the percent of non-NSB residents and non-Inupiats could be high. Since its incorporation, the NSB has implemented a program to improve skills of the residents and reduce unemployment (*NSB 1993/94 Economic Profile and Census Report Volume VII*, NSB, 1995).

Unemployment has been in the 4- to 5-percent range in the 1975 to 1995 period, according to data (USDOL/BLS) obtained through the ADOL *Historical Reports on Labor Force and Employment* (undated) (see Fig. III.C.1-1). The USDOL/BLS data, however, count only those officially seeking work and exclude anyone who has made no attempt to find work in the previous 4-week period. Most Alaskan economists believe that Alaska's rural communities have a large percentage of "discouraged workers," that is, those who are involuntarily unemployed and not counted in the USDOL/BLS data (Windisch-Cole, 1996, pers. comm.). According to data collected for the 1993 NSB Census of Population and Economy, the unemployment rate is 11 percent, and the portion of the labor force that worked <40 weeks in the previous year is 22 percent. The latter figure does not include employees of the NSB School District. Also according to the 1993 NSB Census, 24 percent of the Borough resident labor force believe themselves to be underemployed (NSB, 1995).

Boroughwide data indicate that 62 percent of the resident labor force is Inupiat, 26 percent is Caucasian, and 12 percent is other minorities. In contrast, 16 percent of the unemployed resident labor force is Inupiat, 2.5 percent is Caucasian, and 7.5 percent other minorities. The labor force, both employed and unemployed, consists of 59 percent Inupiat, 28 percent Caucasian, and 13 percent other minorities (NSB, 1995).

A primary goal of the NSB has been to create employment opportunities for Native residents, and they have been successful in hiring large numbers of Natives for NSB construction projects and operations. Only a small number of permanent residents hold jobs at the industrial enclaves at Prudhoe Bay. Residents seem to prefer the employment created by the NSB to jobs potentially available in industry. Pay scales offered by the NSB are equal to or better than those in the oil and gas industry, and the working conditions and flexibility offered by the NSB are considered by the Natives to be superior to those prevailing in the oil and gas industry. The NSB employment has been both high paying and very flexible compared to standards prevailing in other parts of the State, permitting employees to take time off, particularly for subsistence hunting. Subsistence hunting is a noncash portion of the NSB economy and is an important part of the whole economy. Subsistence is an even more important part of the culture (see Secs. III.C.2, and III.C.3).

Very few North Slope Natives have been employed in the oil-production facilities and associated work in and near Prudhoe Bay since production started in the late 1970's. Also, North Slope Natives are not motivated to move because of employment. This historical information is relevant to assessing potential economic effects of proposed oil and gas exploration and development on the North Slope Native population. A study contracted by MMS shows that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised <1 percent of the 6,000 North Slope oil-industry workers. In a second portion of the study, interviews with 39 North Slope Natives in 1992 indicated that they were motivated to change residence to obtain a job. However, they also were even more strongly motivated to change residence to be with relatives or friends and to return to their home village and to marry (USDOI, MMS, 1993).

2. Subsistence-Harvest Patterns:

a. Characteristics of Harvest Patterns: This section describes the subsistence-harvest patterns of the Inupiat (Eskimo) communities adjacent to the Sale 170 area: Barrow, Nuiqsut, and Kaktovik. This community-by-community description provides general information on subsistence-harvest patterns, harvest information by resource and community, timing of the subsistence-harvest cycles, and harvest-area concentrations by resource and by community. Descriptions of the subsistence-harvest patterns of the communities of Barrow (west) and Kaktovik (east) of the Beaufort Sea Sale 170 area are summarized here and are described in greater detail in Section III.C.3 of the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a). These previous descriptive sections are incorporated by reference. Because the community of Nuiqsut is just south of the Sale 170 area, and its subsistence-harvest areas for marine mammals could be directly impacted by Sale 170 exploration and development activities, this community is described in greater detail. The following summary description is augmented by information from current studies including State of Alaska, Dept. of Fish and Game (ADF&G), (1995a,b,c), Stephen R. Braund and Associates (1996), Kruse et al. (1983), Alaska Natives Commission (1994), City of Nuiqsut (1995), and USDOI, MMS (1996b,c).

The community residents adjacent to the Sale 170 area participate in a subsistence way of life. While new elements have been added to the way people live, this way of life is a continuation of centuries-old Inupiat traditional patterns. Until January 1990, Alaska statutes defined "subsistence uses" as "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (Alaska Statutes [AS] Sec. 16.05.940); and subsistence uses were given priority over other uses. In January 1990, as a result of *McDowell vs. State of Alaska*, this law was declared unconstitutional by the Alaska Supreme Court. However, Federal law (Title VIII of the Alaska National Interest Lands Conservation Act [ANILCA]) continues to define Alaskan subsistence and grants it priority over other uses as well. The new ruling means Alaska cannot legally (according to State law) establish rural preference for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State had until then to devise a solution to the issues raised in the McDowell decision. The Alaska State Legislature was not able to pass any subsistence legislation despite a special session called for that purpose. On Federal lands in Alaska, Federal laws grant subsistence priority over other uses, and Federal Agencies are now managing these hunts and will continue to do so until State legislation can be enacted (USDOI, FWS, 1992). Spurred by a number of recent court decisions and the State of Alaska's failure to enact a subsistence plan that guarantees some type of rural preference, a plan for managing subsistence fisheries on Federal lands is being developed by the FWS.

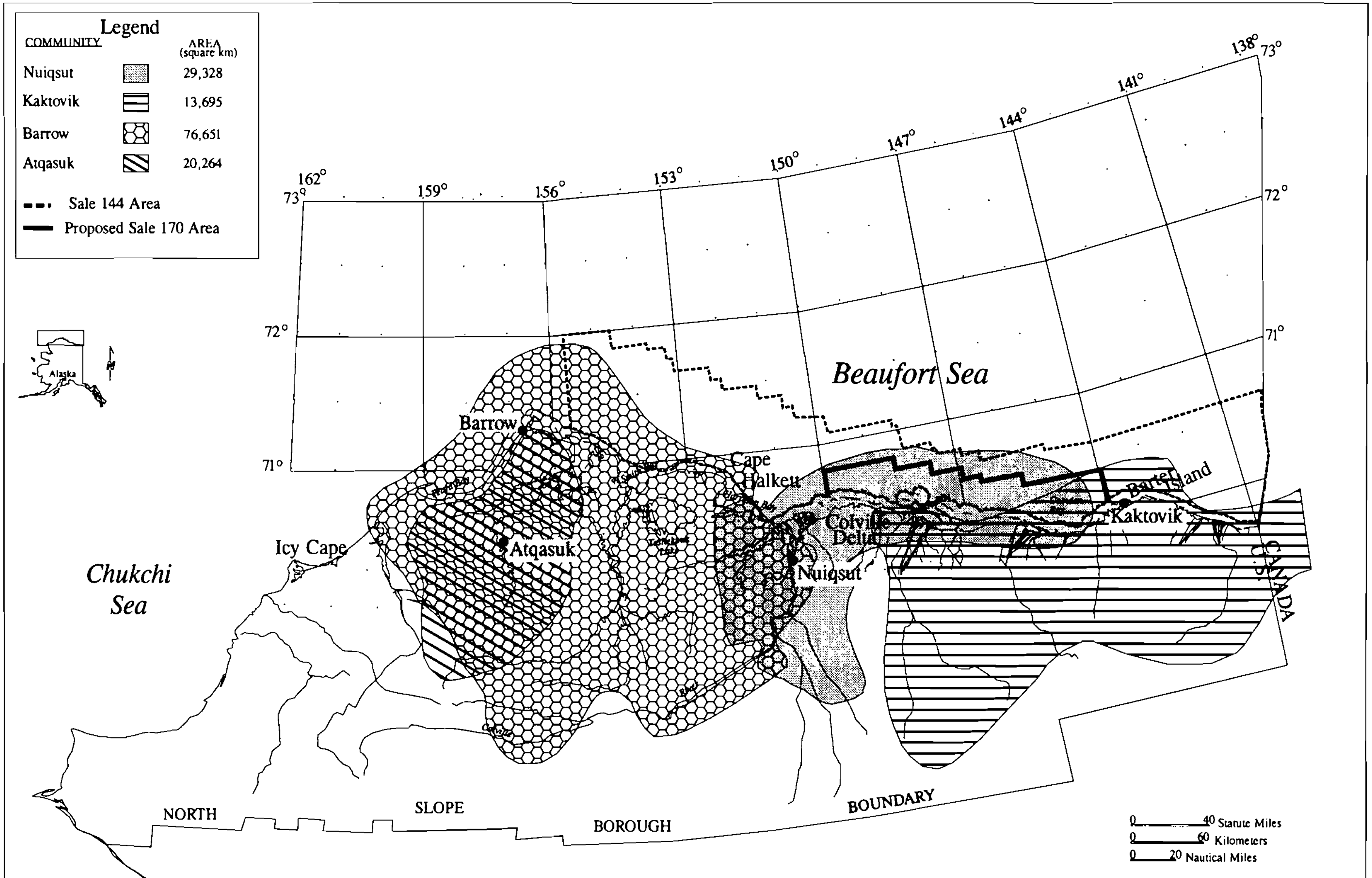
Subsistence activities, which are assigned the highest cultural values by the Inupiat, provide a sense of identity as well as an important economic activity. The importance of subsistence harvests to the maintenance of cultural identity has grown as social pressures associated with development build.

Inupiat concerns regarding oil development for Sale 170 that were identified during scoping can be divided into five categories: (1) disruption of subsistence species during migration; (2) direct damage to subsistence resources and habitats; (3) disruption of access to subsistence areas; (4) loss of Native food; and (5) insufficient recognition of Inupiat indigenous knowledge concerning subsistence resources, subsistence harvest areas, and subsistence practices. One analysis of Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. The majority of concerns centered on the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, or interruption of subsistence-species migration. These four concerns represent the concerns expressed in 83 percent of all the testimony taken on the North Slope (Kruse et al., 1983, Table 16; USDOI, MMS, 1994; Human Relations Area Files, Inc., 1992).

Many species are important for the role they play in the annual cycle of subsistence-resource harvests, yet effects on subsistence could be serious even if the net quantity of available food failed to decline. The consumption of harvestable subsistence resources provides more than dietary benefits; these resources also provide materials for personal and family use, and the sharing of harvestable subsistence resources helps maintain traditional Inupiat family organization. Subsistence resources provide special foods for religious and social occasions such as Christmas, Thanksgiving, and—the most important ceremony in the communities adjacent to the Sale 170 area—Nalukataq, which celebrates the bowhead whale harvest. The sharing, trading, and bartering of harvestable subsistence resources structures relationships among communities adjacent to the Sale 170 area, while the giving of such foods helps maintain ties with family members elsewhere in Alaska. Additionally, subsistence provides a link to the cash economy. Households within the communities earn cash from crafting whale baleen and walrus ivory and from harvesting furbearing mammals. If the availability of wage earnings associated with the oil industry and NSB CIP projects declines, this link may be expected to increase in importance in the communities of the sale area. These conditions could have effects on consumption, but the production side of the subsistence system could be affected as well. The temporary elimination of a species from a community's subsistence-harvest spectrum could impair the hunt of that particular species without drastically affecting the overall diet.

b. Annual Cycle of Harvest Activities: The primary subsistence harvest areas for Barrow, Nuiqsut, and Kaktovik are depicted in Figure III.C.2-1, Subsistence-Harvest Areas for Sale 170 Communities. Figures III.C.3-2 through III.C.3-7a in the Beaufort Sea Sale 144 FEIS depict subsistence-harvest-concentration areas for bowhead whales, belukha whales, caribou, seals, walrus, fishes, and waterfowl, respectively and are incorporated here by reference (USDOI, MMS, 1996a). The annual subsistence cycles for Barrow and Kaktovik are described below. Nuiqsut's annual subsistence cycle is shown in Figure III.C.2-4.

c. Community Subsistence-Harvest Patterns: This section provides general information regarding subsistence-harvest patterns in all of the communities close to the Sale 170 area. More specific information regarding the harvest areas, species harvested, and quantities harvested can be found in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a) and is incorporated here by reference. Under certain conditions, harvest activities may occur anywhere in the sale area; but they tend to be concentrated along rivers and coastlines, near communities, and at particularly productive sites.



Source: Impact Assessment Inc., 1990a and b (Nuiqsut and Kaktovik); and Braund, 1989a and b (Barrow).

Figure III.C.2-1. Subsistence-Harvest Areas for Sale 170 Communities

Table III.C.2-2 Participation in Successful Harvests of Selected Resources (percentage of households per resource)

	Barrow[1]	Nuiqsut[2]	Kaktovik[3]
Total	87 %	90 %	89 %
Marine mammals	76	37	40
Terrestrial mammals	77	76	68
Fish	60	81	81
Birds	65	76	64
Marine mammals			
Bowhead whale	75 %	5 %	6 %
Walrus	29	0	2
Bearded seals	46	7	28
Ringed seals	19	31	26
Spotted seals	1	2	4
Polar bear	7	2	4
Terrestrial mammals			
Caribou	77 %	74 %	55 %
Moose	7	10	6
Brown bear	0	8	0
Dall sheep	3	0	28
Wolverine	1	16	13
Arctic Fox	5	13	15
Red Fox	*	23	11
Fish			
Whitefish (all species)	54 %	74 %	70 %
Grayling	21	65	15
Arctic Char	5	31	79
Salmon (all species)	16	36	9
Burbot	10	57	0
Birds			
Geese	40 %	73 %	47 %
Eiders	52	36	38
Ptarmigan	26	45	57

All numbers are percentages.
Sources: Stephen R. Braund and Assoc. and ISER, 1993; Pedersen, 1995a, 1995b; Stephen R. Braund and Assoc., 1996. Dates resources used: [1]1987–1990. [2]1993. [3]1992–1993. *Represents less than 0.1%.

Table III.C.2-1 Proportion of Inupiat Household Food Obtained from Subsistence Activities, 1977, 1988, and 1993 (proportion is measured in percent)

	All Communities of the North Slope Borough		
Proportion	1977	1988	1993
None	13	20	18
Less Than Half	42	31	25
Half	15	14	15
More Than Half	30	35	42

Source: Harcharek, 1995.

Table III.C.2-3 Individual Subsistence Resource Percentages of Average Total Community Annual Subsistence Harvest

	Barrow (%)		Nuiqsut (%)		Kaktovik (%)	
Resource	1962-82[1]	1989	1985	1993	1962-82	1992
Bowhead Whale	21.3	38.7	4.6	28.7	27.5	63.2
Caribou	58.2	22.2	37.5	30.6	16.2	11.1
Walrus	4.6	8.9	0.9	0	3.2	*
Bearded Seal	2.9	2.1	1.6	0.3	7.4	2.4
Hair Seals	4.3	1.6	1.0	2.7	4.1	1.0
Belukha Whales	0.5	0	---	0	6.2	0
Polar Bears	0.3	2.2	0	0	2.8	0.7
Moose	0.3	2.2	4.1	1.6	3.5	1.1
Dall Sheep	0	0.1	---	0	3.8	2.5
Muskox	---	---	---	0	---	1.8
Small Land Mammals	0.1	*	0.1	*	0.4	*
Birds[2]	0.9	3.3	4.8	1.5	0.4	1.9
Fishes	6.6	7.8	44.1	33.7	21.7	13.4
Vegetation	---	0.1	0.1	1.4	---	0.1
Total Harvest (lb)	928,205	872,092	160,035	267,818	32,408	170,939
Per Capita Harvest (lb)	540	289.16	399.19	741.75	219	885.60

Source: Stoker, 1983, as cited by ACI/Braund, 1984; Stephen R. Braund & Associates, 1989b; ADF&G, 1995b.
[1] Averaged for the period. [2] Birds and eggs. * Represents less than 0.1 percent.

While the subsistence areas and activities of all three communities near the sale area could be affected at least indirectly by proposed Sale 170, most of the marine-subsistence-harvest areas of Nuiqsut and roughly the western half of the major portion of Kaktovik's subsistence-harvest areas lie within or near the Sale 170 boundary. The eastern portion of Barrow's subsistence waterfowl harvest area also lies within the Sale 170 boundary.

The subsistence harvest of vegetation by communities adjacent to the Sale 170 area is limited, while the harvest of faunal resources such as marine and terrestrial mammals and fishes is heavily emphasized. The spectrum of available resources in this region is limited when compared with more southerly regions. For a list of resources harvested by each community in the sale area, see Table III.C.3-1 in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a); for a comparison of the proportion of Inupiat household foods obtained from subsistence in the years 1977, 1988, and 1993 see Table III.C.2-1 in this section (see also the Beaufort Sea Sale 144 FEIS, Sec. III.C.3 [USDOI, MMS, 1996a]). Table III.C.2-2 indicates the participation success by percentage of successful households harvesting identified subsistence resources for the communities of Barrow, Nuiqsut, and Kaktovik. Subsistence resources used by these communities are listed in Table III.C.2-7 by common species name, Inupiaq name, and scientific name.

While subsistence-resource harvests differ from community to community, the resource combination of caribou, bowhead whales, and fishes was identified as being the primary grouping of resources harvested (Table III.C.2-3). Caribou is the most important overall subsistence resource in terms of effort spent hunting, quantity of meat hunted, and quantity of meat consumed (effort spent hunting is measured by frequency of hunting trips rather than total kilograms harvested). The bowhead whale is the preferred meat and the subsistence resource of primary importance by providing the basis for sharing and community cooperation (Stoker, 1984, as cited by Alaska Consultants, Inc. [ACI]/Braund, 1984); in fact, the bowhead could be said to be the foundation of the sociocultural system (see Sec. III.C.3 for the Beaufort Sea Sale 97, 124, and 144 FEIS's). Depending on the community, fish is the second or third most important resource after caribou and bowhead whale (Table III.C.2-3). Bearded seal and various types of birds also are considered primary subsistence species. Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. Seal oil from hair and bearded seals is an important staple and a necessary complement to other subsistence foods.

Whaling is a major concern in the Sale 170 area. The subsistence pursuit of bowhead whales occurs at Barrow, Nuiqsut, and Kaktovik and has been and continues today to be the most valued activity in the subsistence economy of these communities. This is true even in light of harvest constraints by imposed quotas of the International Whaling Commission (IWC); relatively plentiful supplies of other resources such as caribou, fish, and other subsistence foods; and supplies of retail grocery foods. Whaling traditions include kinship-based crews, use of skin boats (in Barrow), shoreline preparation for distribution of the meat, and total community participation and sharing. In spite of the rising cash income, these traditions remain as central values and activities for all Inupiat in these North Slope communities (see Sec. III.C.3 for the Beaufort Sea Sale 97, 124, and 144 FEIS's for a further discussion on the cultural importance of whaling). Figure III.C.2-2 indicates bowhead whale-subsistence harvests for the communities of Barrow, Nuiqsut, and Kaktovik for the 23-year period from 1973 to 1995.

Bowhead whaling strengthens family and community ties and the sense of a common Inupiat heritage, culture, and way of life. In this way, whaling activities provide strength, purpose, and unity in the face of rapid change. Barrow is the only community within the area that harvests whales in both the spring and the fall (see Fig. III.C.3-2, Beaufort Sea Sale 144 FEIS). Nuiqsut and Kaktovik residents hunt bowheads only during the fall season.

Harvest data for Barrow, Nuiqsut, and Kaktovik are only estimates that represent average values. Because of this limitation, resource-harvest data are presented in terms of a 20-year average (from 1962-1982) for selected North Slope communities (Table III.C.2-3). Table III.C.2-3, which shows the contribution made by various harvestable subsistence resources to the Native diet, is based on the amount of usable meat and fat contributed to the diet rather than on the number of animals harvested. The 20-year averages do not reflect the important shift in subsistence-harvest patterns that occurred in the late 1960's, when the substitution of snowmachines for dogsleds decreased the importance of ringed seals and walruses (two key dogfoods) and increased the relative importance of waterfowl in the subsistence system. This shift illustrates that technological or social change may lead to long-term modifications of subsistence practices. Because of changes in technology and in the subsistence-harvest patterns mentioned above, the dietary importance of waterfowl also may continue to increase; however, none of these changes would affect the central and specialized dietary roles that bowhead whales, caribou, and fish—the three most important subsistence-food resources—play in the subsistence harvests of Alaska's North Slope Inupiat, and for which there are no viable substitutes.

(1) **Barrow:** As with other communities adjacent to the Sale 170 area, Barrow residents (population 3,469 in

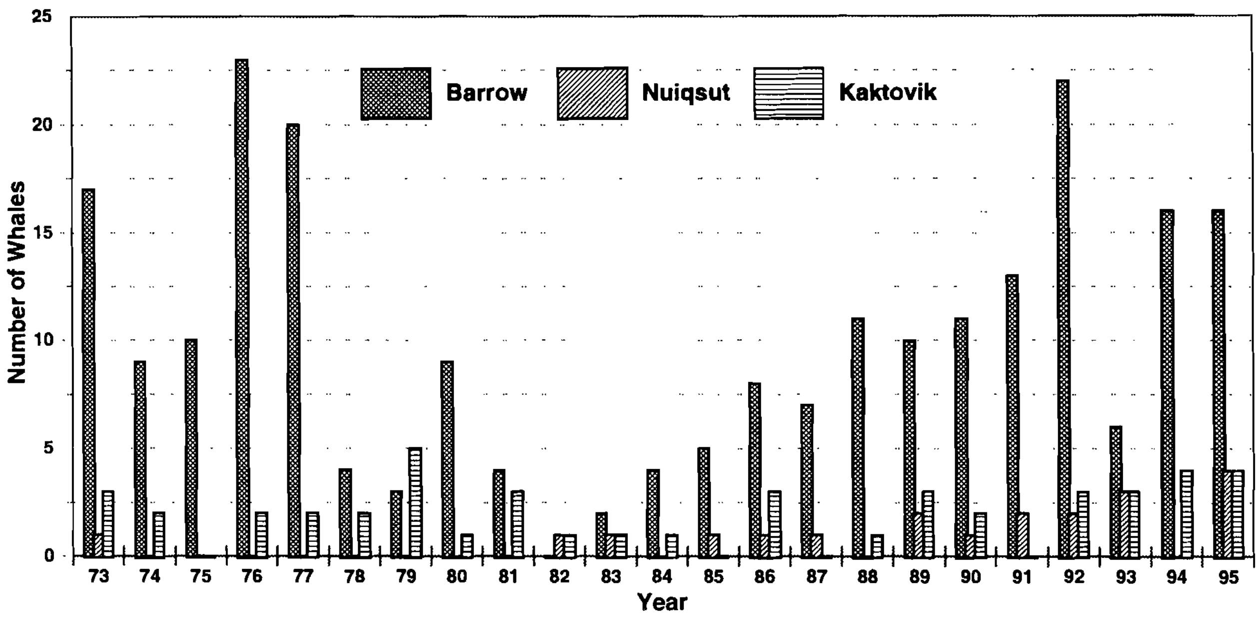


Figure III.C.2-2 Annual Subsistence Harvest of Bowhead Whales by the North Slope Communities of Barrow, Nuiqsut, and Kaktovik, 1973–1995. Sources: Stoker, 1983, as cited in ACI/Braund, 1984; ADF&G, 1993a, b; George et al., 1993; Gusey, 1993; Philo et al., 1994; Stoker and Krupnik, 1993; AEWC, 1993, 1994, 1995.

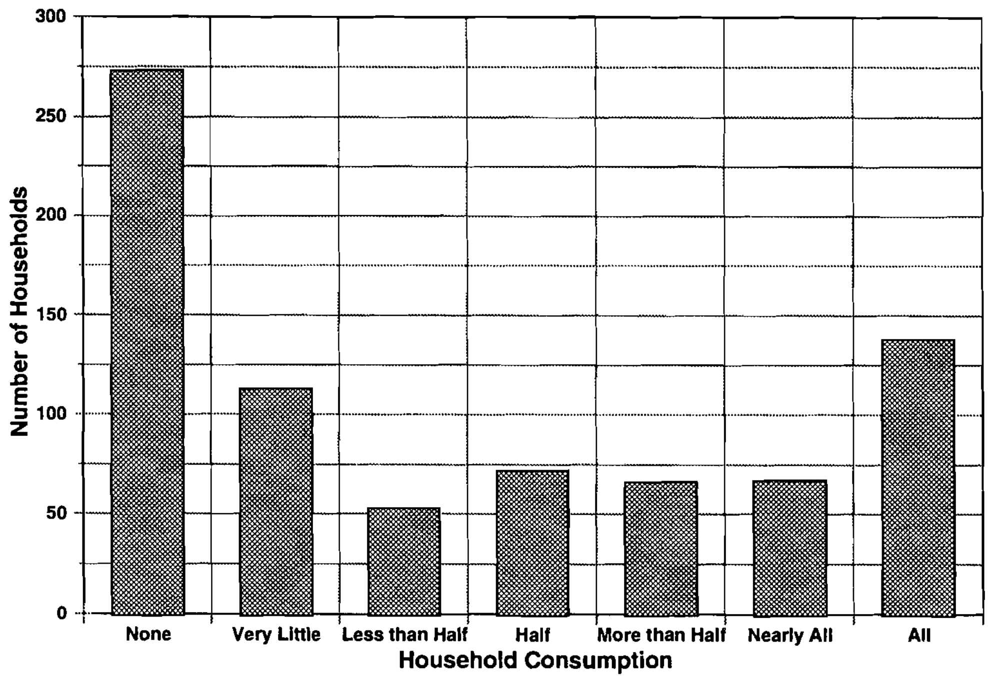


Figure III.C.2-3 Barrow Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

1990 and 4,234 in 1995 [U.S. Dept. of Commerce {USDOC}, Bureau of the Census, 1991; ADOL figures from ADF&G, 1995d]) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location is unique among the communities in the sale area: the community is a few miles southwest of Point Barrow, the demarcation point between the Chukchi and Beaufort seas. This location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes.

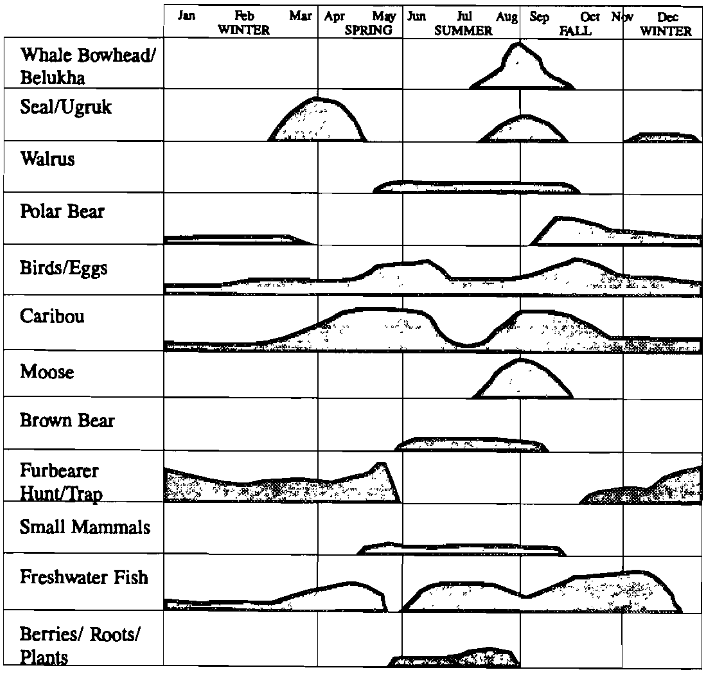
Unlike residents of other communities close to the Sale 170 area, Barrow residents hunt the bowhead whale during both spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season. In 1977, the IWC established an overall quota for subsistence hunting of the bowhead whale by Alaskan Inupiat. The quota currently is regulated by the Alaska Eskimo Whaling Commission (AEWC), which annually decides how many bowheads each whaling community may take. Figure III.C.2-2 indicates bowhead whale-subsistence harvests for Barrow for the 23-year period from 1973 to 1995.

Depending on the season, the bowhead whale is hunted in two different areas. In the spring (from early April until the first week of June), bowheads are hunted from leads that open when pack-ice conditions deteriorate. At this time, bowhead whales are harvested along the coast from Point Barrow to the Skull Cliff area. Typically, the lead is open from Point Barrow to the coast; and hunters whale only 2 to 5 km from shore. A stricken whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats because the narrow leads prohibit the use of aluminum skiffs, which are more difficult to maneuver than the traditional skin boats (Alaska Consultants, Inc. [ACI]/Courtnage/Braund, 1984). Fall whaling occurs east of Point Barrow (Fig. III.C.2-1) from the Barrow vicinity to Cape Simpson. Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water up to 48 km (30 mi) offshore.

No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale. Bowheads are very important in the subsistence economy, and they accounted for 21.3 percent (an average of 10.10 whales/year) of the annual subsistence harvest from 1962 to 1982 (Table III.C.2-3). In 1988 and 1989, a 2-year subsistence study was conducted in Barrow (S.R. Braund and Assocs., 1989b). In this 2-year period, 40.7 percent of the total harvest was marine mammals, and 38.7 of the total harvest was bowhead whales (Table III.C.2-3). As with all species, the harvest of bowheads varies from year to year; over the past 24 years, the number taken each year has varied from 0 to 23. In the memory of community residents, 1982 is the only year in which a bowhead whale was not harvested (ACI/Courtnage/Braund, 1984).

The harvest cycles for other important subsistence species follow. Belukha whales are available from the beginning of the spring whaling season through June; caribou are hunted throughout the year with peak harvests from February through early April; seals are available from October through June, with peak harvests in the winter months; walruses are hunted in the spring west of Point Barrow and southwest to Peard Bay; polar bears are hunted by Barrow residents from October to June but represent only a small portion of the subsistence harvest; fishing, primarily for capelin, char, cod, grayling, salmon, sculpin, trout, and whitefish, occurs primarily in the summer and fall with the peak harvest period in the months of September and October; migratory birds, especially eiders and geese, are an important early-season subsistence-meat source for Barrow residents. The waterfowl hunt begins in late April, continues to late June, resumes again in late August, and continues into September. The subsistence seasons for moose and brown bear run from May through September; small furbearers are taken in the fall and winter months. The percentages of the overall annual subsistence harvest for belukha whales, caribou, moose, brown bears, small furbearers, seals, fishes, walruses, migratory birds, and polar bears are shown in Table III.C.2-3. A more detailed discussion of harvest areas, harvest cycles, and annual harvest percentages for each of these species can be found in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a) and is incorporated here by reference. Trends in Barrow household consumption of subsistence foods from an NSB subsistence survey conducted in 1993 are shown in Figure III.C.2-3.

(2) **Nuiqsut:** Nuiqsut (population 354 in 1990 and 410 in 1995 [USDOC, Bureau of the Census, 1991; ADOL figures from ADF&G, 1995d]) is situated near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, the subsistence resources that might be affected by Sale 170 include bowhead and belukha whales, seals, walruses, polar bears, caribou, fishes, and marine and coastal birds. The preferred harvest periods for Nuiqsut are indicated in Figure III.C.2-4. Figures III.C.3-2 through III.C.3-7a in the Beaufort Sea Sale 144 FEIS depict subsistence-harvest-concentration areas for bowhead whales, belukha whales, caribou, seals, walruses, fishes, and waterfowl, respectively, and are incorporated here by reference (USDOI, MMS, 1996a). Most of Nuiqsut's marine subsistence-harvest area lies within the proposed Sale 170 area; its terrestrial mammal, fish, and bird subsistence-harvest areas are in the vicinity of possible landfalls at Oliktok and Milne points. Additionally, pipelines from Oliktok Point and Point Thompson would go through Nuiqsut's land subsistence-harvest area.



Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources. (Data for invertebrates, sheep, and ocean fish are unavailable.) Source: North Slope Borough Contract Staff, 1979.

Figure III.C.2-4 Nuiqsut Annual Subsistence Cycle

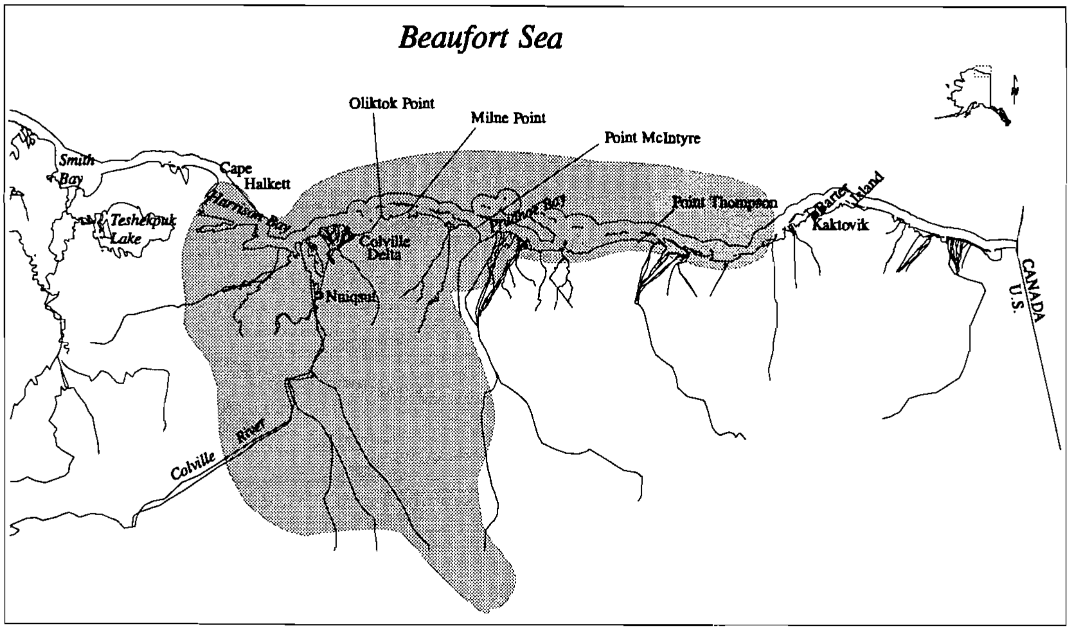


Figure III.C.2-5 Nuiqsut Subsistence-Use Area. Sources: NSB Contract Staff, 1979; Hoffman, Libbey, and Spearman, 1988; Impact Assessment, 1990a. Resource categories: birds, hunting and trapping furbearers, caribou, moose, walrus, whale, seal, invertebrates, fish, polar bear, grizzly bear, sheep, small mammals, fuel and structural material, vegetation.

(a) Bowhead Whales: Even though Nuiqsut is not located on the coast, marine mammals are a major subsistence resource, especially bowhead whales. Bowhead whaling usually occurs between late August and early October; the exact timing depends on ice and weather conditions. Also, ice conditions dramatically can extend the season to last longer than 2 months or contract it to <2 weeks (Fig. III.C.2-4). Unlike spring-whaling communities, which hunt the bowhead from the edge of ice leads in skin boats, Nuiqsut whalers use aluminum skiffs with outboard motors to hunt bowheads in open water. Generally, they whale within 16 km (10 mi) of shore, but at times they may travel 32 km (20 mi) or more from shore. Bowhead whales commonly are harvested by Nuiqsut residents off of Cross Island, but the entire coastal area from Nuiqsut east to Flaxman Island and the Canning River Delta may be used (see Figs. III.C.2-1, III.C.2-5, and III.C.2-6). In the past, Nuiqsut has not harvested many bowhead whales (20 whales since 1972); however, their success has improved in the past few years, with unsuccessful harvests occurring since 1982 only in the years 1984, 1988, 1993, and 1994 (see Figs. III.C.2-2 and III.C.2-6 and Table III.C.2-4). Figure III.C.2-2 indicates bowhead whale-subsistence harvests for Nuiqsut for the 23-year period from 1973 to 1995.

Although bowheads are not the main subsistence resource in Nuiqsut, they remain, as in other North Slope communities, culturally prominent to residents. The bowhead is shared extensively with other North Slope communities and often with Inupiat residents in communities such as Fairbanks and Anchorage. Bowhead baleen is bartered in traditional networks and is important in the manufacture of traditional arts and crafts.

(b) Belukha Whales: Belukha whales may be harvested throughout the open-water season (Fig. III.C.2-4) and taken incidentally to the bowhead harvest. Little harvest information is available for Nuiqsut harvests of belukha whales (see Table III.C.2-4). While belukhas do not have the same religious significance as bowheads, the distribution of harvested belukha whales may have a special, traditional form that involves many non-kin. Belukha teeth are used in the production of arts and crafts.

(c) Seals: Seals are hunted year-round (Fig. III.C.2-4), but the bulk of the seal harvest occurs during the open-water season, with breakup usually occurring in June. In the spring, seals can be hunted once the landfast ice goes out. Henry Nashanknik from Barrow related that seaward of the McClure Islands, there were huge pressure ridges that hunters traveled through in the spring, and that not too far out from the pressure ridges there were open leads where they would hunt seals (H. Nashanknik, in Shapiro, Metzner, and Toovak, 1979). When elder Bruce Nukapigak lived at Point McIntyre in the 1930's, he noted there was good seal hunting between Cross and McClure islands, because there usually was some open water in the channel between the islands (B. Nukapigak, in Shapiro, Metzner, and Toovak, 1979). Nuiqsut elder Samuel Kunaknana, when interviewed in 1979, noted that when the ice is nearshore in the summer, it is considered to be good for seal hunting (S. Kunaknana, in Shapiro, Metzner, and Toovak, 1979). During the winter, these harvests consist almost exclusively of ringed seals taken along open leads in the ocean ice. In summer, boat crews harvest ringed, bearded, and spotted seals; and the hunt can take place along the entire Beaufort Sea coast from Cape Halkett to Anderson Point (Table III.C.2-4). While seal meat is eaten, the dietary significance of seals primarily comes from seal oil, served with almost every meal that includes subsistence foods. Seal oil also is used as a preservative for meats, greens, and berries. Seal skins are important in the manufacture of clothing and, because of their beauty, spotted seal skins often are preferred for making boots, slippers, mitts, and parka trim. In practice, however, ringed seal skins are used more often in the making of clothing because the harvest of this species is more abundant. Also important are bearded seal hides that are necessary for the manufacture of boot soles. Handmade products such as boots, slippers, mitts, and parkas are sold, given as gifts to relatives and friends, and bartered.

(d) Walruses: Walruses also are occasionally harvested during the open-water season from June through early October (Fig. III.C.2-4). Walrus hunting occurs along the entire Beaufort Sea coast from Cape Halkett to Anderson Point. Recent ADF&G subsistence-survey data indicate that a single walrus was harvested in 1985; no new walrus data for the community have been gathered since then (see Table III.C.2-4; ADF&G, 1995d). Walrus meat is eaten and its ivory used in the manufacture of traditional arts and crafts.

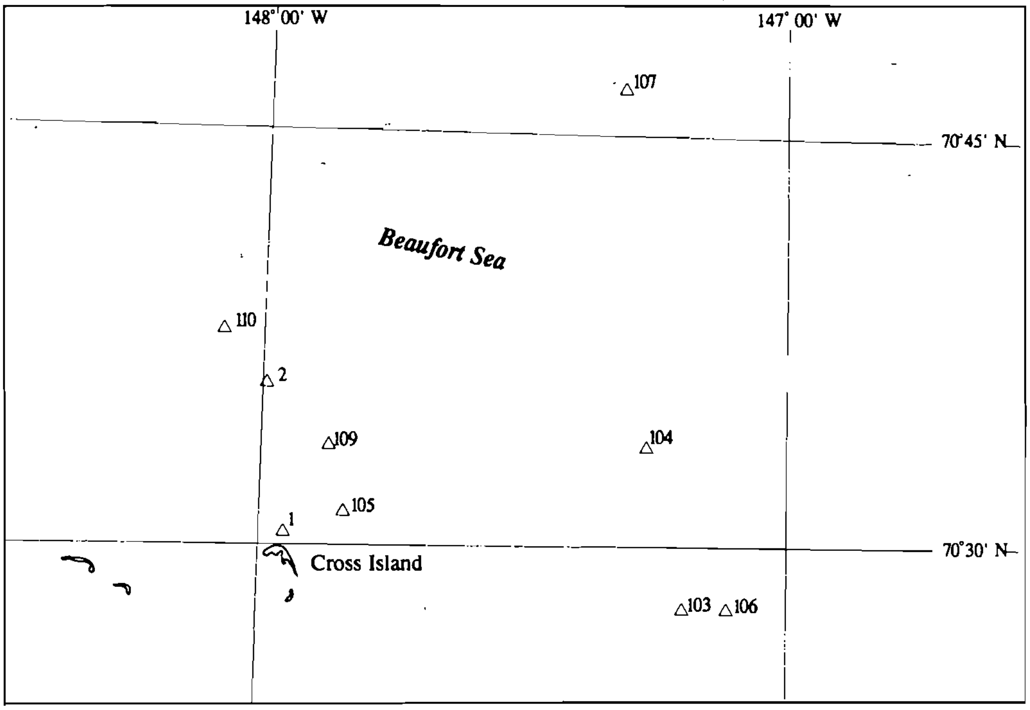
(e) Polar Bears: The harvest of polar bears by Nuiqsut hunters begins in mid-September and extends into late winter (Fig. III.C.2-4). Polar bear meat often is consumed, although little harvest data are available. One bear was harvested in the 1962 to 1982 period; more recent polar bear-subsistence harvests for the community can be seen in Tables III.C.2-4 and III.C.2-5; ADF&G 1995d). According to Nuiqsut resident and whaling captain Thomas Napageak, the taking of polar bear is not very important now because Federal regulations prevent the selling of the hide: ". . .as valuable as it is, [it] goes to waste when we kill a polar bear" (Napageak, 1986, pers. comm., as cited in USDOI, MMS, 1986b).

(f) Caribou: Nuiqsut harvests several large land mammals, including caribou, moose, and brown bears; of these, caribou is the most important subsistence resource. Caribou may be the most preferred mammal in Nuiqsut's diet and, during periods of high availability, caribou provides a source of fresh meat throughout the year

Table III.C.2-4
Nuiqsut 1993 Subsistence-Harvest Summary for Marine Mammals, Terrestrial Mammals, Fish, and Birds

	Total Number Harvested	Edible Pounds Harvested: Total	Household Harvest Mean	Per capita
Marine Mammals				
Total Marine Mammals	113	85,216	936.44	236.01
Bowhead Whale	3	76,906	845.12	213.00
Belukha Whale	0	0	0.00	0.00
Walrus	0	0	0.00	0.00
Polar Bear	1 *	0	0.00	0.00
Bearded Seal	6	1,033	11.35	2.86
Ringed Seal	98	7,277	79.96	20.15
Spotted Seal	4 *	0	0.00	0.00
Terrestrial Mammals				
Large Land Mammals	691	87,306	959.40	241.80
Brown Bear	10 *	734	8.06	2.03
Caribou	672	82,169	902.95	227.57
Moose	9	4,403	48.38	12.19
Muskox	0	0	0.00	0.00
Dall Sheep	0	0	0.00	0.00
Small Land Mammals/ Furbearers	599 §	84	0.92	0.23
Arctic Fox	203	0	0.00	0.00
Red Fox	63	0	0.00	0.00
Marmot	0	0	0.00	0.00
Mink	0	0	0.00	0.00
Parka Squirrel	336	84	0.92	0.23
Weasel	10	0	0.00	0.00
Wolf	31	0	0.00	0.00
Wolverine	19	0	0.00	0.00
Fish				
Total Fish	71,897	90,490	994.39	250.62
Total Salmon	272	1,009	11.08	2.79
Total Non-Salmon	71,626	89,481	983.30	247.83
Smelt	304	42	0.46	0.12
Cod	62	7	0.07	0.02
Burbot	1,416	5,949	65.37	16.48
Char	618	1,748	19.20	4.84
Grayling	4,515	4,063	44.65	11.25
Total Whitefish	64,711	77,671	853.53	215.12
Cisco	51,791	34,943	383.98	96.78
Arctic Cisco	45,237	31,666	347.97	87.70
Least Cisco	6,553	3,277	36.00	9.08
Birds				
Total Birds and Eggs	3,558	4,325	47.53	11.98
Migratory Birds	2,238	3,540	38.90	9.80
Ducks	772	1,152	12.66	3.19
Eider	662	1,059	11.63	2.93
Oldsquaw	78	62	0.68	0.17
Geese	1,459	2,314	25.43	6.41
Brant	296	356	3.91	0.99
Canada Geese	691	830	9.11	2.30
White Fronted	455	1,092	12.00	3.02
Swan	7	73	0.80	0.20
Ptarmigan	973	681	7.48	1.89
Bird Eggs	346	104	1.14	0.29

Number of households in the sample = 62; number of households in the community = 91.
Source: ADF&G, Community Profile Database, 1995b. Footnotes: *Not eaten. §Some not eaten.



Location	Whaling Captain	Year
1	Taaqpak	1937
2	Taaqpak	1940
101	Thomas Napageak	1973
102	Thomas Napageak	1982
103	Billy Oyagak	1983
104	Lloyd Kittick	1985
105	Patsy Tukle	1986
106	Thomas Napageak	1990
107	Archie Achiviana	1991
108	Billy Oyagak	1991
109	Roxy Oyagak	1992
110	Patsy Tukle	1992

Figure III.C.2-6 Bowhead Whale Harvest Locations Near Cross Island. Sources: Long, 1996; North Slope Borough Planning Dept., 1993.

(Table III.C.2-4). Data gathered in 1976 show it provided an estimated 90.2 percent of the total subsistence harvest (Stephen R. Braund and Assocs., 1993b). More recent subsistence caribou-harvest data are shown in Table III.C.2-4 (ADF&G, 1993a). Caribou are harvested throughout the year, with peak harvests from April through June and in September and October (Fig. III.C.2-4). Caribou-harvest statistics for 1976 show 400 caribou provided approximately 28,000 kilograms (kg) of meat (Stoker, 1983, as cited by ACI/Braund, 1984). In 1985, an estimated 513 caribou were harvested, providing an estimated 60,021 edible pounds of meat (37.5% of the total subsistence harvest; ADF&G, 1995d). A subsistence-harvest survey conducted by the NSB Department of Wildlife Management covering the period from July 1994 to June 1995 reported 249 caribou harvested by Nuiqsut hunters. The report noted this as quite a low number of caribou harvested when compared to reported harvests for earlier years. Explanations offered by local hunters were: (1) the need to travel longer distances to harvest caribou than in the past; (2) the increasing numbers of muskox that hunters believe keep caribou away from traditional hunting areas; and (3) restricted access to traditional subsistence hunting areas due to oil exploration and development in these areas (Brower and Opie, 1997).

Because of the unpredictable movements of the Western Arctic, Central Arctic, and Porcupine caribou herds and because of ice conditions and weather-dependent hunting techniques, Nuiqsut's annual caribou harvest can fluctuate markedly; but when herds are available and when weather permits, caribou are harvested year-round. Elders Samuel and Sarah Kunaknana related that caribou hunters in the past had to go inland to hunt caribou, because they never came down to the coast as they do now (Shapiro, Metzner, and Toovak, 1979). In 1992, caribou and moose accounted for 27 percent of the total subsistence harvest (George and Fuller, in prep.); in 1993, moose and caribou accounted for 33 percent (Pedersen, in prep.); and in the period covered by the NSB subsistence survey (July 1994-June 1995), caribou and moose accounted for 69 percent of the edible pounds of subsistence resources harvested by Nuiqsut hunters (Brower and Opie, 1997). This jump to a much higher percentage for terrestrial mammals is likely explained by an unsuccessful bowhead whale harvest during the study period (Suydam et al., 1994).

Table III.C.2-5 Annual Harvest of Polar Bear for the Harvest Years 1983 to 1995 for the Communities of Barrow, Nuiqsut, and Kaktovik

	Number of Bears		
Harvest Season[1]	Barrow	Nuiqsut	Kaktovik
1983/84	27	0	1
1984/85	31	1	0
1985/86	13	4	5
1986/87	21	5	3
1987/88	12	3	6
1988/89	31[2]	2	8
1989/90	14	0	0
1990/91	14	0	0
1991/92	22	0	0
1992/93	24	0	3
1993/94	28	3	5
1994/95	8	1	1

Source: Schliebe, 1995.
[1] Harvest year runs from 1 July to 30 June.
[2] Atqasuk harvested 2 bears during the 1988/89 season.

(g) **Fishes:** Anadromous fishes provide an important subsistence resource for Nuiqsut (see Table III.C.2-4; ADF&G, 1995d). The harvests of most subsistence resources, such as caribou, can fluctuate widely from year to year because of variable migration patterns and because harvesting techniques depend on ice and weather conditions. The harvest of fishes is not subject to seasonal limitations, a situation that adds to their importance in the community's subsistence round, and Nuiqsut has been shown to have the largest documented subsistence-fish harvest on the Beaufort Sea coast (Moulton, Field, and Brotherton, 1986). Moreover, in October and November, fishes may provide the only source of fresh subsistence foods.

Fishing is an important activity for Nuiqsut residents due to the community's location on the Nechelik Channel of the Colville River with its large resident fish populations. The river supports 20 species of fishes, and approximately half of these are taken by Nuiqsut residents (George and Nageak, 1986). Local residents generally harvest fishes during the summer and fall, but the fishing season runs basically from January through May and from late July through mid-December, with the peak harvest apparently occurring in November and early December (Fig. III.C.2-4). The summer open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a greater area and is longer in duration than the fall/winter harvest, and a greater number of species are caught. Broad whitefish is the primary species harvested during the summer and is the only anadromous species harvested in July in the Nechelik Channel. In July, lake trout, northern pike, broad whitefish, and humpback whitefish are harvested in the Main Channel of the Colville south of Nuiqsut. Traditionally, coastal areas were fished in June and July when rotting ice created enough open water for seining. Nuiqsut elder Sarah Kunaknana, interviewed in 1979, said: ". . .in the little bays along the coast we start seining for fish (iqalukpik). After just seining 1 or 2 times, there would be so many fish we would have a hard time putting them all away" (Shapiro, Metzner, and Toovak, 1979). Salmon species reportedly have been caught in August, but not in large numbers; all five species of Pacific salmon have been reported in the Colville. Pink and chum salmon are the most commonly caught, although there reportedly has not been a great interest in harvesting them (George and Nageak, 1986). Arctic char is found in

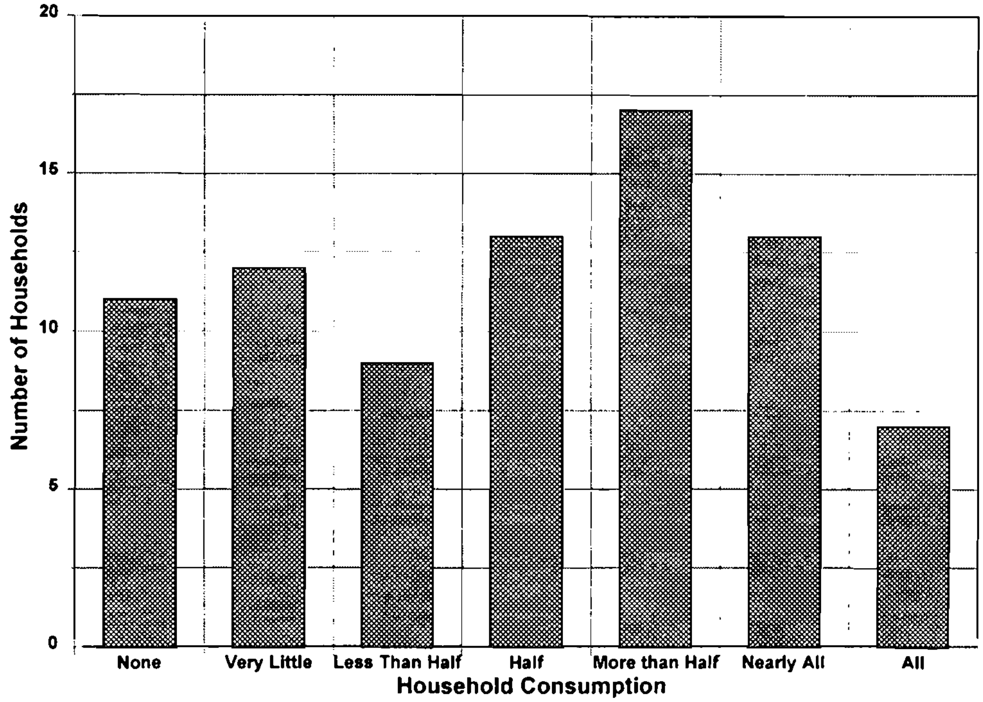


Figure III.C.2-7 Nuiqsut Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

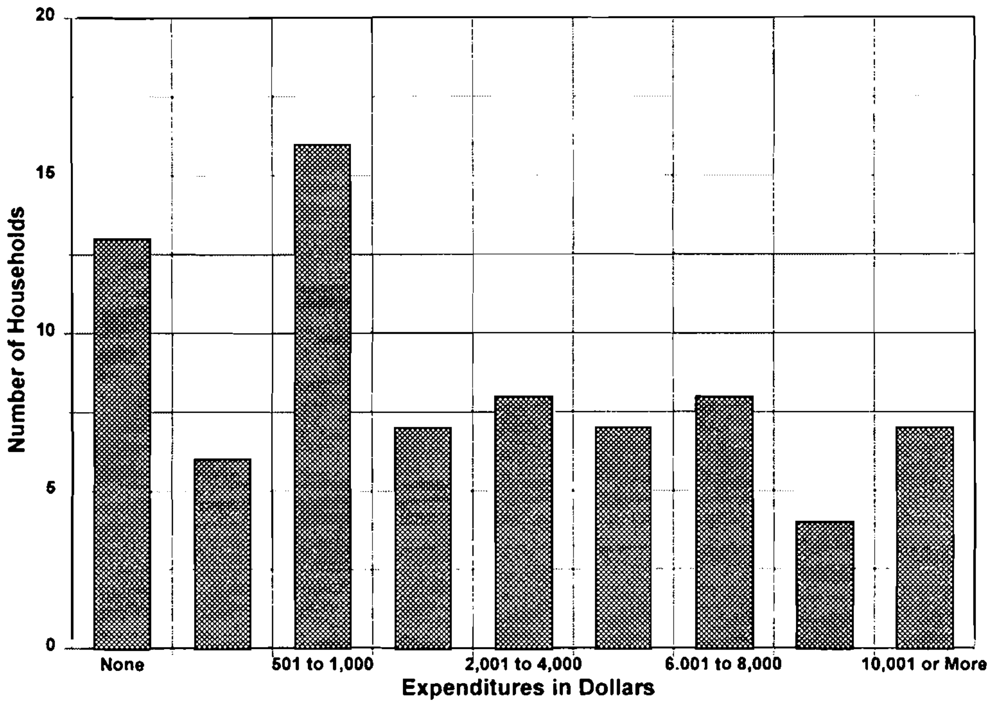


Figure III.C.2-8 Nuiqsut Household Expenditures on Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

the Main Channel of the Colville River (Entrix, Inc., 1986), but it does not appear to be an important subsistence species because although apparently liked, it is not abundantly caught (George and Nageak, 1986; George and Kovalsky, 1986; ADF&G, 1995d).

The fall/winter under-ice harvest of fishes begins after freezeup when the ice is safe for snowmachine travel. Local families fish for approximately ≤1 month after freezeup. The Kupigruak Channel is the most important fall-fishing area in the Colville region, and the primary species harvested are arctic and least cisco; other fishing for cisco occurs in the Nechelik and Main channels of the Colville River. Arctic and least cisco amounted to 88 and 99 percent of the harvest in 1984 and 1985, respectively; however, this percentage varied greatly depending on the net-mesh size. Humpback and broad whitefish, sculpin, and some large rainbow smelt also are harvested, but only in low numbers (George and Kovalsky, 1986; George and Nageak, 1986). A fish identified as "spotted least cisco" also has been harvested. This fish is not identified by Morrow (1980) but may be a resident form of least cisco (George and Kovalsky, 1986). Weekend fishing for burbot and grayling occurs at Itkillikpaat, 10 km from Nuiqsut, but the success rate for grayling is quite low (George and Nageak, 1986).

The summer catch in 1985 totaled about 8,755 kg of mostly broadfish; and in the fall, approximately 27,682 kg of fish were caught, totaling 36,436 kg—an annual per capita catch of 109 kg (244 lb); some of this catch was shipped to Barrow (Craig, 1987). A 1985 ADF&G subsistence survey estimated the edible pounds of all fish harvested at 176.13 lb per capita (ADF&G, 1995d). In 1986, there was a reduced fishing effort in Nuiqsut; and the fall harvest was only 59 percent of that taken in 1985 (Craig, 1987). In a 1993 ADF&G subsistence survey, the estimate for edible pounds of all fish harvested had risen to 250.62 lb per capita (ADF&G, 1995d).

Fish are eaten fresh or frozen; salmon also may be split and dried. Because of their important role as an abundant and stable food source, and as a fresh-food source during the midwinter months, fish are shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Fish also appear in traditional sharing and bartering networks that exist among North Slope communities. Because it often involves the entire family, fishing serves as a strong social function in the community, and most Nuiqsut families (out of a total 91 households in 1993) participate in some fishing activity (ADF&G, 1995d).

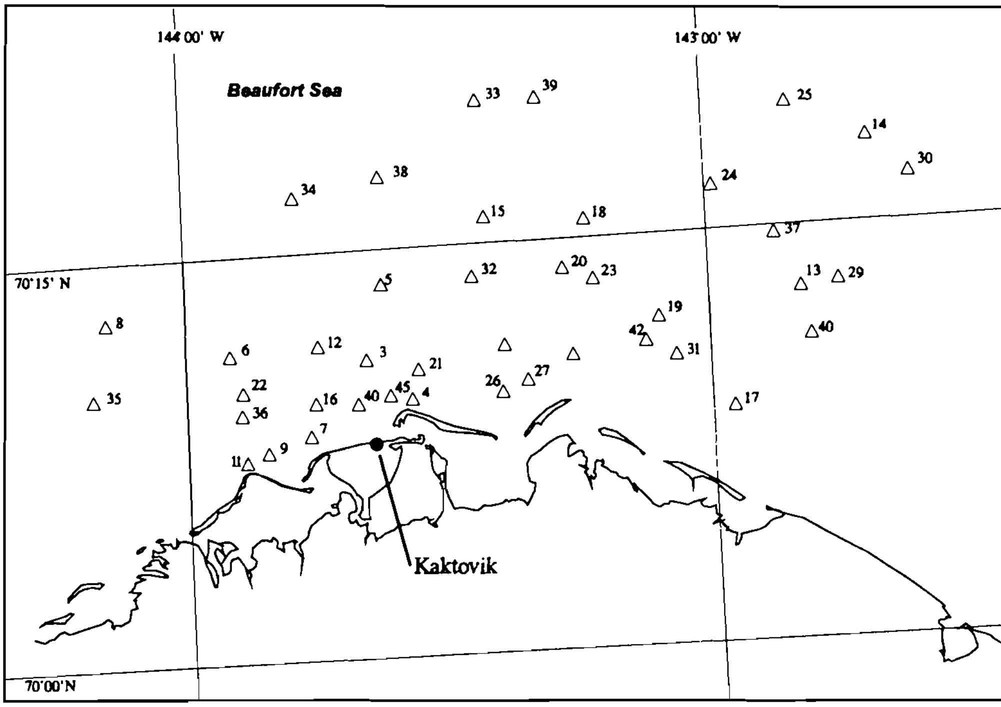
(h) **Marine and Coastal Birds:** Waterfowl and coastal birds are a subsistence resource that has been growing in importance since the mid-1960's. Birds are harvested year-round, with peak harvests in May to June and September to October (Fig. III.C.2-4). The most important species at Nuiqsut are the white-fronted goose, Canada goose, Pacific brant, oldsquaw, eider, snow goose, and pintail duck, although other birds, such as loons, occasionally may be harvested (see Table III.C.2-4; ADF&G, 1995d). Waterfowl hunting occurs mostly in the spring, beginning in June, and continues throughout the summer and probably into September. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking nets. Nuiqsut hunters may harvest Pacific brant intensely in August and early September.

(i) **Moose:** Moose is harvested from August to September by boat on the Colville, Chandler, and Itkillik rivers (Fig. III.C.2-4). When water levels become too low in fall for access to prime moose-harvest areas, the hunt is discontinued as moose is too large and difficult to handle to be hunted by Nuiqsut hunters on snowmachines (Impact Assessment, Inc., 1990c). In 1985, seven moose were harvested by 40 households (out of a total 76 households) surveyed (ADF&G, 1995d). In 1993, nine moose were harvested by 62 households (out of a total 91 households) surveyed (ADF&G, 1995d; see Table III.C.2-4).

Figures III.C.2-7 and III.C.2-8 indicate recent trends in Nuiqsut household consumption of subsistence foods and expenditures on subsistence activities (Harcharek, 1995).

(3) **Kaktovik:** Kaktovik is situated on Barter Island off the Beaufort Sea coast (population 224 in 1990 and 210 in 1995 [USDOC, Bureau of the Census, 1991; ADOL figures from ADF&G, 1995d]). For Kaktovik, the subsistence resources that could be affected by Sale 170 are bowhead and belukha whales, seals, polar bears, caribou, fishes, and marine and coastal birds. Much of Kaktovik's marine subsistence-harvest area is within the proposed Sale 170 lease-sale area, and the western edge of the community's terrestrial mammal, fish, and bird subsistence-harvest areas overlap a possible landfall location at Point Thompson.

Bowhead whaling occurs between late August and early October, with the exact timing depending on ice and weather conditions. The whaling season can range anywhere from >1 month to <2 weeks, depending on these conditions. As in Nuiqsut, Kaktovik whalers hunt the bowhead in aluminum skiffs in open water rather than in skin boats from the edge of ice leads. Whaling crews generally hunt bowheads within 16 km (10 mi) of shore but occasionally may range as much as 32 km (20 mi) from the coast (Fig. III.C.2-1). Bowhead whales provide a fairly large proportion of Kaktovik's subsistence harvest, but the number landed has varied from zero to as many as four each year since 1962, with the exception of 1979 when five were landed (see Figs. III.C.2-2 and III.C.2-9 and Table III.C.2-6). In the 1992 ADF&G subsistence-harvest



Location	Whaling Captain	Year	Location	Whaling Captain	Year
3	Archie Brower	1964	27	Joseph Kaleak	1986
4	Herman Aishanna	1973	28	Nolan Solomon	1986
5	Herman Aishanna	1974	29	Archie Brower	?
6	Herman Rexford	1975	30	Isaac Akootchook	?
7	Herman Aishanna	1975	31	Tommy Agiak	1988
8	Archie Brower	1976	32	Tommy Agiak	1989
9	Archie Brower	1977	33	James Killbear	1989
10	Alfred Linn	1977	34	Joseph Kaleak	1989
11	Nolan Solomon	1977	35	Herman Aishanna	1990
12	Tommy Agiak	1977	36	Jimmie Soplu	1990
13	Joseph Kaleak	1977	37	Daniel Akootchook	1991
14	Joseph Kaleak	1978	38	James Lampe, Sr.	1992
15	Joseph Kaleak	1978	39	Daniel Akootchook	1992
16	Nolan Solomon	1978	40	Joseph Kaleak	1992
17	Alfred Linn	1980	41	James Killbear	1993
18	Tommy Agiak	1982	42	Herman Aishanna	1993
19	Alfred Linn	1982	43	Joseph Kaleak	1993
20	Isaac Akootchook	1983	44	James Killbear	1994
21	Nolan Solomon	1983	45	Herman Aishanna	1994
22	Tommy Agiak	1983	46	Edward Rexford	1994
23	Herman Aishanna	1984	47	Tommy Agiak	1995
24	Isaac Akootchook	1984	48	James Killbear	1995
25	Nolan Solomon	1984	49	James Lampe, Sr.	1995
26	Alfred Linn	1986	50	Issac Akootchook	1995

Figure III.C.2-9 Bowhead Whale Harvest Locations Near Kaktovik. Sources: Kaleak, 1996; North Slope Borough Planning Dept., 1993.

Table III.C.2-6
Kaktovik 1992 Subsistence-Harvest Summary for Marine Mammals, Terrestrial Mammals, Fish, and Birds

	Total Number Harvested	Edible Pounds Harvested: Total	Household Harvest Mean	Per capita
Marine Mammals				
Total Marine Mammals	---	115,645	1,835.64	599.13
Bowhead Whale	---	108,160	1,716.82	560.35
Belukha Whale	0	0	0.00	0.00
Walrus	47 §	52	0.81	0.27
Polar Bear	3	1,330	21.10	6.89
Bearded Seal	24 §	4,246	67.40	22.00
Ringed Seal	42	1,689	26.80	8.75
Spotted Seal	4 §	169	2.68	0.88
Terrestrial Mammals				
Large Land Mammals	212	28,705	455.63	148.71
Brown Bear	0	0	0.00	0.00
Caribou	158	19,136	303.74	99.14
Moose	4	2,011	31.91	10.42
Muskox	5	3,179	50.46	16.47
Dall Sheep	44	4,379	69.51	22.69
Small Land Mammals/ Furbearers	213	162	2.56	0.84
Arctic Fox	36 *	0	0.00	0.00
Red Fox	11 *	0	0.00	0.00
Marmot	21	107	1.70	0.55
Mink	0	0	0.00	0.00
Parka Squirrel	133	54	0.86	0.28
Weasel	0	0	0.00	0.00
Wolf	3 *	0	0.00	0.00
Wolverine	9 *	0	0.00	0.00
Fish				
Total Fish	18,468	22,952	364.32	118.91
Total Salmon	50	105	1.66	0.54
Total Non-Salmon	18,415	22,847	362.65	118.37
Smelt	---	---	---	---
Cod	3,673	300	4.76	1.55
Burbot	---	---	---	---
Char	5,741	16,337	259.31	84.64
Grayling	176	158	2.50	0.82
Total Whitefish	8,823	6,051	96.04	31.35
Cisco	8,809	6,027	95.66	31.22
Bering Cisco	8,103	5,672	90.03	29.39
Least Cisco	697	349	5.53	1.81
Birds				
Total Birds and Eggs	1,796	3,249	51.56	16.83
Migratory Birds	970	2,702	42.88	14.00
Ducks	369	553	8.77	2.86
Eider	248	372	5.90	1.93
Oldsquaw	106	159	2.52	0.82
Geese	601	2,135	33.89	11.06
Brant	378	1,134	18.00	5.87
Canada Geese	164	736	11.68	3.81
White Fronted	50	223	3.54	1.16
Swan	1	13	0.21	0.07
Ptarmigan	769	539	8.54	2.79
Bird Eggs	56	8	0.13	0.04

Number of households in the sample = 62; number of households in the community = 91.
Source: ADF&G, Community Profile Database, 1995b. Footnotes: *Not eaten. §Some not eaten.

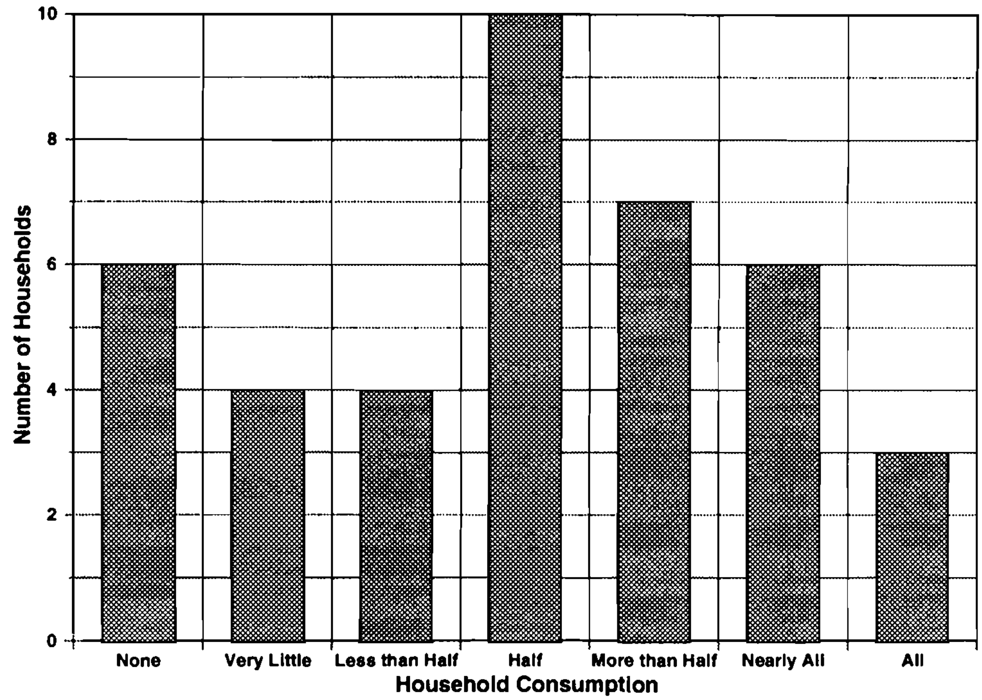


Figure III.C.2-10 Kaktovik Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

survey, bowhead whales amounted to 63 percent of the total subsistence harvest for the community, or 560.35 lb per person (ADF&G, 1995d; see Table III.C.2-6). Figure III.C.2-2 indicates bowhead whale-subsistence harvests for Kaktovik for the 23-year period from 1973 to 1995.

Bowheads are an important meat resource and the source for maktak, an especially preferred food. The sharing of the bowhead is a central aspect of Kaktovik's Thanksgiving and Christmas feasts and the focus of the community's whale feast, Nalukataq. As in other North Slope communities, the bowhead is shared extensively. Its baleen is bartered in traditional networks and is used in the manufacture of traditional arts and crafts.

Kaktovik hunts the muskox, a big-game species unavailable to other North Slope communities. The community also has an important Dall sheep hunting tradition and also is more heavily dependent on fish than most communities (Jacobson and Wentworth, 1982).

In 1969, ADF&G, with the assistance of the FWS, reintroduced muskoxen into the Kaktovik area. Originally indigenous, the muskox was extinct by the late 1800's, probably hunted out by non-Native hunters. Not until 1983 was a hunt permitted and then only by a limited permit drawing and the payment of a large permit fee. From 1986 to 1989, permitting problems for local hunters prevailed. More recently, the situation has changed and for the 1997 to 1998 season, five State of Alaska Tier II muskoxen permits will be available for qualified Alaska residents in Game Management Unit (GMU) 26B (the area between the Itkillik River drainage and the west bank of the Canning River). Fifteen Federal subsistence-registration permits are available for rural residents of Kaktovik for hunting muskoxen in GMU 26C (the area from the Canning River to the Alaska-Canada border). The preferred season is in early spring, when the days are long and travel by snowmachine good. The Camden Bay area and the Sadlerochit River drainage are preferred hunting areas. At this time, there is no sport hunting for muskoxen on the North Slope. See Table III.C.2-6 for muskox-harvest numbers.

Although not a major subsistence resource in terms of pounds harvested, Dall sheep are a preferred subsistence resource by Kaktovik hunters. With difficulties in muskox-permit availability and the variability of caribou as a summer subsistence-meat source, sheep might be one of the more stable meat sources available to the community. Sheep are hunted by snowmachine from late October through November and in the spring from March through April. The preferred hunting period is in the fall, when the sheep have more fat. See Table III.C.2-6 for recent subsistence-harvest numbers for sheep (Impact Assessment, Inc., 1990d; ADF&G 1995d).

Table III.C.2-7 Resources Used in Barrow, Kaktovik, and Nuiqsut

Species	Inupiaq Name	Scientific Name	Location B[1]	Location K[2]	Location N[3]
Marine Mammals					
Bearded seal	*Ugruk*	Erignathus barbatus	√	√	√
Ringed seal	*Natchiq*	Phoca hispida	√	√	√
Spotted seal	*Qasigiaq*	Phoca largha	√	√	√
Ribbon seal	*Qaigulik*	Phoca fasciata	√		
Beluga whale	*Quilalugaq*	Delphinapterus leucas	√	√	√
Bowhead whale	*Agviq*	Balaena mysticetus	√	√	√
Polar bear	*Nanuq*	Ursus maritimus	√	√	√
Walrus	*Aiviq*	Odobenus rosmarus	√	√	√
Terrestrial Mammals					
Caribou	*Tuttu*	Rangifer tarandus	√	√	√
Moose	*Tuttuvak*	Alces alces	√	√	√
Brown bear	*Aklaq*	Ursus arctos	√	√	√
Dall sheep	*Imnaiq*	Ovis dalli	√	√	√
Musk ox	*Uminmaq*	Ovibus moschatus		√	√
Arctic fox (Blue)	*Tigiganniaq*	Alopex lagopus	√	√	√
Red fox (Cross, Silver)	*Kayuqtuq*	Vulpes fulva	√	√	√
Porcupine	*Qinagluk*	Erethizon dorsatum	√		
Ground squirrel	*Siksrik*	Spermophilus parryii	√	√	√
Wolverine	*Qavvik*	Gulo gulo	√	√	√
Weasel	*Itigiaq*	Mustela erminea		√	√
Wolf	*Amaguk*	Canis lupus	√	√	√
Marmot	*Siksrikpak*	Marmota broweri		√	√
Fish					
Salmon (ns)			√	√	√
Chum	*Iqalugruaq*	Oncorhynchus keta	√		√
Pink (humpback)	*Amaqtuuq*	Oncorhynchus gorbuscha	√	√	√
Silver (coho)	*Iqalugruaq*	Oncorhynchus kisutch	√	√	√
King (chinook)		Oncorhynchus tshawytscha	√	√	√
Sockeye (red)		Oncorhynchus nerka		√	√
Whitefish (ns)	*Aanaakliq*	Coregonus sp.	√	√	
Round w.f.	*Aanaakliq*	Prosopium cylindraceum	√		
Broad w.f.	*Aanaakliq*	Coregonus nasus	√	√	√
Humpback w.f.	*Pikuktuuq*	Coregonus clupeaformis	√		√
Least cisco	*Iqalusaaq*	Coregonus sardinella	√	√	√
Bering,Arctic cisco	*Qaaktaq*	Coregonus autumnalis	√	√	√
Other f.w. fish					
Arctic grayling	*Sulukpaugaq*	Thymallus arcticus	√	√	√
Arctic char	*Iqalukpik*	Salvelinus alpinus	√	√	√
Burbot (Ling cod)	*Tittaaliq*	Lota lota	√	√	√
Lake trout	*Iqaluaqpak*	Salvelinus narnaycush	√	√	√
Northern pike	*Siulik*	Esox lucius	√		
Fish (continued)					
Other coast. fish					
Capelin	*Pagmaksraq*	Mallotus villosus	√		
Rainbow smelt	*Ilhuagniq*	Osmerus mordax	√		√
Arctic cod	*Iqalugaq*	Boreogadus saida	√	√	√
Tomcod	*Uugaq*	Eleginus gracilis	√	√	
Flounder (ns)	*Nataagnaq*	Liopsetta glacialis		√	
Birds					
Snowy owl	*Ukpik*	Nyctea scandiaca			√
Red-throated loon	*Qaqsraupiagruk*	Gavia stellata	√		
Tundra swan	*Qugruk*	Cygnus columbianus		√	√
Eider					
Common eider	*Amauligruaq*	Somateria mollissima	√	√	√
King eider	*Qinalik*	Somateria spectabilis	√	√	√
Spectacled eider	*Tuutalluk*	Somateria fischeri	√		
Steller's eider	*Igniqauqtuq*	Polysticta stelleri	√		
Other ducks (ns)	*Qaugak*		√	√	√
Pintail	*Kurugaq*	Anas acuta		√	√
Oldsquaw	*Aaqhaaliq*	Clangula hyemalis	√	√	√
Surf scoter	*Aviluktuq*	Melanitta perspicillata	√		
Goose					
Brant	*Niglingaq*	Branta bernicla n.	√	√	√
White-fronted g.	*Niglivialuk*	Anser albifrons	√	√	√
Snow goose	*Kanuq*	Chen caerulescens	√	√	√
Canada goose	*Iqsragutilik*	Branta canadensis	√	√	√
Ptarmigan (ns)	*Aqargiq*	Lagopus sp.	√	√	√
Willow ptarmigan	*Nasaullik*	Lagopus lagopus	√		
Other resources					
Berries (ns)			√	√	√
Blueberry	*Asiaq*	Vaccinium uliginosum	√		
Cranberry	*Kimminnaq*	Vaccinium vitis-idaea	√		
Salmonberry	*Aqpik*	Rubus spectabilis	√		
Bird eggs (ns)	*Mannik*		√	√	√
Gull eggs				√	√
Geese eggs				√	√
Eider eggs			√	√	√
Greens/roots (ns)			√	√	√
Wild rhubarb	*Qunulliq*	Oxyric digyna	√		
Wild chives	*Quagaq*	Allium schoenoprasum	√		
Clams	*Imaniq*		√		
Wood				√	√
Fresh water	*Imiq*		√		
Fresh water ice	*Sikutaq*		√		
Sea ice	*Siku*		√		

Sources: Stephen R. Braund and Associates and ISER, 1993; Pedersen, 1995a, 1995b; Stephen R. Braund and Associates, 1996.
Footnotes: [1] B, Barrow. Resources used 1987–1990. [2] K, Kaktovik. Resources used 1992–1993. [3] N, Nuiqsut. Resources used 1993.
Note: An unchecked box may mean a resource was not used or, especially in the case of "Other Resources," the resource might have been used but use was reported as "berries" rather than "blueberries," for example. **Abbreviations:** ns, nonspecified; w.f., whitefish; f.w., freshwater; coast., coastal.

Fishes provide an important subsistence resource at Kaktovik. The community's harvest of most other subsistence resources can fluctuate widely from year to year because of variable migration patterns of game and because harvesting technologies are extremely dependent on ice conditions and weather. The harvest of fishes is not subject to these conditions, and this adds to their importance in Kaktovik's subsistence system. Moreover, in January and February, fishes may provide the only source of fresh subsistence foods. Fishing, primarily for arctic char, arctic cisco, grayling, least cisco, broad whitefish, and less commonly for round whitefish and pink and chum salmon occurs primarily in the summer and fall. In winter, char, whitefish, ling cod, and blackfish are taken by ice fishing on the Canning River drainage. See Table III.C.2-6 for more recent data on Kaktovik's subsistence harvests of fishes.

Harvest cycles for belukha whales, caribou, seals, walruses, polar bears, migratory birds, moose, and small furbearers follow. Belukha whales, if hunted, are taken from August through November; caribou are hunted year-round, with peak harvests from July to mid-August. More than 70 percent of Kaktovik's subsistence-caribou harvest takes place on the coastal plain with most of the harvest coming by boat crews hunting along the coast; seals are hunted throughout the year, with the main harvest occurring in the open-water season from July to September; walruses are harvested only opportunistically by boat crews hunting other marine mammals in July and August; polar bears are hunted during the winter months on ocean ice. Migratory birds, especially black brant, oldsquaw, eider, and snow geese, are growing in importance as a subsistence resource for Kaktovik. Waterfowl hunting occurs mostly in the spring from May through early July; a less intensive hunt continues through summer and lasts into September. The subsistence season for moose runs from January through May; small furbearers are taken in the late fall, winter, and early spring. Percentages of the overall annual subsistence harvest for these species are depicted in Table III.C.2-3. See Table III.C.2-6 for more recent data on Kaktovik's subsistence harvests of birds. A more detailed discussion of harvest areas, harvest cycles, and annual harvest percentages for each of these species can be found in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a) and is incorporated here by reference.

Trends in Kaktovik household consumption of subsistence foods from an NSB subsistence survey conducted in 1993 are shown in Figure III.C.2-10.

3. Sociocultural Systems: The topic of sociocultural systems encompasses the social organization and cultural values of the society. This section provides a profile of the sociocultural systems that characterize the communities near the Sale 170 area that might be affected by this lease sale: Barrow, Nuiqsut, and Kaktovik (see Fig. II-A.1). All of these communities are within the NSB. The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Inupiat. Sociocultural systems of the North Slope Inupiat are described and discussed in detail in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a, Sec. III.C.2); the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b, Sec. III.C.3); the Beaufort Sea Sale 124 FEIS (USDOI, MMS, 1990a, Sec. III.C.2); and the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a), which are incorporated by reference. The following summary is augmented by additional material, as cited.

a. Characteristics of the Population: The North Slope has a fairly homogeneous population of Inupiat—approximately 72 percent Inupiat in 1990. This is an approximation because the 1990 Census did not distinguish between other Inupiat, other Alaska Natives, and American Indians, although there were only 110 individuals (1.8% of the total NSB population) in the NSB that fell into these latter two classifications. The percentage in 1990 ranged from 92.7 percent Inupiat in Nuiqsut to 61.8 percent Inupiat in Barrow (USDOC, Bureau of the Census, 1991). In 1990, the populations of each of the communities in the sale area were 3,469 in Barrow, 354 in Nuiqsut, and 224 in Kaktovik (USDOC, Bureau of the Census, 1991). In 1995, ADOL estimates were 4,234 for Barrow, 410 for Nuiqsut, and 210 for Kaktovik (ADOL figures from ADF&G, 1995d).

North Slope society responded to early contacts with outsiders by successfully changing and adjusting to new demands and opportunities (Burch, 1975; Worl, 1978; NSB Contract Staff, 1979). Since the 1960's, the North Slope has witnessed a period of "super change," a pace of change quickened by the area's oil developments (Lowenstein, 1981). In the Prudhoe Bay-Kuparuk industrial complex, oil-related work camps have altered the seascape and landscape, making some areas off limits to traditional pursuits such as hunting. Large NSB CIP's dramatically have changed the physical appearance of NSB communities.

Social services have increased dramatically from 1970 to the present, with increased NSB budgets and grants acquired by or through the Inupiat Corporation of the Arctic Slope. In 1970 and 1977, residents of North Slope villages were asked about their state of well-being in a survey conducted by the UAA, ISER (Kruse et al., 1983). Significant increases in complaints about alcohol and drug use were noted in all villages between 1970 and 1977. Health and social-services programs have attempted to meet the needs of alcohol and drug-related problems with treatment programs and shelters for wives and families of abusive spouses and with greater emphasis on recreational programs and services.

The introduction of modern technology has tied the Inupiat subsistence economy to a cash economy (Kruse, 1982). Nevertheless, oil-supported revenues help support a lifestyle that is still distinctly Inupiat; indeed, outside pressures and opportunities have sparked what may be viewed as a cultural revival (Lantis, 1973). North Slope residents exhibit an increasing commitment to areawide political representation, local government, and the cultural preservation of such institutions as whaling crews and dancing organizations. People continue to hunt and fish, but aluminum boats, outboards, and all-terrain vehicles now help blend these pursuits with wage work. Inupiat whaling remains a proud tradition that involves ceremonies, dancing, singing, visiting, cooperation between communities, and the sharing of foods.

The possible effects of the proposed action on subsistence, specifically whales and whaling, has been and continues to be a major scoping issue for residents of the North Slope (Kruse et al., 1983; ACI/Braund, 1984; USDOI, MMS, 1996a; Braund/Northstar DEIS, In prep.). Whaling remains a primary subsistence activity for Barrow, Nuiqsut, and Kaktovik (see Sec. III.2.3)—an activity that has roots in Eskimo prehistory (Giddings, 1967). Whales are not only an important subsistence issue; they are and have been the singlemost important animal in the long prehistory of the North Slope sociocultural system (Lantis, 1938;

Bockstoce et al., 1979; Worl, 1979; Braund/Northstar DEIS, In prep.).

b. Social Characteristics of the Communities: The following describes the communities that may be affected by Sale 170. These community-specific descriptions discuss factors relevant to the sociocultural analysis of the community in relation to industrial activities, population, and current socioeconomic conditions. Following these descriptions, social organization, cultural values, and other issues of all Sale 170 communities are discussed.

(1) Barrow: On the North Slope, Barrow is the largest community and the regional center. A portion of Barrow's waterfowl subsistence-harvest area is within the western boundary of the proposed Sale 170 area. Barrow already has experienced dramatic population changes as a result of increased revenues from onshore oil development and production in Prudhoe Bay and other smaller oilfields; these revenues have stimulated the NSB CIP. In 1970, the Inupiat population of Barrow represented 91 percent of the total population (USDOC, Bureau of the Census, 1971); by 1990, the proportion had dropped to 63.9 percent (USDOC, Bureau of the Census, 1991; Harcharek, 1992). In 1985, non-Natives outnumbered Natives between the ages of 26 and 59 (NSB, Dept. of Planning and Community Services, 1989).

In the period from 1975 to 1985, Barrow experienced extensive social and economic transformations. The NSB CIP stimulated a boom in the Barrow economy and an influx of non-Natives to the community; between 1980 and 1985, Barrow's population grew by 35.6 percent (Kevin Waring Associates, 1989). Inupiat women entered the labor force in the largest numbers ever and achieved positions of political leadership in the newly formed institutions. The proportion of Inupiat women raising families without husbands also increased during this period. The extended family, operating through interrelated households, is salient in community social organization (Chilkat Institute, 1986). During this same period, the social organization of the community became increasingly diversified with the proliferation of formal institutions and the large increase in the number of different ethnic groups. Socioeconomic differentiation is not new in Barrow. During the commercial-whaling period and the reindeer-herding period, there were influxes of outsiders and significant shifts in the economy. Other fluctuations have occurred during different economic cycles (fur trapping, U.S. Navy and arctic contractors' employment, the CIP boom, and periods of downturn [Chilkat Institute, 1986]). As a consequence of the changes it already has sustained, Barrow may be more capable of absorbing additional changes as a result of Sale 170 than would a smaller, homogeneous Inupiat community.

(2) Nuiqsut: Nuiqsut (population 354 in 1990, 92% Inupiat [USDOC, Bureau of the Census, 1991]) is located on the west bank of the Nechelik Channel of the Colville River Delta, about 40 km (25 mi) from the Arctic Ocean and approximately 241 km (150 mi) southeast of Barrow. Nuiqsut, one of three abandoned Inupiat villages in the North Slope region identified in ANCSA, was resettled in 1973 by 27 families from Barrow.

Most of Nuiqsut's marine subsistence-harvest area lies within the proposed Sale 170 area; and its terrestrial, fish, and bird subsistence-harvest areas are in the vicinity of landfalls at Oliktok and Milne Points. Additionally, pipelines from Oliktok Point and Point Thompson would go through Nuiqsut's land subsistence-harvest area; and Nuiqsut could be used for some air support for lease activities.

(3) Kaktovik: Kaktovik (population 224, 83% Inupiat in 1990 [USDOC, Bureau of the Census, 1991; ADF&G, 1995d]), the easternmost village in the NSB was incorporated in 1971 (Kevin Waring Associates, 1989). It is located on the north shore of Barter Island, which is between the Okpilak and Jago rivers on the Beaufort Sea coast. Barter Island is one of the largest of a series of barrier islands along the north coast and is about 482 km (300 mi) east of Point Barrow.

Like Nuiqsut, much of Kaktovik's marine subsistence-harvest area is within the proposed Sale 170 area; its terrestrial mammal, fish, and bird subsistence-harvest areas also overlap or lie adjacent to the sale area.

c. Social Organization: The social organization of communities near the Sale 170 area is strongly kinship oriented. Kinship formed "the axis on which the whole social world turned" (Burch, 1975). Historically, households were composed of large, extended families; and communities were kinship units. Today, there is a trend away from the extended-family household because of increases in mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Inupiat society continue to be important and remain a central focus of the social organization.

The social organization of the North Slope Inupiat encompasses not only households and families but wider networks of kinspeople and friends. These various types of networks are related through various overlapping memberships and also are embedded in those groups that are responsible for hunting, distributing, and consuming subsistence resources (Burch, 1970). An Inupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. The interdependencies that exist among Inupiat households differ markedly from those found in the U.S. as a whole. In the larger, non-Inupiat society, the demands of wage work emphasize a mobile and prompt workforce. While modern transportation and communication technologies allow for contact between parents, children, brothers, sisters, and other extended-family members, more often than not independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) form independent "production" units that do not depend on extended-family members for the day-to-day support of food, labor, or income. However, a key contrast between non-Native and Inupiat cultures occurs in their differing expectations—the Inupiat expect and need support from extended-family members on a day-to-day basis.

Associated with these differences, the Inupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units; and giving, especially by successful community members (e.g., hunters), is regarded as an end in itself, although community status and esteem accrue to the generous. Kinship ties are strengthened through sharing and exchanging of subsistence resources (Nelson, 1969; Burch, 1971; Worl, 1979; ACI/Braund, 1984; ACI/Courtnage/Braund, 1984; Luton, 1985; Chance, 1990).

d. Cultural Values: Traditionally, Inupiat values centered on the Inupiat's close relationship with natural resources, specifically game animals. The Inupiat also had a close relationship to the supernatural with specific beliefs in animal souls and beings who controlled the movements of animals. Other values included an emphasis on the community and its needs and its support of other individuals. The Inupiat respected persons who were generous, cooperative, hospitable, humorous, patient, modest, and/or industrious (Lantis, 1959; Milan, 1964; Chance, 1966, 1990). Although there have been substantial social, economic, and technological changes in Inupiat lifestyle, subsistence continues to be the core or central organizing value of Inupiat sociocultural systems in the Sale 170 area. The Inupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1969). This refrain is repeated again and again by the residents of the North Slope (Kruse et al., 1983; ACI/Braund, 1984; Impact Assessment Inc., 1990a,b; USDOI, MMS, 1994). Task groups still are organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an important part of the Inupiat life. With whom one cooperates is a major component of the definition of significant kin ties (Heinrich, 1963). Large amounts of subsistence foods are shared within the community. Whom one gives to and receives from are major components of the definition of significant kin ties (Heinrich, 1963; ACI/Courtnage/Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system; the hunt, the sharing of products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men. Good hunters are often respected leaders. Good health comes from a diet of products of the hunt. Young hunters still give their first game to the community elders. To be generous brings future success. These are but some of the ways in which subsistence and beliefs about subsistence join with sociocultural systems.

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities that occur in Inupiat society, as discussed above. However, cultural value also is apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations (some families will dominate one type of government administration, e.g., the village corporation), employment, sports activities, and membership in voluntary organizations (Mother's Club, Search and Rescue, etc.) (ACI/Courtnage/Braund, 1984).

Bowhead whaling remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess (see Bockstoce et al., 1979; ACI/Courtnage/Braund, 1984). Barrow resident Beverly Hugo, testifying at the public hearings for Beaufort Sea Sale 124, summed up Inupiat cultural values this way:

> . . .these are values that are real important to us, to me; this is what makes me who I am. . .the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others. . .and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility to our tribe, humility. . . . These are some of the values. . .that we have. . .that make us who we are, and these values have co-existed for thousands of years, and they are good values. . .(USDOI, MMS, 1990a).

The ramifications of the whale hunt are more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and also to define community-leadership patterns. The structured sharing of the whale helps determine social relations both within and between communities (Worl, 1979; ACI/Courtnage/Braund, 1984; Impact Assessment, Inc., 1990a). What occurs for summer boat hunting also holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to elders does more than feed old people; it bonds giver and receiver together, joins them to a living tradition, and draws them into their community.

Today, this close relationship between the spirit of a people, their social organization, and the cultural value of subsistence hunting may be unparalleled when compared with other American energy-development situations. The Inupiat people's continuing strong dependence on subsistence foods, particularly marine mammals, creates a unique set of potential effects from offshore oil development on the social and cultural system. Barrow resident Daniel Leavitt articulated these concerns this way during the 1990 public hearing for Beaufort Sea Sale 124: "...as I have lived in my Inupiat way of livelihood, that's the only...thing that drives me on is to get something for my family to fill up their stomachs from what I catch" (USDOI, MMS, 1990c).

Another great concern that NSB Inupiat communities observe is the lack of traditional knowledge and testimony appearing in governmental analyses documents, particularly MMS's oil lease-sale EIS's. Mayor George N. Ahmaogak, Sr. of the NSB said in a 1990 letter to MMS: "The elders who spoke particularly deserve a response to their concerns.... You should respect the fact that no one knows this environment better than Inupiat residents..." (Ahmaogak, 1990, pers. comm.). In 1993 public testimony concerning a Letter of Authorization for bowhead whale monitoring at the Kuvlum Prospect, Burton Rexford, Chairman of the AEWC, stated that the most important information would come from whaling captains, crew members, and whaling captains' wives. "We know our environment—our land and resources—at a deep level" (USDOC, NOAA, NMFS, 1993). These same concerns were unanimously echoed by those testifying at the Barrow, Kaktovik, and Nuiqsut public hearings for Beaufort Sea Sale 144 in November 1995 (Barrow, Kaktovik, and Nuiqsut Public Hearing Transcripts, Beaufort Sea Sale 144 [USDOI, MMS, 1995b,c,d]).

e. Institutional Organization of the Communities: The NSB provides most government services for the communities that might be affected by Sale 170. These services include public safety, public utilities, fire protection, and some public-health services. Future fiscal and institutional growth is expected to be limited because of economic constraints to direct Inupiat participation in oil-industry employment and growing constraints in the Statewide budget, although NSB revenues remain healthy and its own permanent fund account continues to grow as does its role as primary employer in the region (Kruse et al., 1983; Harcharek, 1992). The ASRC, formed under ANCSA, runs several subsidiary corporations. Most of the communities also have an Indian Reorganization Act (IRA) government as well as a city government. The IRA and village-corporation governments have not provided much in the way of services in the NSB.

f. Other Issues: Other issues important to an analysis of sociocultural systems are those that will affect or are already affecting Inupiat society. Sections III.C.1 of the Sale 97, Sale 124, and Sale 144 FEIS's detail issues about fiscal and institutional growth in the NSB, changes in employment, increases in income, decreases in Inupiaq fluency, rising crime rates, and substance abuse (USDOI, MMS, 1987a; 1990a; and 1996a) and discuss as well NSB's fiscal and institutional growth. These discussions, augmented here by additional material, as cited, are incorporated by reference. In addition, Smythe and Worl (1985) and Impact Assessment, Inc. (1990a) detail the growth and responsibilities of local governments.

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasingly close scrutiny and regulation. This increase in stresses on social well-being and on cultural integrity and cohesion comes at a time of economic well-being that has not been challenged as significantly as once thought by the decline in CIP funding from the State of Alaska. This has come about mostly through the dramatic growth of the Borough's own permanent fund and the NSB taking on more of the burden of its own capital improvement and as well as becoming the largest regional employer of local residents.

4. Archaeological Resources: Archaeological resources are those deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or objects that are made or modified by humans. These resources provide information pertaining to history or prehistory. It is the policy of the MMS to consider the effects on archaeological resources in all aspects of planning, leasing, permitting, and regulatory decisions. To do this, an assessment of potential archaeological resources within the area to be affected by a proposed action must take place (MMS Manual Part 620.1.1).

The National Register of Historic Places is a national inventory of sites that meet specific criteria of significance. Most archaeological sites listed on or eligible for the Register meet Criterion D, Information Potential: Properties may be eligible for the National Register if they have yielded, or may be likely to yield, information important in prehistory or history. With rare exception, properties must be 50 or more years old to be considered eligible for the National Register (USDOI, NPS, 1991).

A site is nominated to the National Register by preparing and submitting documentation that details specific information, measurements, locational data, and historic background—a time-consuming process that requires detailed information. Consequently, properties officially listed on the Register represent only a fraction of those sites that would be considered eligible for assessment purposes in the event of a proposed action. Sites identified in this manner are afforded equal protection in the process. Therefore, merely checking the Register for a list of sites is a minor part of the archaeological assessment that must take place. In the case of the Federal OCS, most of the Beaufort Sea Planning Area has never been surveyed for archaeological sites; and no sites on the OCS have been listed on the National Register. In that case, archaeological resources or potential resources within the planning area must be identified using regional baseline studies that are predictive models, geophysical/geological data, historic accounts of shipwreck disasters, and marine remote-sensing data compiled from required shallow-hazards surveys.

The following analyses represent the Prehistoric Resource Analysis and Shipwreck Update Analysis required in the MMS Handbook for Archaeological Resource Protection (620.1-H).

a. Prehistoric Resources: Prehistoric resources are those that " . . .pertain to that period of time before written history. In North America, 'prehistoric' usually refers to the period before European contact" (MMS Manual 620.1-H).

A review of the Alaska Heritage Resources Survey site files indicates that sites with prehistoric components have been recorded in the proposed Beaufort Sea sale area. They are comprised of habitation sites, lithic scatters, and isolated finds. Paleontological sites also have been recorded. These sites are located onshore (Dale, 1996, pers. comm.).

The potential for submerged prehistoric sites in the Sale 170 area was determined by an evaluation of the geophysical/geological and archaeological data available. This analysis was prepared to aid in the identification of lease blocks with prehistoric-site potential. The geologic processes that have acted on the ocean floor of the sale area are summarized with regard to the distribution, survivability, and detectability of potential archaeological resources sites. The Sale 170 area includes lease blocks that previously were offered in the following Beaufort Sea lease sales: the Joint Federal/State Beaufort Sale, Diapir Field Sale 71, Sale 87, Sale 97, Sale 124, and Sale 144.

Archaeological analyses were prepared for previous Beaufort Sea lease sales and are cited by reference in this report. The Sale 170 geologic report incorporates the previous work of Friedman and Schneider (USDOI, MMS, 1987a) concerning the geomorphological processes pertaining to the survivability of potential prehistoric resource sites in the sale area and is updated with current reports, surveys, and information pertinent to this analysis.

(1) Review of the Baseline Study: There have been no new regional archaeological resource baseline studies prepared for the Beaufort Sea sale area. The analyses prepared by Friedman and Schneider for Sales 87 and 97 and referenced in the Sale 124 and 144 EIS's are the most current baseline studies prepared for the Beaufort Sea sale area (USDOI, MMS, 1987a).

(2) Review of Existing Geologic and Cultural Resource Reports: The MMS review of the geohazards report for the British Petroleum Liberty Prospect at Tern Island and of the geohazards data for Arco Alaska's Warthog Prospect in Camden Bay conclude that at both locations, there are indications of well-preserved paleochannel features. At the Warthog Prospect, the subbottom profiler data also indicate the presence of well-preserved channel-edge features such as levees and terraces. These channel features all occur just below the seafloor, suggesting that they date from the most recent low stand of sea level that occurred during the late Wisconsinan glaciation (ca. 19,000-6,000 B.P.); however, their absolute age is uncertain. If the features are late Wisconsinan in age, they would represent areas having potential for prehistoric archaeological resources to occur. A sediment core southwest of the Liberty Prospect contained a 10-ft thick layer of Holocene sediments consisting of a 3-ft thick basal layer of gray, silty sand with a trace of shell fragments overlain by a layer of soft, saturated, fibrous peat. This core indicates that an intact sequence of Holocene-age terrestrial and nearshore sediments exists near the Liberty Prospect. A sediment core collected approximately 5 km southwest of the Warthog Prospect contained a layer comprised of 40 percent organics at a depth of approximately 15 ft subbottom. This high percentage of organic material may indicate an intact peat deposit similar to the one recorded at the Liberty Prospect; however, this layer was not differentiated as marine or nonmarine, nor has it been radiocarbon dated.

(3) Review of Sea-Level History: The Friedman and Schneider analysis for Sales 87 and 97 used -125 m as the maximum sea-level recession during the late Wisconsin. The Sale 124 analysis cites Hopkins et al. (1982) and uses a maximum sea-level lowering of -90 m for a minimum on the sea-level curve. The -90-m value was identified with the maximum glacial sea-level lowering approximately 18,000 years ago and is considered the earliest date for the arrival of people in the Arctic. Blocks in water deeper than the -90-m isobath would not have archaeological resource potential and have been removed from further consideration in this report.

(4) Review of Geological/Geophysical Data to Determine Survivability and Detectability of Archaeological Resource Sites: The Prehistoric Resources analysis for Beaufort Sea Sale 144 concluded that because of destructive geologic processes such as ice gouging, thermokarst erosion, and storm surges, all of the near-surface shelf sediments in the Beaufort Sea Planning Area had been reworked extensively and, therefore, that there was a very low potential for prehistoric archaeological sites to have survived. The geophysical data from the Liberty and Warthog prospects contradict this previous conclusion. The sidescan sonar data and underwater video images of the seafloor indicate that ice gouging is sparse to nonexistent at these two locations. Although it was suggested in the geohazards report for the Liberty Prospect that the ice gouges may have just been infilled by the reworking of sediments at the seafloor, the possibility also was raised that there was little ice gouging at this location, because it was in the area of floating shorefast ice. A second possibility is that those locations landward of the barrier islands are offered more protection from ice gouging and other destructive geologic processes operating on the open shelf. In addition to the lack of intensive ice gouging, there also is evidence from geologic cores and from seismic profiles of well-preserved paleochannels that Holocene terrestrial sedimentary sequences at these two locations may have survived intact. This recent evidence is sufficient basis to question the previous conclusions about the survival of prehistoric archaeological sites in the Beaufort Sea Planning Area. Although this new information may be relevant only to locations landward of the coastal barrier islands, until additional data are collected and evaluated, there is no basis for concluding that those areas seaward of the barrier islands have a low potential for prehistoric site survival.

In summary, review of geophysical and geologic core data from the Liberty and Warthog prospects in the Beaufort Sea Planning Area indicate areas where prehistoric archaeological sites may be preserved just beneath the seafloor. Based on this new information, the geohazards survey data from all lease blocks in water depths shallower than 90 m will need to be reviewed to evaluate the potential for prehistoric archaeological resources prior to approving lease activities.

b. Historic Resources: Historic resources pertain ". . .to the period of time for which written history exists" (MMS Manual 620.1-H). They would include, but not be limited to, shipwrecks. A review of the AHRS (Alaska Heritage Resources Survey) site files indicates that sites with historic components have been recorded in the planning area. They are comprised of habitation, Distant Early Warning Line station/research, cemetery, military debris, camp, hunting, reindeer herding, trapping, ice cellar, and lookout-tower site types (Dale, 1996, pers. comm.). These sites are located onshore.

A review of the MMS computerized shipwreck list for the proposed Sale 170 area shows two known shipwrecks: The *Reindeer*, a 340-ton whaling bark wrecked near Reindeer Island in the Midway Islands in 1894, and the *Duchess of Bedford*, a 60-ton expedition schooner wrecked near Flaxman Island in 1907 (Burwell, 1996, pers. comm.; Tornfelt and Burwell, 1992). The final distribution of a shipwreck on the seafloor is governed by factors such as sediment depth and composition, sea currents, water depth, size and type of ship, and geologic processes. To date, no surveys have been made to locate these wrecks, and the information on their location is insufficient to assign them to specific lease blocks.

Rates of sedimentation sufficient enough to bury shipwrecks within recent history have not been identified for the Sale 170 area. Therefore, any surviving shipwrecks still would be exposed on the seafloor and capable of detection by sidescan sonar and other geophysical instruments during a site-specific geohazard survey. Because the locational information on the two known shipwrecks within the Sale 170 area is insufficient to assign them to specific lease blocks, the geohazards-survey data from all lease blocks will need to be reviewed for evidence of shipwrecks prior to approving lease activities.

5. Land Use Plans and Coastal Management Programs:

a. Land Status and Use: Most land in the NSB is held by a few major landowners. The predominant landowner within the NSB is the Federal Government. Of the approximately 20 million hectares (ha) in the region north of 68° N. latitude, more than one-half is contained in the National Petroleum Reserve-Alaska (NPR-A) and the ANWR. Other major landholders include the State of Alaska (1.4 million ha) and the eight Native village corporations and the ASRC (1.9 million ha). Complexity in land-ownership patterns is a result of the ANCSA provisions that only surface-estate rights are to be conveyed to Native village corporations; subsurface-estate rights can be conveyed to Native regional corporations. Moreover, in selected Federal holdings, such as ANWR and NPR-A, selection was restricted to surface estate for village corporations. The subsurface estate was reserved for the Federal Government; the ASRC was required to select its subsurface estate outside these boundaries.

Major land uses on the North Slope are divided between traditional subsistence uses of the land and hydrocarbon-development operations. The traditional settlement patterns and subsistence uses of land are discussed in Section III.C.3. The extent and location of hydrocarbon exploration and development and production operations on the North Slope and offshore areas are discussed in the description of projects included for the cumulative case, Section IV.A.5.

b. Land Use Planning Documents: Documents addressing land use in the NSB include the NSB Comprehensive Plan and Land Management Regulations, and the NSB Coastal Management Program (CMP). The NSB CMP and the Statewide Standards of the Alaska Coastal Management Program (ACMP) are described in the following section. Land use plans, policies, and controls for the ANWR are addressed in the ANILCA, which established the ANWR as a wildlife refuge, the National Wildlife Refuge System Administration Act, and the Comprehensive Conservation Plan for the ANWR. These plans, policies, and controls are also described in the following section.

(1) **NSB Comprehensive Plan and Land Management Regulations:** The NSB Comprehensive Plan and Land Management Regulations (LMR's) were adopted initially in December 1982. The LMR's were revised on April 12, 1990. The following description is based on the new regulations. The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan—to preserve and protect the land and water habitat essential to subsistence living and the Inupiat character of life.

The new LMR's have five zoning districts—Village, Barrow, Conservation, Resource Development, and Transportation Corridor. All areas within the Borough are in the Conservation District unless specifically designated as within the limited boundaries of the villages or Barrow, as a unitized oil field within the Resource Development District, or along the Trans-Alaska Pipeline corridor within the Transportation Corridor. Therefore, any new large-scale development occurring outside an existing Resource Development District will require a Master Plan for the development to be submitted to the NSB and adopted by the NSB Assembly as an amendment to the Comprehensive Plan, and the land must be rezoned from Conservation District to Resource Development District.

In the regulations, uses are categorized as (1) uses that can be administratively approved without public review, (2) uses that require a development permit and must have public review before they can be administratively approved, and (3) uses that are considered conditional development that must be approved by the Planning Commission.

Policy revisions in the LMR's incorporated the NSB CMP's and supplemented these with several additional policy categories—Village Policies, Economic Development Policies, Offshore Development Policies, and Transportation Corridor Policies. Offshore policies are specifically limited to development and uses in the portion of the Beaufort Sea that is within the NSB boundary. All the policies address offshore drilling.

(2) **National Wildlife Refuge System Administration Act:** This Act, as amended, states that the mission of the refuge system is to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats.

(3) **Alaska National Interest Lands Conservation Act (ANILCA):** This Act redesignated the Arctic National Wildlife Range as the Arctic National Wildlife Refuge. The purposes of the Refuge, as listed in ANILCA, include the conservation of fish and wildlife populations and habitats in their natural diversity; to fulfill international treaty obligations with respect to fish and wildlife and their habitats; and to provide, in a manner consistent with the purposes set out by the Act, the opportunity for continued subsistence uses by local residents; and to ensure, to the maximum extent practicable, and consistent with the purposes of the Act, water quality and necessary water quantity within the refuge.

(4) **Comprehensive Conservation Plan (CCP):** The CCP was prepared pursuant to ANILCA and is a long-term management plan for the refuge. The CCP provides for maintenance of the existing conditions of areas that have high fish and wildlife or other resource values by maintaining the refuge in an undeveloped state. No onshore developments necessary to service offshore oil facilities are permitted. The analyses included in the final EIS are based on the premise that no facilities will be located within the boundaries of the ANWR.

c. **Coastal Management:** The Federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act (ACMA) were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. The provisions and policies of both the Federal and State CMP's are described in MMS Reference Paper 83-1 (McCrea, 1983), which is summarized in the following paragraphs and incorporated by reference in this EIS. Statewide standards of the ACMP may be refined through local coastal programs prepared by coastal districts. Coastal districts are encouraged to prepare local CMP's to supplement the Statewide standards in their district. District programs must be approved by the Alaska Coastal Policy Council and the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management (OCRM) before they are fully incorporated into the ACMP. The NSB is the only coastal district in proximity to the sale area; its CMP has been fully incorporated into the ACMP. A description of the NSB CMP follows that of the Statewide standards of the ACMP.

(1) **Statewide Coastal Management Standards:** The ACMP, as initially approved by OCRM, includes the ACMA, guidelines and standards developed

by the Coastal Policy Council (CPC), a series of maps depicting the interim boundaries of the State coastal zone, and an EIS prepared by OCRM. The Statewide standards that may be relevant to activities hypothesized in this EIS are summarized in the following paragraphs under three headings: coastal habitats, coastal resources, and uses and activities.

(a) **Coastal Habitats:** Eight coastal habitats were identified in the standards (offshore; estuaries; wetlands and tidelands; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands). Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources (6 Alaska Administrative Code [AAC] 80.130[b] and [c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need, no feasible prudent alternatives to meet that need, and all feasible and prudent mitigation measures are incorporated to maximize conformance. Habitat policies frequently are cited in State consistency reviews.

(b) **Coastal Resources:** Two policy areas come under the heading of coastal resources: (1) air, land, and water quality and (2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the State of Alaska, Department of Environmental Conservation (ADEC). The standards incorporate by reference all the statutes, regulations, and procedures of the ADEC that pertain to protecting air, land, and water quality (6 AAC 80.140). Concerns for air and water quality are cited frequently during State reviews for consistency.

The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC 80.150).

(c) **Uses and Activities:** Nine topics are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy-facility siting, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to the activities hypothesized for this OCS lease sale include coastal development, energy-facility siting, transportation and utilities, and subsistence.

Both the Federal CZMA and the ACMP require that uses of State and Federal concern be addressed (CZMA Sec. 303[2][C], AS 46.40.060, and AS 46.40.070). The ACMA further stipulates that local districts may not arbitrarily or unreasonably restrict or exclude such uses in their CMP's. Among the uses of State concern is the siting of major energy facilities.

(2) **NSB District CMP:** The NSB CMP was adopted by the Borough in 1984. Following several revisions, the NSB CMP was approved by the Alaska CPC in April 1985 and OCRM in May 1988. The coastal management boundary adopted for the NSB CMP varies slightly from the interim boundary of the ACMP. In the mid-Beaufort sector, the boundary was extended inland on several waterways to include anadromous-fish-spawning and -overwintering habitats. Along the Chukchi Sea coast, it was extended inland to include the Kukpuk River and a 1.6-km corridor along each bank.

The NSB CMP was developed to balance exploration, development, and extraction of nonliving natural resources and maintenance of and access to the living resources upon which the Inupiat traditional cultural values and way of life are based. The NSB CMP contains four categories of policies: (1) standards for development, (2) required features for applicable development, (3) best-efforts policies that include both allowable developments and required features, and (4) minimization-of-negative-impacts policies.

Standards for development prohibit severe harm to subsistence resources or activities or disturb cultural and historic sites. Required features address reasonable use of vehicles, vessels, and aircraft; engineering criteria for offshore structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways; residential development associated with resource development; and air quality, water quality, and solid-waste disposal.

Best-efforts policies allow for exceptions if (1) there is "a significant public need for the proposed use and activity" and (2) developers have "rigorously explored and objectively evaluated all feasible and prudent alternatives" and briefly documented why the alternatives have been eliminated from consideration. If an exception to a best-efforts policy is granted, the developer must take "all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent."

Best-efforts policies allow development if all feasible and prudent steps are taken "to avoid the adverse impacts the policy was intended to prevent." Policies in this category address developments that could cause significantly decreased productivity of subsistence resources or ecosystems, displace belukha whales in Kasegaluk Lagoon, or restrict access of subsistence users to a subsistence resource. They also create restrictions on various modes of transportation, mining of beaches, or construction in certain floodplains and geologic-hazard areas.

Best-efforts policies also address features that are required by "applicable development except where the development has met the [two criteria identified above] and the developer has taken all feasible and prudent steps to maximize conformance with the policy." Developments and activities regulated under these policies include coastal mining, support facilities, gravel extraction in floodplains, new subdivisions, and transportation facilities. Siting policies include the State habitat policies and noninterference with important cultural sites or essential routes for transportation to subsistence resources.

All applicable developments must minimize "negative impacts." Regulated developments include recreational uses, transportation and utility facilities, and seismic exploration. Protected features include permafrost, subsistence activities, important habitat, migrating fish, and wildlife. Geologic hazards must be considered in site selection, design, and construction.

Two "areas meriting special attention" (AMSA's) were identified in the CMP—Point Thomson and Kasegaluk Lagoon. Upon further examination, Point Thomson was dropped and the Colville River Delta was added. Planning for the Kasegaluk Lagoon AMSA and the Colville River Delta AMSA is proceeding.

The NSB has adopted administrative procedures for implementing these policies based on the permit process established under Title 19 of the Borough's Land Use Regulations and the consistency-review process of Title 46 of the Alaska Statutes.