This is a preliminary draft. The contents and recommendations are subject to change.

August 1973
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>Chapter I</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Chapter II</td>
<td>WILDERNESS STUDY OBJECTIVES</td>
<td>8</td>
</tr>
<tr>
<td>Chapter III</td>
<td>HISTORY</td>
<td>9</td>
</tr>
<tr>
<td>Chapter IV</td>
<td>LAND STATUS</td>
<td>13</td>
</tr>
<tr>
<td>Chapter V</td>
<td>RESOURCES</td>
<td></td>
</tr>
<tr>
<td>A. Wildlife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Land Mammals</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>a. Muskox</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>b. Reindeer</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>c. Furbearers</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>d. Rodents</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>2. Marine Mammals</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>a. Sea Lion</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>b. Walrus</td>
<td></td>
<td>33</td>
</tr>
<tr>
<td>c. Seals</td>
<td></td>
<td>33</td>
</tr>
<tr>
<td>d. Whales</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>3. Birds</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>a. Waterfowl</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>b. Seabirds</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>c. Shorebirds</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>d. Passerines</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>e. Hawks and owls</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>f. Other species</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>4. Fish</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>a. Salmon fishery</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>b. Other fisheries</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>5. Invertebrates</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>B. Vegetation</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>C. Water</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>D. Minerals</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>Chapter VI</td>
<td>MANAGEMENT AND DEVELOPMENT</td>
<td></td>
</tr>
<tr>
<td>A. Reindeer</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>B. Muskox</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>C. Developments</td>
<td></td>
<td>61</td>
</tr>
</tbody>
</table>
Chapter VII  SOCIO-ECONOMIC CONSIDERATIONS..............64
   A. Recreation..................................65
   B. Economic...................................66

Chapter VIII  CONCLUSIONS..............................79

Photographs

Figures
1. Location and land status map.................2
2. Summer distribution of muskox............26
3. Winter distribution of muskox.............27
4. Location of major seabird rookeries......37
5. Streams on Nunivak with salmon runs.....42
6. Developments on Nunivak NWR.............63
7. Alternatives.................................84

Tables
1. Native allotments filed under the Native Allotment Act of 1906............15
2. Summary of muskox censuses, 1965 to 1972........20
3. Muskox population on Nunivak, 1936 to 1972......22
4. Species of fish recorded and identified during 1962 survey.....................41
5. Vegetative types and subtypes on Nunivak........46
6. Location and population of villages on Nunivak Island in 1890..............76

Appendices
A. Legal documents relating to the Land Status and use of Nunivak Island.
   1. Executive Order 5095, dated April 15, 1929, establishing the Nunivak Island Reservation.
   2. Executive Order 5289, dated March 4, 1930, reserving lands in Native villages for educational purposes.
3. Executive Order 5470, dated October 22, 1930, enlarging Nunivak Island Reservation to include adjacent small islands and waters.
4. Presidential Proclamation 2419, dated July 30, 1940, changing the name to Nunivak National Wildlife Refuge.
5. Public Land Order 1177, dated June 28, 1955, withdrawing 5.6 acres near Mekoryuk for school purposes.
7. Memorandum dated August 1, 1968, from Bureau of Indian Affairs transferring 3.33 acres of land at Nash Harbor to the Bureau of Sport Fisheries and Wildlife.
9. Special-use permit 28739, Dated March 1, 1959, allowing the Army to use 0.32 acre for a National Guard Armory.
10. Cooperative Agreement dated July 24, 1956, between BSF&W and Territory of Alaska allowing use of 574.6 acres for Mekoryuk landing strip and access road right-of-way.
11. Amendment to cooperative agreement, dated May 12, 1958, between BSF&W and Territory of Alaska, increasing the effective period to December 31, 1981.
12. Cooperative Agreement, dated February 8, 1962, between BSF&W and Alaska Department of Fish and Game on muskox management objectives and policy for Nunivak Island.
14. Right-of-way grant, dated June 22, 1972, providing an easement to the State of Alaska, Department of Highways, for a road between Mekoryuk and the airport.

B. Climatological data for Nunivak Island.

C. Animal lists
1. Mollusks collected on the island.
2. Fish found in refuge waters.
3. Refuge bird lists.
4. Principal salmon spawning streams.

D. Reports and publications
2. Bibliography pertinent to Nunivak Island.
3. Letter from State of Alaska, Department of Highways, dated December 6, 1972, relating to the need for surface transportation corridors on national wildlife refuges.
PREFACE

Nunivak National Wildlife Refuge is located off the western coast of Alaska in the Bering Sea. The main island is separated from the mainland by the 23-mile-wide Etolin Strait.

The refuge was established by Executive Order and consists of Nunivak Island and approximately 50 small offshore islands and rocks along with about 2.5 million acres of surrounding submerged lands. The total combined acreage of emerged and submerged lands is 3.6 million, ranking Nunivak as the largest island refuge and the second largest refuge in the National Wildlife Refuge System.

Its diverse topography of sea cliffs, miles of sand beaches and towering dunes, interior mountains, crater lakes, vast expanses of rolling tundra and numerous streams and lakes supports a fascinating variety of flora and fauna. The island is perhaps best known for the muskox herd which was introduced in 1935.

Management of Nunivak Refuge is dedicated primarily to preserving and protecting the ecological integrity of its natural environment.

The entire refuge was studied for its suitability or non-suitability as wilderness. The following is an evaluation of that study and is presented in partial fulfillment of the requirements of the Wilderness Act (P.L. 88-577).
NUNIVAK NATIONAL WILDLIFE REFUGE WILDERNESS STUDY
CHAPTER I
INTRODUCTION

The Nunivak National Wildlife Refuge was created on April 15, 1929, by Executive Order 5095 signed by President Herbert Hoover. The initial withdrawal included only the main island, but a second Executive Order 5470 on October 22, 1930, included Triangle Island, all adjacent small unnamed islands and rocks, as well as all lands under water within approximately twelve miles of Nunivak Island, (Appendix A). The original withdrawal was made under the provisions of a 1927 act (44 Stat. 1452) entitled "An Act to provide for the protection, development, and utilization of public lands in Alaska by establishing an adequate system of grazing livestock thereon". In the instance of Nunivak the withdrawal was made...

"for the use of the Department of Agriculture in conducting experiments in the crossing and propagation of reindeer and native caribou, for contemplated experiments in re-establishing muskox as a native animal of Alaska, and also as a preserve and breeding ground for native birds and wild game and furbearing animals ...".

Nunivak Island is located in the Bering Sea off the western coast of Alaska between 166°30' West Longitude and between 59°45' and 60°30' North Latitude (Figure 1). Separated from the mainland by the 23 mile-wide Etolin Straits, Nunivak lies offshore of the Yukon-Kuskokwim River Delta and the Clarence Rhode Wildlife Range.

Administrative headquarters for Nunivak are located in Bethel, 145 miles east-northeast of the Island. Bethel is approximately 400 miles west of
Figure 1. Location, approximate refuge boundary, and land status of Nunivak National Wildlife Refuge
Anchorage and is the region's largest village.

Nunivak Island is approximately 70 miles long and 50 miles wide, with an area of about 1,700 square miles or 1,109,387.7 acres. In addition to the main island, the adjacent offshore waters contain over 50 smaller islands and rocks. The offshore area included in the withdrawal adds about 2,547,000 acres, making a total refuge area of 3,656,387 acres. This makes Nunivak not only the largest island refuge, but also the second largest refuge in the National Wildlife Refuge System. Nunivak is also one of the few refuges to have jurisdiction over submerged lands, and able to provide protection to the critical estuarine zone.

The island topography consists of a diversified coastal area with high sea cliffs on the west, miles of sand beaches combined with magnificent dunes and larger saltwater lagoons on the south, rocky beaches with numerous coves and bays to the east and north. The interior contains an upland plateau-like area rising from the 500-to-800-foot elevation, culminating in a mountainous area. Roberts Mountain reaches an elevation of 1,675 feet and is the highest point on the island. The mountainous area was formed by volcanic action and contains several lava flows and this is one of the island's most scenic features. The remaining land is composed of flat or rolling tundra interspersed with low hills, isolated mountains and buttes, many small lakes, and over 70 streams and rivers.

Nunivak is one of many islands on the Bering Sea continental shelf and geologically is part of the North American Continent. Nunivak is situated
in a late Cenozoic basaltic province. The island geology is known primarily from the work of Coonrad (1957) and Hoare (1968). This basaltic flow rests on Cretaceous sedimentary deposits of continental origin as evidenced by gently dipping plain extending from Nunivak to the continental shelf. This shelf is less than 100 feet deep beneath the Bering Sea.

The earliest known volcanic activity was the eruption of alkalic basalt on the western tip of the island some 6.1 million years ago. Each successive volcanic action shifted progressively eastward, the youngest activity taking place about 300,000 years ago. Even the waters adjacent to Nunivak, according to available hydrographic information, cover submarine volcanic cones.

Roberts Mountain was formed by a series of volcanic benches, with the top being the steep side of a breached crater. The remainder consist of volcanic cones rising to some 500 feet above the central plains. To the east the plain slopes off to beach cliffs under 50 feet in height. On the western coast bluffs rise abruptly from the sea to a height of 100 to 200 feet. The abundance of polygonal columnals in these sea cliffs proclaim their volcanic origin.

Cretaceous sedimentary deposits crop out on the north side of Nunivak. In these outcrops sedimentary occurrences of coal have been reported. Plant fossils found on the north side are probably from the same area as the coal deposits.

Nunivak's subarctic climate receives considerable influence from the surrounding sea which produces a relatively stable temperature regime. The island's mean annual temperature is 29 degrees with mean daily temperatures
ranging from 10.5 degrees in January and February to 49.9 degrees in August. Extreme temperatures have been recorded, however, ranging from below -4 degrees F to over 70 degrees F. The frost-free period or growing season is 105 days. A 19-year summary of the climatological data for Nunivak Island is attached in Appendix B of this report.

The surrounding sea has considerable effect on Nunivak's weather. Rain and snowfall is heavier than in adjacent mainland areas. Skies are frequently overcast and dense fogs are common. Normally the late winter and early spring months have the longest period of clear skies. The mean annual rainfall is 16 inches with August, September and October considered the wettest months. Rain has been recorded every month of the year and snowfall in all but two months. Mean annual snowfall is 54.4 inches.

During warm spells in winter, Nunivak is frequently subjected to periods of freezing rain when the landscape is covered with a coat of ice. This may happen several times and create a series of ice lenses in the snow. These ice layers may be as much as an inch thick, creating an almost impenetrable barrier to grazing animals seeking forage beneath the snow.

Strong winds are common throughout the year, but are usually more severe from August through October, and February through April. Winter winds create severe blizzards with blowing snow and zero visibilities.

The island's vegetation is, for the most part, of the dwarf arctic tundra form containing a variety of lichens, grasses, sedges, flowers and shrubs. There are no trees on the island but willows up to eight feet in height along some of the river courses are the tallest vegetation.
Eelgrass is the most important species of marine flora. The large beds that occur in the bays and lagoons represent an important food source for migrant waterfowl as well as providing food and cover for a variety of marine organisms.

Indigenous species of terrestrial mammals include the arctic and red fox, mink, weasel, lemmings, mice and shrews. Reindeer and muskox were introduced in 1920 and 1935 respectively and are now well established as part of the island's fauna. Marine mammals inhabiting the surrounding waters include walrus, whales, sea lions, and four species of seals.

The island has considerable bird life, most of which is present only during the summer months. Nunivak's sea bird rookeries are some of the largest in Alaska and contain countless numbers of murres, kittiwakes, puffins, cormorants and auklets. Ducks and geese nest on the island in relatively small numbers, but feed in the eelgrass beds and rich offshore waters in large numbers during migration. Some species of sea ducks, notably harlequin and eider, are present nearly year-round wherever there is open water. The island is also host to swans, cranes, ptarmigan, and a variety of passerine and shorebirds.

The freshwater streams and rivers provide habitat for all five species of Pacific salmon as well as resident populations of char. One stream contains grayling. Some of the freshwater ponds and lakes contain populations of sticklebacks and blackfish. The surrounding marine waters are rich in fish life, including halibut, flounder, tom cod, smelt, herring and a variety of sculpins, and also contain king and tanner crabs, clams, mussels
and cockles, especially in the intertidal area.

As a unit of the National Wildlife Refuge System, the primary management objectives for Nunivak are:

1. To preserve and protect the natural environment as a prerequisite to maintaining fish, wildlife, and other natural resource values.

2. To provide the opportunity for wildlife- and wildlands-oriented recreation of a type and in a manner consistent with the purpose for which the area was established.

3. Provide for continued use of refuge habitats for grazing reindeer which provide an economic resource for residents of the island.

4. Maintain populations of muskox and reindeer at levels which will permit maximum sustained yield within the carrying capacity of their range.

5. Expand understanding and appreciation of wildlife and wildlands ecology and man's role in his environment by (a) establishing interpretive facilities and informal handout literature, and (b) encouraging scientific studies by teachers, students, scientists and other persons.

6. Provide maximum human benefits which include harvest of surplus and renewable resources for recreation and subsistence use.
CHAPTER II
WILDERNESS STUDY OBJECTIVES

The Wilderness Act of September 3, 1964 (Public Law 88-577), requires the Secretary of the Interior to review every roadless area of 5,000 contiguous acres or more and every roadless island within the National Wildlife Refuge System and, within ten years after the effective date of the Act, report to the President of the United States his recommendations as to the suitability or non-suitability of each such area or island as wilderness. In defining wilderness, the Act requires the review of roadless areas of less than 5,000 acres that are of sufficient size to make preservation practical.

The principal objective of field investigations was to evaluate at the direction of the Secretary of the Interior, the suitability or non-suitability of the Nunivak National Wildlife Refuge for inclusion in the National Wilderness Preservation System. In addition, field studies were designed to:

1. Clearly delineate and describe those areas within the Refuge that were found to be suitable for consideration as wilderness.

2. Clearly delineate and describe those areas within the Refuge that were found to be unsuitable as wilderness.

3. Determine whether classifying all or part of the Refuge as wilderness would be within and supplemental to the purposes for which it was established and is administered as a unit of the National Wildlife Refuge System.

4. Determine what conflicts or benefits there might be if all or part of the Refuge were classified as wilderness by the Congress of the United States.

5. Identify and evaluate impacts on the human environment in the extent a wilderness proposal is made.
Evidence obtained by archaeological excavations indicates that Nunivak Island has been continually occupied by Eskimos for at least 2,000 years (Nowak, 1970). This occupation period consists of three principal phases. The earliest, or Norton phase, produced a maximum radio-carbon date to 2100 years before present. The intermediate, or Nukleet-like phase, dates back to 670 years ago. The most recent or, Western Thule-like phase dates to 350 years before present and continued to the time of contact. The effect of insular isolation has resulted in the development of a different dialect than spoken on the mainland. It is likely that further study of archaeological sites will indicate occupation for a much longer period than the time supported by present evidence. This hypothesis is not without support as a site in nearby Bristol Bay exhibiting many similarities in artifacts has been found to have a continual occupation period of 4,000 years.

Nunivak Island just missed being discovered by the English explorer Captain James Cook in 1778. Cook reached Cape Newenham in July of that year and intended to follow the coastline north which would have brought him in sight of the island. However, he experienced difficulty in sailing in the shallow waters of Kuskokwim Bay and put out to sea on a northwesterly course, bypassed Nunivak, and did not sight land again until reaching St. Matthew Island.

The island remained undiscovered for another 43 years when in 1821 an expedition by the Russian American Company led by Khromchenko in the brig GOLOVIN and Etolin in the cutter BARANOV sailed in the Bering Sea and recorded the sighting of Nunivak. Khromchenko claimed to have discovered the island in the summer of 1821 but did not survey it. Khromchenko sailed to
Norton Sound from Nunivak and on the return trip is supposed to have defined many landmarks along the coast of Nunivak Island.

Captain A. K. Etolin, for whom Etolin Strait is named, discovered Nunivak the same summer and followed along the north shore of the island where he met with some of the residents. Etolin reported that there were 400 people living on the island in sixteen villages and described them as follows: "The Natives of Nunivak do not do very much hunting and trapping of furbearing animals in spite of the fact that there is considerable number of foxes on this island. Their main occupation is hunting hair seals, wolverines, caribous, and catching fish found in the sea not far offshore. These islanders lead a sedentary life, coming to the mainland in the summer to barter seal skins, blubber and a few foxes for tobacco from the local Natives. They are very little acquainted with the use of dry goods and do not use it for clothes."

The next recorded visit was that of Dr. William Healy Dall in 1874. Dall made geological observations on the northeastern portion of the island. He commented that the people seemed to have fewer trade goods than other Alaskan Natives with whom he was familiar (Van Stone, 1954).

The Eleventh Census in 1891 produced the first detailed observations of the island and its people. Ivan Petroff, arriving on the U. S. Revenue steamer CORWIN, was landed on Cape Mendenhall and from there worked his way around the island by kayak. Petroff covered most of the island and his census report lists nine villages and a few small settlements with a population of 559 and an estimated island population of 700.

Even after the island was discovered and its location plotted on marine charts, it was seldom visited by vessels trading in the Bering Sea. Sailing routes
were generally further to the west and after a number of whaling vessels were wrecked off the coast in the 1890's, sailors learned to give the island wide birth.

In 1899, 1900, and 1902, the Revenue Cutter CORWIN and the Coast and Geodetic Survey vessel MANNING explored the shoreline and plotted the position of shoals and rocks. Editions of the U. S. Coast Pilot as late as 1954 warned that the area should be approached with extreme caution.

Actual on-the-island contact with Europeans was probably minimal until the Lomen Brothers introduced reindeer in 1920 and the building of an Alaska Native Service School in 1923. However, the effect of contact was felt by the islanders through trade with other Native groups and white traders in the Yukon, Kuskokwim and Bristol Bay areas.

Epidemics during the early 1900's that originated on the mainland and carried to the island had a drastic effect on the population. When the ethnographer Dr. Margaret Lantis worked on the island in 1939-40, the population was estimated to be slightly under 200. This is a considerable decline from the population mentioned by Petroff in 1891.

The population continued to decline and reached a low of about 150 in the 1950's. Following this low, the population increased to slightly over 300 in the mid 1960's and then again declined to the population of 249 recorded in 1970.

Currently the entire population lives year-round in the village of Mekoryuk, a fourth-class city located on the west shore of Shoal Bay near the northeast end of the island. The village extends for approximately 1,500 feet along a high bank overlooking the entrance to the bay and about 900
feet inland from the beach.

Fifty-seven houses were counted in the 1970 census, but since then additional houses, including 33 new homes now under construction, have been added. Other buildings in the village include a six-teacher BIA school with an enrollment of approximately 100 students, a National Guard Armory, Electrical Power Plant, church, community well, Native Cooperative Store, pool hall, and the Reindeer Project facilities. All the village property and buildings with the exception of the school are on refuge lands.

The island's only road connects the village to the 3,550-foot runway approximately 4 miles west of town. This is the only landing field on the island.

Mekoryuk is served by one scheduled airline with a twice-weekly schedule. Chartered air service to Mekoryuk is also available from Bethel. Heavy freight and fuel is delivered to the village by the BIA vessel NORTH STAR or by barge line operating out of Bethel. In winter, heavy freight can be brought in only by air.
CHAPTER IV
LAND STATUS

Specific legislation affecting Nunivak Island in the order of occurrence follows. Copies of pertinent legislation are appended to this report (Appendix A).

1. Executive Order 5095, dated April 15, 1929, and signed by President Herbert Hoover, established the Nunivak Island Reservation. The EO withdrew the lands on Nunivak Island from all forms of appropriation, except mining and mineral leasing laws, which were not mentioned in the Act. The establishment of the reservation shall not interfere with the use of the island for lighthouse, military, or Naval purposes, or the construction of schools, buildings, or other improvements by the Bureau of Education.

2. Executive Order 5289, dated March 4, 1930, and signed by President Herbert Hoover, reserved lands in Native villages for educational purposes. The Act specifies that up to 40 acres be set apart for education and erection of school buildings.

3. Executive Order 5470, dated October 22, 1930, and signed by President Herbert Hoover, enlarged Nunivak Island Reservation to include Triangle and all small unnamed islands and rocks adjacent, and all adjacent waters located in latitude 60⁰W of Greenwich in the Bering Sea.


5. Public Land Order 1177, dated June 28, 1955, withdrew 5.6 acres of
public lands near the village of Mekoryuk for school purposes.

6. Public Land Order 3987, dated April 15, 1966, revoked prior withdrawals wholly or in part and withdrew specific lands for school purposes.

7. Memorandum dated August 1, 1968, from the Bureau of Indian Affairs transferring 3.33 acres of school land at Nash Harbor to the Bureau of Sport Fisheries and Wildlife.

8. Public Law 92-203, the Alaska Native Claims Settlement Act, dated December 18, 1971, allows the Natives of Mekoryuk to select and obtain fee title to three townships of land from within the refuge. These selections will be made from lands contiguous to the village as shown on the status map (Figure 1). Selections must be made by December 18, 1974, and, therefore, a determination cannot be made at this time as to which lands will be affected.

The Act also provides that the Secretary of the Interior is authorized to withdraw and convey to appropriate Native regional corporations fee title to existing cemetery sites and historical places. The Secretary may convey, to a Native, upon application within two years of the enactment of the Act, the surface estate not to exceed 160 acres of land occupied by the Native as a primary place of residence on August 31, 1971.

9. Natives have filed for 7 parcels of refuge land totalling 575 acres (Table 1) under terms of the Native Allotment Act of May 17, 1906, amended (U.S.C. 357, 357a, 357b 1958). "This Act authorizes the Secretary of the Interior to allot not to exceed 160 acres of vacant, unappropriated, and unreserved non-mineral land in Alaska......to any Indian, Aleut, or Eskimo of full or mixed blood who resides in and is
Table 1. Native allotments filed under the Native Allotment Act of 1906.

<table>
<thead>
<tr>
<th>BLM FILE NUMBER</th>
<th>LEGAL DESCRIPTION</th>
<th>SEC</th>
<th>TNSP</th>
<th>RNG</th>
<th>ACRES</th>
<th>CLAIMANT</th>
<th>RESIDENCY CLAIM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F 17470</td>
<td>SW1/4NE1/4, SE1/4NW1/4, NE1/4SW1/4, NW1/4SE1/4</td>
<td>35</td>
<td>3S</td>
<td>100W</td>
<td>160</td>
<td>Jesse Moses, Bethel, Ak.</td>
<td>January 1921</td>
</tr>
<tr>
<td>F 18463</td>
<td>S1/2NE1/4NE1/4, N1/2NE1/4SE1/4, SW1/4NE1/4, NE1/4NE1/4</td>
<td>36</td>
<td>3S</td>
<td>100W</td>
<td>80</td>
<td>Rex Mathlaw, Sr., February, Bethel, Ak.</td>
<td>1923</td>
</tr>
<tr>
<td></td>
<td>portion E1/2NW1/4</td>
<td>1</td>
<td>1N</td>
<td>102W</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 18012</td>
<td>SE1/4</td>
<td>1</td>
<td>2N</td>
<td>100W</td>
<td>160</td>
<td>Edna Mathlaw, Bethel, Ak.</td>
<td>July 1, 1941</td>
</tr>
<tr>
<td>F 16843</td>
<td>W1/2SW1/4, E1/2SW1/4</td>
<td>24</td>
<td>3N</td>
<td>99W</td>
<td>40</td>
<td>Emma Moses, Bethel, Ak.</td>
<td>August 1, 1927</td>
</tr>
</tbody>
</table>

Total acreage involved 575
a Native of Alaska, and who is the head of a family, or is twenty-one years of age."

This and other Indian allotment laws were extinguished by the Alaska Native Claims Settlement Act of 1971 (P.L. 92-203). Claim applications under the Native Allotment Act were accepted by the Bureau of Indian Affairs until midnight of December 18, 1971, however.

It is noteworthy that under this Act an application for a Native allotment must make satisfactory proof of substantially continuous use and occupancy of the land for a period of five years by him. The term "substantially continuous use and occupancy" contemplates the customary seasonality of use and occupancy by the applicant of any land used by him for his livelihood and wellbeing and that of his family.

It is not known at this time whether these allotment claims have legal merit and the Bureau of Land Management reports that it may be a number of years before such a determination can be made. All but claim number F-18012 lists residency prior to withdrawal of Nunivak Island from the public domain on October 22, 1930.

10. July 21, 1972, confirmation from U. S. Solicitor that Executive Order 5470 dated October 22, 1930, also includes the surrounding tidelands as being within the Nunivak Refuge boundaries.

The following agreements issued by the Bureau of Sport Fisheries and Wildlife affect lands near the village of Mekoryuk:

1. Special-Use Permit 28739, dated March 1, 1959, allowed the Department of the Army to use 0.32 acres of land for a National Guard Armory.
permit is effective from January 1, 1959 to December 31, 1979.

2. Right-of-way Grant F-12541, dated May 20, 1970, provided easement for electrical facilities for an indefinite period.

3. Special-use Permit dated September 26, 1966, allowing the removal of gravel for surfacing the road between Mekoryuk and the airport (approx. 3 miles). Gravel must be obtained from beaches between Mekoryuk and the first bay to the westward but not from within the bay. Permit effective until revoked.

4. Right-of-way grant, dated June 22, 1972, provided an easement to the State of Alaska, Department of Highways for a road between Mekoryuk and the airport.
CHAPTER V
RESOURCES

A. WILDLIFE

1. Land Mammals

   a. Muskox

(1) History: In Alaska, muskox were originally found only along the Arctic Slope and probably were never abundant. Reports conflict as to the date of the last recorded Alaskan muskox. The generally-accepted date is 1865, when a herd of 13 was killed by Eskimos near Barrow. However, there is another report of a herd of 15 to 20 being killed by two Frenchmen near Chandalar Lake in 1898. Most records of their occurrence in Alaska are based on the recovery of a few skulls and in the traditions of the Eskimos.

In 1930, Congress appropriated funds for the reintroduction of muskox to Alaska. The appropriation provided for the purchase of thirty animals to be placed at the Biological Survey Experiment Station of the U. S. Department of Agriculture at the University of Alaska for domestication studies. The purpose given for the reintroduction of muskox was twofold: namely, "(1) to aid in conserving a species threatened with extinction and (2) to study the possibility of domestication and breeding of muskox with a view of making greater economic use of the vast forage resource of northern Alaska."
A total of 34 calves and yearlings were captured in Greenland and shipped to College, arriving there on November 5, 1930. The animals were held at the University of Alaska for study until transferred to Nunivak Island in 1935 and 1936.

(2) Population: In the summer of 1935, four adult animals, two bulls and two cows, were transferred from Fairbanks to Nunivak. The following summer the remaining 27 animals at the University of Alaska were released on the island. Initial survival of the 31 animals was good and the production of calves high. Records of early growth in the herd indicate that by 1938 there were 52 animals and probably as many as 76 by 1941. During the 1940's, however, the population apparently suffered severe losses and in 1947, only 49 animals could be found. These losses coincided with a series of winters with abnormally deep snow. During the same period, reindeer herds suffered major losses on Nunivak, St. Paul, and Nelson Islands. From 1947 to 1965, the herd grew rapidly, reaching a peak population of about 750 in 1968, although, since 1968, the rate of increase has declined and this factor, coupled with heavy mortality and transplants, has reduced the herd to about 500 animals by 1972 (Table 2).

This decrease has been due in part to a decline in calf production. The herd had increased at an average of 16% each year between 1947 and 1968, reaching a high of 21% in 1965. Since 1965, the
Table 2. Summary of Muskox Censuses, 1965-1972.

<table>
<thead>
<tr>
<th>Date of Survey</th>
<th>4 years M</th>
<th>4 years F</th>
<th>3 years M</th>
<th>3 years F</th>
<th>2 years M</th>
<th>2 years F</th>
<th>Yearling or calf</th>
<th>Not Classified</th>
<th>Total</th>
<th>Estimated Mortality¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer Censuses²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1965</td>
<td>100</td>
<td></td>
<td>108</td>
<td></td>
<td>306</td>
<td></td>
<td>514</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1966</td>
<td></td>
<td>141</td>
<td>306</td>
<td></td>
<td>569</td>
<td></td>
<td></td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1967</td>
<td></td>
<td></td>
<td>120</td>
<td></td>
<td>390</td>
<td></td>
<td>651</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1968</td>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>386</td>
<td></td>
<td>714</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1969</td>
<td></td>
<td></td>
<td>84</td>
<td></td>
<td>288</td>
<td></td>
<td>593</td>
<td>153</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1970</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td>447</td>
<td></td>
<td>497</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept 1971</td>
<td></td>
<td></td>
<td>71</td>
<td></td>
<td>239</td>
<td></td>
<td>540</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Winter Censuses³</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March 1966</td>
<td>143</td>
<td>161</td>
<td>54</td>
<td>11</td>
<td>85</td>
<td>32</td>
<td>486</td>
<td>673</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1968</td>
<td>209</td>
<td>150</td>
<td>44</td>
<td>52</td>
<td>63</td>
<td>45</td>
<td>110</td>
<td>593</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb 1970</td>
<td>221</td>
<td>140</td>
<td>32</td>
<td>44</td>
<td>23</td>
<td>31</td>
<td>78</td>
<td>491</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March 1971</td>
<td>252</td>
<td>83</td>
<td>13</td>
<td>26</td>
<td>5</td>
<td>5</td>
<td>32</td>
<td>483</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1972</td>
<td>214</td>
<td>121</td>
<td>6</td>
<td>12</td>
<td>19</td>
<td>20</td>
<td>69</td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Mortality estimate by difference in annual censuses corrected for the number of calves born and animals removed in transplants.

²Only bulls and calves can be identified with certainty on summer (aerial) censuses.

³Winter censuses conducted before period of highest winter mortality.
percentage of calves has decreased each year, reaching a low of 10% in 1970. In 1971, calves made up 13% of the herd, only a slight increase in an otherwise downward trend.

There are other important factors contributing to the decline of the herd; namely, a deteriorating winter range, weather, and distortion of sex ratios caused by higher winter loss of cows than bulls and preferential selection of females for transplants. Table 3 illustrates the population trends since 1936.

(3) Mortality: Dead animals are recorded during annual surveys and are reported by student investigators and island residents. This provides a good record of muskox mortality. This is further augmented by nearly 100% accurate counts of the total muskox population each year. This count, when compared with the previous year's, provides an excellent record of mortality. Since the introduction, natural mortality has accounted for over 380 animals, with over 240 of the losses having occurred since 1968.

Since there are no predators of muskox on the island, all natural losses can be attributed to accidents, starvation, and debility usually associated with old age. Accidents are one of the major causes of loss and most can be attributed to animals wandering out onto the sea ice. On a number of occasions, muskox have been observed on the sea ice and floating on ice cakes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Adults and subadults</th>
<th>Calves</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1936</td>
<td>31</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>1938</td>
<td>39</td>
<td>8 minimum</td>
<td>50</td>
</tr>
<tr>
<td>1942</td>
<td>60</td>
<td>11</td>
<td>76</td>
</tr>
<tr>
<td>1947</td>
<td>?</td>
<td>5</td>
<td>49</td>
</tr>
<tr>
<td>1948</td>
<td>50</td>
<td>7</td>
<td>57</td>
</tr>
<tr>
<td>1949</td>
<td>57</td>
<td>8</td>
<td>65</td>
</tr>
<tr>
<td>1950</td>
<td>54</td>
<td>7</td>
<td>61</td>
</tr>
<tr>
<td>1951</td>
<td>60</td>
<td>16</td>
<td>76</td>
</tr>
<tr>
<td>1952</td>
<td>68</td>
<td>9</td>
<td>77</td>
</tr>
<tr>
<td>1953</td>
<td>75</td>
<td>15</td>
<td>90</td>
</tr>
<tr>
<td>1954</td>
<td>79</td>
<td>21</td>
<td>100</td>
</tr>
<tr>
<td>1955</td>
<td>97</td>
<td>19</td>
<td>116</td>
</tr>
<tr>
<td>1956</td>
<td>100</td>
<td>26</td>
<td>126</td>
</tr>
<tr>
<td>1957</td>
<td>118</td>
<td>25</td>
<td>143</td>
</tr>
<tr>
<td>1958</td>
<td>149</td>
<td>32</td>
<td>181</td>
</tr>
<tr>
<td>1959</td>
<td>167</td>
<td>39</td>
<td>206</td>
</tr>
<tr>
<td>1960</td>
<td>199</td>
<td>57</td>
<td>256</td>
</tr>
<tr>
<td>1961</td>
<td>224</td>
<td>69</td>
<td>293</td>
</tr>
<tr>
<td>1962</td>
<td>275</td>
<td>78</td>
<td>353</td>
</tr>
<tr>
<td>1963</td>
<td>333</td>
<td>73</td>
<td>406</td>
</tr>
<tr>
<td>1964</td>
<td>365</td>
<td>102</td>
<td>467</td>
</tr>
<tr>
<td>1965</td>
<td>406</td>
<td>108</td>
<td>514</td>
</tr>
<tr>
<td>1966</td>
<td>459</td>
<td>110</td>
<td>569</td>
</tr>
<tr>
<td>1967</td>
<td>531</td>
<td>120</td>
<td>651</td>
</tr>
<tr>
<td>1968</td>
<td>614</td>
<td>100</td>
<td>714</td>
</tr>
<tr>
<td>1969</td>
<td>509</td>
<td>84</td>
<td>593</td>
</tr>
<tr>
<td>1970</td>
<td>447</td>
<td>50</td>
<td>497</td>
</tr>
<tr>
<td>1971</td>
<td>469</td>
<td>71</td>
<td>540</td>
</tr>
<tr>
<td>1972</td>
<td>414</td>
<td>69</td>
<td>483</td>
</tr>
</tbody>
</table>

Total 1,365

1Spring census taken in April of 1972
Carcasses have also been found washed up on the shores of the adjacent mainland. How many animals are lost in this manner each year is not known, but in some years this may account for over half the natural mortality. The difference between the 1968 and 1969 census indicated that 153 animals had been lost. As only a small fraction of these losses could be accounted for from carcasses found on the island, it is assumed that many of the animals were lost on the sea ice.

Other accidents include falls from cliffs, drownings in rivers and bays, miring in bogs and fighting. Of these losses, falls from cliffs probably account for the greatest number, particularly on the west end of the island where large snow cornices form on the tops of 200-foot cliffs. Five drownings and four deaths from being mired in a bog have been recorded.

Starvation is also a major cause of death, due to a combination of factors, principally weather and range conditions. Food is plentiful in summer when muskox range the entire island, but in winter they are confined to areas adjacent to high cliffs or sand dunes where prevailing winds uncover forage. Such areas are limited, and available habitat may not exceed 4,000 acres. Elsewhere, the snow is deep and packed so firm by wind that it can support the weight of a man or a muskox. Icing conditions may occur with mid-winter thaws or rains, producing a surface comparable to concrete through which no animals, including reindeer, can paw for food. A severe winter with deep
snow or icing conditions can reduce this already critical forage area, causing a heavy mortality.

Winter mortality corresponds to weather conditions and the size of the population. Since 1965 the winter kill has ranged from 28 to 153 animals. As a result of heavy snow and severe icing during the 1971-72 winter, it is estimated that mortality will exceed 75 animals. This reduction is necessary for the security of the herd and protection of the range, but population control by starvation of a Nationally Unique Species can in no way be considered a good management technique.

(4) Distribution: Muskox distribution on the island is determined largely by the seasonal differences in habitat conditions which effect movement and range occupancy. Since the time of their introduction, large areas of the island have received little or no use, while other areas, such as Cape Mohican and the Cape Mendenhall sand dunes, have always been favored locations. Palmer and Rouse noted that in the 1940's the animals were confined to the dry tundra range at the west end of the island and to the sand dune type on the south side of the island. Wet tundra areas were avoided. Soon after their introduction, Palmer reported a group of muskox on Twin Mountain. Muskox have been seen regularly in that area ever since. The Twin Mountain-Cape Corwin area has now become a major summer range with large numbers seen there in 1964-1966.
Areas of the island avoided by most muskox are the primarily wet tundra areas between Nash Harbor and Mekoryuk, and the central interior areas. The northeast portion of the island from Cape Etolin to Twin Mountain does not receive as much use as the western and southern areas.

Distribution of muskox differs considerably between summer and winter (Figures 2 and 3). In most winters, muskox are concentrated along the coast of the island, along the northwestern bluffs and southern sand dunes. Winter surveys (March) show highest concentrations of muskox in the Cape Mohican and Cape Mendenhall areas. Most animals in winter are found within one mile of the coast. Usually very few animals are observed in the interior, although, in 1971, when snowfall was extremely light and icing negligible, a number of animals were found in the interior where they foraged on mountain slopes that were nearly bare of snow.

Another exception is intermittent use of Muskox Mountain for many years by groups of bulls. Areas with the largest number of herds in winter include the dune area between Cape Corwin and Bangookbit Dunes, Mikisagimiut to Dooksook Lagoon and with smaller groups on the coast between Ingri Butte and Jayalik River on the southern coast and between Ahdingamiut and Kamirukmiut on the northern coast.
Figure 2. Distribution of Muskox in July, 1968, typical of summer dispersal patterns.
Figure 3. Distribution of Muskox in March 1968, with concentration in confined areas of winter range.
In winter, muskox tend to occupy points and projections of the coast. Small offshore islands are occupied to such an extent that animals have been stranded on these islands when the sea ice melts in the spring. Stranded muskox have spent most of the summer on these islands with no reported ill effects.

In spring, the herds disperse and greatly increase their movements. In summer, this movement is mainly along stream drainages. At this time, animals can be found throughout the island except for the mountainous interior. Few animals remain along the coast except along the northwestern bluffs which are occupied to some extent year-round. In general, summer distribution is only an extension of the winter distribution, with the northcentral and northeast interior having the fewest animals and the northwest and southeast having the most.

Seasonal movements of up to 100 miles have been recorded in Canada, but movements on Nunivak are much more restricted due to the proximity of winter and summer ranges. However, animals marked in the south dunes have subsequently been observed in all other regions of the island. Mobility is much lower in winter than in summer. Herds will frequently feed in one place for many days and may use a relatively small area during a major portion of the winter.
In summer, daily travel of two to three miles is common and the entire island may be traversed during the course of the season. There is some sexual segregation in summer when single and small bull groups leave the herd. These animals may wander extensively. Very old bulls are less prone to wander and may remain in wintering areas.

b. Reindeer

(1) History and population: Reindeer were placed on the island in 1920 and filled the niche left by native caribou which, according to Eskimo legend, walked away into the sky about 1880. The original introduction of 81 animals was made by the Lomen Reindeer Company of Nome. By 1925, the herd totalled 578 deer and at that time, ten caribou bulls were introduced by the Bureau of Biological Survey to begin cross breeding experiments. In 1928, an additional 528 female reindeer were introduced. Carrying capacity of the range at that time was estimated to be 40,000 head. The herd contained 17,000 head when the U. S. Government purchased Lomen's holdings in 1939 and the management was turned over to the Bureau of Indian Affairs. In 1939, the carrying capacity of the range was estimated to be about 25,000, but it was recommended that the herd be reduced to 10,000-to-17,000 head to safeguard against competition with the recently introduced muskox.

No accurate censuses were conducted during the 1940's, but it is believed the herd may have increased to more than 30,000
animals. A series of severe winters in the mid-40's caused heavy mortality, with only about 4,000 remaining. The range was severely damaged and in 1948 it was recommended that the herd, then estimated at 7,000 to 10,000 head, be reduced to 3,000.

In the 1950's the herd again increased and by 1959 it was estimated to number about 13,000 head. The rate of butchering under the direction of BIA was increased from 658 deer in 1957 to 1,636 in 1959. In addition, 200 to 300 deer were taken annually by residents for subsistence purposes.

The herd again declined in the 1960's from an estimated population of 16,000 in 1960 to 10,000 in 1969. The average summer slaughter was 1,882 deer with a winter kill from 300 to 500 deer. In 1970, the refuge staff obtained an aerial photo count of 5,600, with a maximum estimated population of 6,000 prior to the summer butchering of 1,362 deer. The herd was turned over to the village in 1970, under the direction of the village corporation, Bering Sea Reindeer Products. In the 1972 survey conducted by the corporation, 3,691 deer were counted and the total herd was estimated to contain approximately 4,000.

(2) Distribution: During summer, reindeer form into large herds and, while a few small groups can be found, the major portion of the population generally occurs in herds of several hundred to several thousand. Movement during the summer may be extensive, with daily travel being as much as 20 to 40 miles. This movement is strongly influenced by weather and insect activity, with the
greatest movement usually occurring on hot, windless days when flies and other biting insects are most active. There is some yearly variation, but for the most part during the summer the animals occupy the southern and western areas of the island.

The distribution of reindeer changes in the winter. Animals range primarily in lowlands bordering the southeast or northern portions of the island, although scattered groups may be found throughout the island. During the winter months, reindeer occur in small scattered groups or in large, widely dispersed herds, rather than in the closer-knit, large concentrations of summer. The animals also tend to be somewhat more sedentary than in the summer.

c. Furbearers

Mink, weasel, red and arctic foxes are the only furbearing animals on the island. Population size of these species is not known, but in the case of mink and weasel is probably not large. On the other hand, the fox population is quite variable. Of the two species, the red fox is the more numerous. During periods of high populations, red fox become extremely abundant and it is possible to see several at one time among the dunes on the southern portion of the island. The red fox is not so valued for its pelt as is the arctic fox, and therefore the population is regulated more by nature than by man. The high fox population is usually associated with a high rodent population. Crashes or
die-offs generally follow a decline in the rodent population, or, not infrequently, are the result of a rabies epidemic.

Arctic fox are resident, but there may also be recruitment to the population by animals reaching the island via the pack ice. Harvest of foxes varies with population, fur prices, and other factors. Trapping usually has negligible influence on the population, and weather and available food are probably the most important factors regulating its size. Local residents believe there is competition between the two species and that the red fox will drive out the arctic fox.

d. Rodents

The species of rodents on Nunivak are imperfectly known, but at least three species have been recorded and there is a possibility that one or two others may occur. Species that have been recorded include the common shrew, collared lemming, and brown lemming. The latter is of a race apparently restricted to Nunivak. Two other species, the red-backed vole and tundra vole, are common on the adjacent mainland and may occur on Nunivak.

2. Marine Mammals

a. Sea Lion

Sea lions occur in the waters surrounding Nunivak during periods
of open water. There are two haul-out areas on the island, one at Nabangoyak Rock on the west side and the other on the south side near the mouth of the Binajoaksmiut River. Sea lions are not abundant on these areas, probably numbering fewer than 250.

b. Walrus

A few walrus occasionally haul out on Nunivak and many may pass close by the island on their way north in the spring. Probably the majority of the walrus pass through Etolin Strait between Nunivak and the mainland. Walrus are hunted by the residents among the ice floes and open leads in the spring, but the harvest is small with usually fewer than ten animals taken annually.

c. Seals

The four species of seals occurring in the waters surrounding Nunivak include the harbor seal, ribbon seal, ringed seal and bearded seal. Of these, the harbor seal is by far the most abundant and most utilized by the residents. The bearded seal is the most prized because of its large size and the quality of its skin for making mukluk soles. The ribbon seal is classified as a rare species and, while not abundant in Nunivak's waters, is not uncommon.
The population of seals is not known, nor is the harvest. However, seals are taken at every opportunity by the residents, who rely on these animals for both food and clothing.

d. Whales

The residents have commonly reported observations of whales near the shores of Nunivak Island, but were unable to identify the species. Whales which occur in the Bering Sea and are likely to be seen in Nunivak's waters include the gray, fin-backed, sei, little piked, blue, humpbacked, bowhead, northern right, Pacific killer, Baird's beaked, sperm and beluga.

The Committee on Rare and Endangered Species in the United States lists the blue and humpbacked whales as endangered, while the gray and bowhead are classified as rare.

3. Birds

A total of 96 species have been listed as occurring or believed to occur on Nunivak Island (Appendix C). All but 12 of these species were identified by C. G. Harold (Swarth, 1934), who spent the period of June 30 to November 6, 1927, on the island. Since then no competent ornithologist has spent more than a few days on the island. Because of the lack of observations, particularly during the early spring and fall migration periods, it is quite
probable that there are other species present which have not been identified.

During the spring and fall migration, Nunivak is host to a number of birds, some of which spend only a few days to a few weeks before moving on. Others (53 species) nest on the island in summer and return to warmer climates with their young in the fall. Only nine species remain on the island or nearby waters throughout the greater part of the year.

a. Waterfowl

Six species of geese and 15 species of duck have been recorded on the island. Black brant and emperor are the most abundant geese, particularly during fall migrations when they make use of the extensive eelgrass beds in the lagoons and bays along the southern and western coastal areas. Over 18,000 brant were counted in these bays in August 1968. While emperors are relatively common nesters, very few brant nest on the island. Two races of Canada geese, Branta canadensis taverneri and B. c. minima, also utilize the island primarily during migration, although both subspecies do nest in limited numbers. The larger taverneri favor the interior portion of the island where several thousand spend the summer near the larger lakes. White-fronted geese are rarely seen and then mainly during the fall migration. Snow geese returning from
nesting grounds on Russia's Wrangell Island in the fall sometimes stop briefly on Nunivak.

The Steller's, king, common and spectacled eiders can be found during any period of the year, whenever there is any open water around the island. In the spring and again in the fall, tremendous flocks of eiders pass by enroute to their nesting or wintering grounds. The oldsouaw and harlequin ducks also spend the period of open water near the island. Pintails are the most abundant puddle duck and probably the most abundant of all nesting waterfowl.

b. Seabirds

Nunivak's seabird rookeries are some of the largest in North America. While scattered nesting colonies occur at many locations around the island, the largest concentration of birds can be seen along the cliffs on the western and southwestern coasts (Figure 4). The approximately 12-mile section of cliffs extending from Cape Mohican and Datheekook Point and the 2-to-3-mile area near Ingi Butte are packed wing-tip-to-wing-tip with nesting sea birds. Black-legged kittiwakes and common murres are by far the most numerous of the variety of species utilizing these rookeries. Numerous, but less abundant species, include the pelagic cormorant, horned and tufted puffins, parakeet and crested auklets, and pigeon guillemot.
Figure 4. Location of major sea bird rookeries.
c. Shorebirds
A variety of shorebirds visit Nunivak, some to nest, others stopping for only a brief period to rest and feed. A number of these birds come from wintering areas far to the south, east and west, i.e., golden plovers, pectoral sandpipers, dowitchers, and northern phalaropes from South America; bristle-thighed curlews from Fiji and Samoa; sharp-tailed sandpipers, bar-tailed godwits and red phalaropes from New Zealand and Australia.

d. Passerines
The beaches, sea cliffs, tundra and willow-lined streams attract a variety of small birds. Many of these birds are common to Alaska and the "lower 48 states", while others come from the Old World. Some of the Old World birds occur only as infrequent strays while others like the yellow wagtail are common nesters. The McKay's snow bunting, which nests only on the Bering Sea National Wildlife Refuge, consisting of St. Matthew and Hall Islands, commonly winters on Nunivak.

e. Hawks and owls
The gyrfalcon and sharp-shinned hawk are the only hawks which have been observed on the island. The former is resident and nests on the island in low numbers while the latter occurs only rarely in migration. Although not recorded, it is likely
that either or both bald and golden eagles occasionally reach Nunivak, as both have been observed on nearby Nelson Island. Two species of owls, the short-eared and snowy, occur with their numbers varying in direct relation to the rodent population.

f. Other species

Whistling swan, lesser sandhill crane, rock and willow ptarmigan, and raven also nest on the island. Of these species, only the raven stays year-round. The ptarmigan generally leave the island in early winter and spend the period of coldest weather in the shelter of willows and spruce on the mainland, returning to the island in early spring.

4. Fish

Nunivak's many rivers, lakes, and marine waters contain a variety of fish. Five species of salmon, along with Dolly Varden and arctic char spawn in the island's rivers and one river contains a small population of grayling. Stickleback and blackfish inhabit many of the streams, ponds and lakes. Saltwater fish include halibut, flounder, herring, smelt, tom cod, sculpins and other species common to the Bering Sea. The total number of species occurring on the island and in the adjacent waters is not known, although 19 species were identified during the 1965 fishery survey
conducted by the refuge staff (Table 4). A list of marine fishes occurring in the Bering Sea and probably in Nunivak's waters is in Exhibit C. Due to the limited opportunity for wage earning, the people rely heavily on fishing, hunting and gathering to provide for their subsistence. Of the available food resources, fish are by far the most important. The fishery is concentrated primarily on salmon, but other species, such as tom cod, halibut, Dolly Varden, flounder, and herring are also utilized.

a. Salmon fishery

Historically, all species of salmon were utilized and practically every river with a salmon run had a fish camp (Figure 5). Currently the fishery is concentrated on chum salmon and most of the fishing takes place on the south side of the island. Chum are preferred because of their greater abundance and the timing of the run. Chum arrive in late June and the run lasts until late July. The principal salmon spawning streams and related species use are listed in Appendix C.

The fishery usually takes place during the first two weeks of July when the peak of the run occurs. This is usually the period when weather conditions are most favorable for drying the catch.

Sockeye and chinook salmon are not abundant enough to attract a
Table 4. Species of Fish Recorded and Identified during 1965 Survey.

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herring</td>
<td>*Clupea harengus pallasi</td>
</tr>
<tr>
<td>Rainbow trout</td>
<td>**Salmo gairdneri</td>
</tr>
<tr>
<td>Arctic char</td>
<td>*Salvelinus alpinus</td>
</tr>
<tr>
<td>Dolly Varden</td>
<td>S. malma</td>
</tr>
<tr>
<td>Pink salmon</td>
<td>Oncorhynchus gorbuscha</td>
</tr>
<tr>
<td>Chum salmon</td>
<td>O. keta</td>
</tr>
<tr>
<td>Chinook salmon</td>
<td>O. tshawytscha</td>
</tr>
<tr>
<td>Coho salmon</td>
<td>O. kisutch</td>
</tr>
<tr>
<td>Sockeye salmon</td>
<td>O. nerka</td>
</tr>
<tr>
<td>Grayling</td>
<td>Thymallus arcticus</td>
</tr>
<tr>
<td>Smelt</td>
<td>**Osmerus eperlanus</td>
</tr>
<tr>
<td>Blackfish</td>
<td>Dallia pectoralis</td>
</tr>
<tr>
<td>Tom cod</td>
<td>**Microgadus proximus</td>
</tr>
<tr>
<td>Halibut</td>
<td>Hippoglossus stenolepis</td>
</tr>
<tr>
<td>Lemon flounder</td>
<td>Parophrys vetulus</td>
</tr>
<tr>
<td>Starry founder</td>
<td>Platichthys stellatus</td>
</tr>
<tr>
<td>Slimy sculpin</td>
<td>Cottus cognatus</td>
</tr>
<tr>
<td>Great sculpin</td>
<td>Myoxocephalus polyacanthocephalus</td>
</tr>
<tr>
<td>Belligerent sculpin</td>
<td>Megalocottus platycephalus</td>
</tr>
<tr>
<td>Threespine stickleback</td>
<td>Gasterosteus aculeatus</td>
</tr>
<tr>
<td>Ninespine stickleback</td>
<td>Pungitius pungitius</td>
</tr>
</tbody>
</table>

*Observed, but not collected for positive identification

**Reported by residents, but not observed.
Figure 5. Streams on Nunivak Island where salmon runs occur.
fishery. The pink salmon run is also small and slightly later than the chum run, but a few are harvested along with the chums. Coho salmon are reported to be as abundant as the chums, but do not become available until August and September. The weather at this season is usually too severe to allow the fish to dry properly. A few cohos are taken by rod and reel, but do not constitute an important food source.

The salmon fishery is a family effort, with each family moving to their fish camp, which they may share with other families, usually in mid June. The family stays until mid-to-late July, by which time enough fish have been caught and dried sufficiently to be brought back to the village.

Small beach seines are used to capture the fish. The seining usually takes place at the mouths of the spawning stream. After the fish are caught, they are split and hung on racks to dry.

b. Other fisheries
A number of flounder and occasionally Dolly Varden are caught in the salmon seines and these fish are utilized. Dolly Varden are also caught with sport tackle and a few are taken with gill nets set under the ice in early spring. Halibut which occur offshore near Cape Etolin are also caught in the spring. A small experimental commercial halibut fishery was attempted
by the residents in 1965-1966. This venture did not prove to be profitable and the only fishing for this species now is for personal use. During the winter the women and children spend many hours fishing for tom cod through the ice in front of the village. These fish are considered relatively important in the diet of the residents. During the time when the people lived entirely off the land many kinds of fish were used, including blackfish and stickleback. These fish are rarely eaten now.

5. Invertebrates

Crabs and mollusks are the only invertebrates on the island which have been identified. Rae Baxter, Alaska Department of Fish and Game, identified 50 species among the mollusks he collected along the coast and offshore of Nunivak in 1972 (Appendix C).

Residents utilize some of the clams, cockles and mussels for food, but Baxter's survey indicated that populations were not sufficient for commercial use.

B. VEGETATION

The vegetation on Nunivak is similar to that of the arctic tundra, but is somewhat modified by the influence of the maritime climate
and topography. Longer growing seasons and milder temperatures produce greater plant abundance and variety, as well as more luxuriant growth than on tundra areas further north.

Bos (1967), who worked on the island in 1965 and 1966, described six basic vegetative types and seven subtypes (Table 5). This classification was based on the dominant cover species and physiography. Rather than repeating or trying to summarize Bos's detailed description of these types, it would be more important to explain the changes which have occurred since vegetation on the island was first described by Miller in 1929 (Palmer, 1938).

In the 1920's, Palmer reported gathering 112 gunnysacks of lichens in two days. At that time, lichens constituted 80% of the vegetative cover on his study quadrats in the dry tundra type and 30% in the wet tundra type. Bos found that lichens now form only trace amounts in the wet tundra areas, and only about 12% of the dry tundra vegetative cover. This loss of lichens is a direct result of reindeer overpopulation. This situation was recognized as early as 1944 when Palmer reported that lichens had been entirely eaten off Cape Etolin.

The greatest damage to the range occurred in the mid-1940's when the reindeer population reached its highest level. Tundra vegetation, particularly lichens, take considerable time to recover even when there is no grazing, but on Nunivak there are areas in which the
Table 5. Vegetation Types and Subtypes of Nunivak Island

<table>
<thead>
<tr>
<th>Vegetation Type &amp; subtype</th>
<th>Location</th>
<th>% of Island</th>
<th>Dominant Species</th>
<th>Associated Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wet tundra</td>
<td>throughout island in low areas, most prevalent on north side</td>
<td>57.5% or 647,905 acres</td>
<td><strong>cloudberry (26%)</strong></td>
<td>lichen, Labrador tea, bearberry, crowberry</td>
</tr>
<tr>
<td></td>
<td>a. Peat mound</td>
<td></td>
<td><strong>sedges (65%)</strong></td>
<td>silveryeed, chickweed, bluegrass, beach rye</td>
</tr>
<tr>
<td></td>
<td>b. Tidal wetland</td>
<td></td>
<td><strong>sedges &amp; cottongrass (35%)</strong></td>
<td>willow, crowberry, bluejoint</td>
</tr>
<tr>
<td></td>
<td>c. Wet tundra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Dry tundra</td>
<td>most common in interior and western tip</td>
<td>13.6% or 150,878 acres</td>
<td><strong>crowberry (29%)</strong></td>
<td>sedge, lichen, moss, bearberry</td>
</tr>
<tr>
<td></td>
<td>a. Grass-hummock</td>
<td></td>
<td><strong>crowberry &amp; bearberry (29%)</strong></td>
<td>broom, willow, Labrador tea, cottongrass</td>
</tr>
<tr>
<td></td>
<td>b. Alpine tundra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Grass-browse</td>
<td>interior upland &amp; drier portions</td>
<td>23.4% or 259,599 acres</td>
<td><strong>fescue &amp; bluejoint (26%)</strong></td>
<td>crowberry, wormwood, willow</td>
</tr>
<tr>
<td></td>
<td>a. Grass-hummock</td>
<td></td>
<td><strong>bluejoint &amp; willow (26%)</strong></td>
<td>fescue, burnet</td>
</tr>
<tr>
<td></td>
<td>b. Riparian</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Beach grass &amp; forb</td>
<td>southern and southwestern coasts</td>
<td>0.4% or 4,438 acres</td>
<td><strong>beach ryegrass (60%)</strong></td>
<td>beach pea, fescue, bluejoint, yarrow</td>
</tr>
<tr>
<td></td>
<td>w/lesser amount along bluffs, buttes &amp; streams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Barren rock</td>
<td>extensive areas in interior w/lesser amount along bluffs, buttes &amp; streams</td>
<td>2.5% or 27,735 acres</td>
<td><strong>crustose lichen</strong></td>
<td></td>
</tr>
<tr>
<td>6. Aquatic</td>
<td>throughout</td>
<td>2.0% or 22,188 acres</td>
<td></td>
<td><strong>horsetail, buttercup, sedge</strong></td>
</tr>
</tbody>
</table>
vegetation is still being destroyed. Reindeer wintering areas in the interior uplands continue to be overgrazed. On Twin Mountains, Bos found that the vegetative cover had been broken in many places by grazing reindeer, leaving numerous small patches of bare ground.

Muskox have also had their effect. The animals range over much of the island in the summer, but during the critical winter period their range is reduced to the windswept areas of the dunes, mountain ridges, and cliff edges. Nearly one half of the muskox forage in the dunes, where beach rye grass is the principal plant species. The dunes cover about 4,500 acres, but more than half of this area may become unavailable in the winter due to snow and ice. Degeneration of vegetation has been noted on both dune and cliff habitats.

The relationship between muskox, reindeer and their range on Nunivak is an unnatural one. Both species have been introduced to the island and are confined to it by the surrounding sea. This confinement results in a more critical limit to the island's carrying capacity since there is no emigration. Lack of predators on the island has resulted in regulation of populations primarily by food availability. This is an unstable situation, especially in the Arctic where plant associations are easily disrupted and slow to recover. The vegetation of the island has been altered by overuse, resulting in lowered carrying capacities. It can be expected that range overuse will
continue unless populations of reindeer and muskox are held at levels commensurate with available forage.

C. WATER

There are over 70 rivers and streams on Nunivak. These rivers vary in length from the approximately 30-mile-long Mekoryuk River to the four-mile-long Jayalik River. While every stream and creek has an Eskimo name, many remain unnamed on existing maps.

All the rivers on the island drain into the sea with most having their headwaters in the interior. For the most part, the streams are shallow, usually averaging less than two feet in depth. Few exceed a width of 50 feet at their widest point. Most have rock bottoms with the rocks varying in size from gravel to large boulders. All the major rivers and many of the streams with suitable gravel are used by spawning salmon and char. The rivers are not negotiable by boat for any great distance beyond the point where they enter the sea because of their shallow depth and presence of large rocks. Nearly all the rivers and streams have clear water.

Numerous small lakes and ponds dot Nunivak's landscape. Most of these are relatively shallow with the exception of the lakes in the volcanic cones. There is no information available on the depth of these crater lakes, but they appear to be quite deep. The lakes have not been adequately tested for fish life, but some are known
to contain populations of blackfish and sticklebacks. It is also possible that some may be used by young salmon to overwinter in, before going to sea. Little use is made of the lakes by the residents except as landing areas for float planes when putting out reindeer herders. Even this use is restricted since few of the lakes are large enough to be suitable.

Nunivak's bays and lagoons are host to a variety of birds, fish and marine mammals. The large eelgrass beds in the lagoons and bays on the south and east side of the island are an important source of food for ducks and geese. Kittiwakes and other sea birds utilize the dead eelgrass washed up along the beaches for nesting material. Duchikthluk Bay is the largest of the bays and is approximately six miles long and three miles wide. This bay has the largest concentrations of fish camps during the summer salmon run. Machagimiut to the west and Ikongimiut and Kewigimiut to the east are also occupied with fish camps. Nash Harbor, 'ilkisagimiut, Ahdingmiut, and Etolin Bay are also favored spots for seal hunters and fishermen.

D. MINERALS

With the exception of some very thin non-commercial coal beds, there are no known minerals of economic value on Nunivak and the discovery of commercial minerals on the island is unlikely. Because of its
volcanic nature, Nunivak Island does not appear to have petroleum possibilities (Ganopole, 1972).

The possibility of Tertiary coal-associated dry-gas-associated accumulations are present throughout the Yukon-Kuskokwim Basin and petroleum possibilities, although more remote, also exist. Petroleum source rocks might be present in underlying older sediments or in postulated marine facies of Tertiary age located in the coastal areas or offshore waters. This basin and the offshore waters are considered worthy of exploratory drilling. The most likely areas for initial effort are the coastal area of the Yukon Delta and between Kuskokwim Bay and Etolin Strait (Ganopole, 1972).
The Executive Orders 5095 and 5470 creating the Nunivak National Wildlife
Refuge specified that the purpose for the establishment was "...for the
use of the Department of Agriculture in conducting experiments in the
crossing and propagation of reindeer and native caribou, for contemplated
experiments in re-establishing the muskox as a Native animal of Alaska,
and also as a preserve and breeding ground for Native birds and wild
game and fur-bearing animals for carrying out the purposes of the Alaska
game law."

A. Reindeer
Reindeer provide a basis for the principal industry of Nunivak. Herding,
butchering, and the many other facets of reindeer management provide the
major source of employment and income, and a number of animals, usually 300
to 400 annually, are slaughtered for local use. Additionally, the herd is
of considerable importance to the residents of the adjacent Yukon Delta,
where reindeer from Nunivak provide the least expensive meat. The importance
of this source of protein can be placed in perspective by considering that
average income of Nunivak and other Delta residents is much below national
standards while retail prices are more than twice national price indices.

Under existing policies of the Bering Sea Reindeer Products, Inc., the
management of deer tends to be labor-intensive and to provide individual
benefits to stockholders, which include all village residents equally. Major
management decisions are made by corporations, although a committee of three residents of Nunivak, an additional knowledgeable Alaska resident, a representative of the State of Alaska, and the Juneau Area Director of the Bureau of Indian Affairs acts in an advisory capacity.

The interest of the Bureau of Sport Fisheries and Wildlife in the management program originates from several sources - the implied intent of the Executive Order establishing the Nunivak Refuge, a continuing responsibility for preserving the character of the island's fauna and flora, and, most recently, the contract transferring the herd from the government to the Native Corporation, which obligated the Bureau to assist and advise on censuses, range surveys, and the biological implications of alternatives in management. The Bureau responsibility is complicated by the fact that under the BIA, reindeer were managed without permit, memo of understanding or other formally recognized statement of responsibilities or channel of communications. This lack continued with the transfer of reindeer to the Native Corporation, and the Bureau is not represented on the advisory committee nor has a permit been issued for grazing of reindeer stipulating conditions under which grazing of deer may be permitted.

Reindeer are grazed on Nunivak in an almost feral state. This annual cycle of management presently includes the following:

1. Winter herding conducted with snowmachines to:
   a. Examine range conditions and to maintain deer on most favorable foraging areas.
   b. Provide evaluation of winter mortality.
c. Conduct slaughter, primarily for local use, but also for sale in mainland villages.

d. Take census, which includes classification by age and sex.

2. Summer herding is limited to corralling deer for slaughter. Herding is largely on foot, but herders must be distributed by aircraft, and aircraft are also used to assist herders in locating and driving deer.

3. Summer slaughter conducted in August or September includes:
   a. Corraling of deer as above. This usually requires several drives in order to corral the separate herds.
   b. Tally by age and sex of all animals corraled, and marking (ear tag) of fawns and castration of a prescribed proportion of male fawns.
   c. Butchering of selected animals.

Logistics is a primary problem in all phases of management, as the deer are extremely wild and the large island (40 x 70 miles) has no roads, is unfenced, and, in summer, areas suitable for aircraft landing are few and frequently inappropriately located. Herders may spend days or even weeks driving a herd to the corral only to have it stampeded and lost at the finish. For this and other economic reasons, management is increasingly oriented toward emphasis on winter operations where use of snowmachines vastly increases logistic capability of herders. Recently, increased marketability of reindeer in adjacent areas of the Yukon Delta and decreased necessity for ocean transport has also encouraged this trend. Herding and handling of deer will also be facilitated by the projected construction of a corral at Nash Harbor in the proximity of favorable summer
foraging areas for deer. This will reduce length of drives and consequent stress on deer.

The herd, presently between 4,000 and 5,000 animals, is believed to be lower than the carrying capacity. Although the herd has fluctuated widely, up to 20,000 or more animals, destruction of range and heavy mortality followed high populations and capacity is presently nearer 8,000 head and certainly not more than 10,000. With proper management, the size of the herd can be limited, but unusually severe winters will undoubtedly result in losses and the size of the herd will normally fluctuate below an optimum level. Maintaining the number of deer at or near the carrying capacity will maximize economic return from the herd while preventing degradation of the range.

B. Muskox

Muskox have been managed under a policy agreement between the Alaska Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife since 1962 (Appendix A). The primary objectives as stated in this agreement are:

1. To develop and maintain a nucleus herd for restocking and restoring muskox to their former range in Alaska, and for education, animal husbandry, and other requirements as may be determined by the Bureau and the State of Alaska.

2. To preserve a unit of environment and a stocking of muskox in the national interest as a representation of a rare species, formerly native to the United States.
This agreement recognized that the population could not increase indefi-
nitely, and stated that the population would be limited to 750 animals
unless a different stocking level was indicated by additional studies.
(Studies have subsequently indicated a population of 500 animals to be
near the maximum carrying capacity of the range.) The agreement further
stipulated that until the herd reached 500 animals, up to one-half of
the annual increment could be removed for re-stocking or scientific
purposes, and educational display. After the herd reached 500 head,
animals could be removed for purposes of domestication or by permit hunting.

Management activities to date have consisted of annual censuses, range
studies, transplants, and cooperative studies with graduate students from
the University of Alaska Wildlife Cooperative Unit.

Censuses: Summer aerial censuses of muskox have been conducted annually
on the island by the Bureau since 1947. The coverage of the island has
been in straight-line patterns, using prominent landmarks as guides. The
length of time required for the survey has varied from two to three days
to over a week, depending on weather. Although extended survey periods
may have resulted in duplication of counts, the surveys are probably
some of the most accurate of any game counts. This is due in part to
the skill of the pilot who has participated in all of the surveys since
1947, and in part to the open terrain which provides no concealment of
animals. The entire population is counted in the summer surveys and the
number of adult bulls and calves, which are the only age-clusters easily
recognized from the air, is recorded.
Starting in 1966, winter ground surveys were initiated and have been made annually with the exception of 1967 and 1969 when transplant operations interfered. In 1966, airplane-engine-powered, propeller-driven slowleds were used, but since then, all surveys have been made with more efficient snowmachines. Winter counts, usually made in March and April, provide accurate data on the sex and age composition of the herd as well as the general condition of the animals. Information from this census forms the basis for management recommendations.

**Range Studies:** Studies of range and snow conditions by the refuge staff are coordinated with annual winter censuses of muskox. Observations include measurements of snow depths and extent of ice layering along the census route, and locations and characteristics of areas in which muskox and reindeer are foraging.

**Transplants:** By 1964, the muskox population had approached a level where control was necessary. In 1964-65, a total of 33 animals was transferred to College, Alaska, for domestication experiments. In 1967 and 1968, an experimental transplant in cooperation with the Alaska Department of Fish and Game resulted in moving 23 animals to nearby Nelson Island. In a much larger operation in 1969, the refuge staff and state biologists transferred 52 animals to Barter Island and in 1970 85 animals were moved to three different locations on the mainland. In the 1970 transplant, 36 animals each were released on the Feather River near Nome and at Cape Thompson on the northwest coast and an additional 13 animals at Kavik near the Arctic Wildlife Range.
While transplants have been quite successful in removing 193 animals since 1964, they are also very expensive. All necessary materials and equipment, hay for captive animals, and finally, the animals themselves must be transported hundreds of miles to remote regions. As an example, the 1969 transplant cost approximately $47,000, or over $900 per head, for the 52 animals moved.

In addition, transplants have created a serious problem by producing a distorted sex ratio, due to the fact that muskox are polygamous and more females than males are required for establishing herds with a maximum productivity potential. Young animals are also selected since they are easier to catch and transport, as well as more gregarious than older animals. Thus, transplants have resulted in a surplus of old bulls on the island, which do not contribute to the productivity of the herd.

Research Studies: Nunivak provides an excellent opportunity to study game populations and their effects on range conditions in an insular situation. These studies are encouraged and guidance as well as assistance in the field is provided whenever possible. Since 1965, graduate students from the University of Alaska's Wildlife Cooperative Unit have utilized the refuge to obtain data for advanced degrees. To date, the following research studies have been undertaken:
Lent, P. G. A study of behavior and dispersal in introduced muskox populations.
Lent, P. G. and D. Knutson. Muskox and snow cover on Nunivak Island, Alaska.
Utermohle, G. and D. Caulkins. Behavioral and ecological study of the Nunivak Island muskox population.

In addition, the following research studies are currently being conducted by refuge personnel: Faunal Survey - WMS No. 1, to formalize recording procedures for information gathered on occurrence, distribution, and population of birds, mammals and fish encountered during the course of any activities on Nunivak; and WMS No. 2, to describe the winter ecology and behavior of muskox and reindeer with particular reference to the effect of snow cover characteristics on the use of winter range. The latter project is in cooperation with Dr. Peter Lent, Assistant Leader, Alaska Cooperative Wildlife Research Unit.

Resident fish and wildlife populations are managed through applications of regulations prescribed by the Alaska Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife.
Management and development as related to the major resources are as follows:

1. **Wildlife:** no habitat manipulation or artificial improvements are planned nor deemed necessary. Population and range surveys and muskox transplants are best accomplished by snowmachines, aircraft, and boats.

2. **Fish:** any surveys, management or research activities carried out by authorized officials would be conducted in a manner similar to those described under Wildlife, above. Aircraft, boat or snowmachine and ground travel on foot should provide adequate mobility to carry out objectives. It is unlikely that any stream rehabilitation is necessary or desirable in the water systems of the refuge.

3. **Water:** all drainages have their source within the refuge, and thus water rights will not be a problem. There are no known potential power sites on the refuge.

4. **Vegetation:** vegetation succession would be permitted to take its natural course. No artificial manipulation is planned to change the vegetation succession now present.

5. **Mineral and petroleum resources:** No known potential mineral or petroleum resources exist on the refuge.

6. **Visitor use:** The Nunivak National Wildlife Refuge, unlike many other refuges, is not besieged with visitors. It is estimated that since 1962, when the Refuge Headquarters was established in Bethel, fewer
than two dozen people have visited the island for the sole purpose of recreation. Of those that have, most have been either walrus hunters or photographers, with many of them professionals on assignment. In addition to these, there are a number of state and federal personnel who come to Mekoryuk on business, but who may taken an occasional boat or snowmachine trip out of the village to see wildlife, visit fish camps, etc.

There are a number of reasons for the lack of visitors, i.e., remoteness, cost of transportation, limited public facilities, frequency of inclement weather, and lack of publicity. These deterrents will probably continue to discourage most visitors, but as other areas become more saturated, the more adventurous, hardy and affluent will seek out new "unspoiled" areas like Nunivak.

Because of the extremely limited visitor use on the Refuge, it has not been necessary to impose restrictions other than those normally in effect on a national wildlife refuge. In fact, visitor use, if anything, has been encouraged. All serious queries are answered in great detail, occasionally going so far as arranging charters and lodging, recommending guides, supplying equipment, etc.

If in the future, visitor use increases, it may become necessary to impose some restrictions in order to protect the resources. It also may become necessary to provide some facilities for the safety of the visitor.

The BSFW National Planning Team, after making their study in 1971, noted the problems limiting extensive public use of the western Alaska refuges and
made the following recommendations:

a. Channel interpretive efforts into publications and films to reach persons who will never visit these refuges, emphasizing relationship of the Eskimos to the wildlife and their natural surroundings.

b. On a smaller scale prepare information brochures to aid those who do plan trips to the refuge. In addition place rotating exhibits highlighting selected features in airport lobbies and in the Bethel Headquarters.

c. Long-range efforts to encourage Alaska-based airlines to conduct special birding, sightseeing or outdoor-recreation-oriented tours. If tours become a reality the Bureau should be prepared to provide on-site interpretive support.

7. Scientific Studies: The Nunivak WNR, because of its insular situation, unusual fauna, geological formation, Eskimo history, etc. will attract scientists from a variety of disciplines. In the past researchers in the field of wildlife and range management, ornithology, geology, archaeology and anthropology have conducted studies on the island and it can be assumed that this type of use will continue.

The policy is to encourage scientific studies and to offer assistance whenever possible. At the same time it will be necessary to require that any studies be conducted in such a manner which insures the least amount of disturbance to the environment.

C. Developments

Other than the developments at Mekoryuk village, one shelter cabin has been built at Duchikthluk Bay and another will be built this winter or next spring at Mikisagamiut. Additional shelter cabins are planned for the
south side at either Dahloogamiut or Chakwakamiut and on the east coast around Twin Mountain. Currently it is not possible to reach shelter at the end of each day during the winter muskox census, necessitating camping in snow caves. The additional cabins would not only increase efficiency, but would make the winter census a safer operation, as storms are common during this time of year. The cabins would also be available to researchers working on the island in either winter or summer, and possibly to visitors by arrangement.

Other structures on the refuge include a marine beacon on Cape Mohican, a deserted Coast Guard cabin near Dooksook Lagoon, three frame buildings at Nash Harbor and a reindeer herder's cabin near the center of the island. Existing and proposed developments for Nunivak are illustrated in Figure 6.

The Alaska State Highway Department Planning Commission envisions a surface transportation corridor on Nunivak as necessary to serve population centers at a future date as resources allow. The proposed road would generally circle the island and connect Mekoryuk with Nash Harbor, the west coast, and Cape Mendenhall. The letter containing these comments is attached (Appendix D).
Figure 6. Developments on the Nunivak Wildlife Refuge.

1. Mekoryuk village, Muskox corral & barn
2. Airstrip
3. Old Buildings
4. Reindeer corral
5. Shelter cabin
6. Navigation Aid
7. Shelter cabin
8. Shelter cabin
9. Shelter cabin
10. Reindeer herd

Existing
Proposed

NUNIVAK ISLAND NATIONAL WILDLIFE REFUGE
SEWARD MERIDIAN

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF SPORTS CONSERVATION AND WILDLIFE
CHAPTER VII
SOCIO-ECONOMIC CONSIDERATIONS

The inhabitants of Nunivak are descendants of Eskimos who have lived on the island for 2,000 years or more. The fact that the island was made a refuge in 1929, without the residents' knowledge, has not deterred the feeling that the entire island and its resources are theirs, and they have continued to use it as such, refuge notwithstanding. Settlement of the Land Claims may establish legal boundaries, but it remains to be seen if attitudes will change.

The residents of Nunivak have availed themselves of over-snow vehicles almost from their inception in the north. When propeller-driven airsleds were introduced approximately 20 years ago, the people adopted this method of transportation and forsook their dogteams. After 1965, the snowmachine rapidly replaced the airsled and virtually every family now has at least one snowmachine. This vehicle is now the sole means of transportation for approximately seven months of the year.

These machines are used in hunting, fishing, trapping, and other subsistence activities. They are used by the reindeer project for herding and harvesting reindeer and by the Bureau on snow- and winter-range surveys, muskox censuses and in capturing muskox for transplanting. In addition, snowmachines are used by the residents for recreation. As the island is essentially roadless, this is the only means they have of getting around the island in the winter. Virtually all of the island receives some snowmachine use, although routes between primary hunting or fishing areas are of major importance.
During the period of open water, outboard-motor-driven boats are used for transportation to and from fishing and seal hunting camps and berry picking areas. Considerable use is also made of boats for pure recreation. As this use is well-established, there would be no conflict with the wilderness concept. Likewise the use of aircraft in reindeer herding or for surveys and censuses by the Bureau would not be in conflict. The aircraft use is primarily restricted to a few of the larger lakes, bays, and lagoons by float planes and the sand beaches by wheel planes.

In contemplating a wilderness designation the socio-economic impact on the following aspects should be considered from the standpoint of the residents, nonresidents and refuge management.

A. Recreation

It is very difficult to separate recreational use of wildlife from subsistence use of wildlife by the residents. To say that these people do not obtain enjoyment in catching a fish or in hunting waterfowl, ptarmigan or seal would be ridiculous. However, these activities are directed more towards the purpose of obtaining food than for the "refreshment of strength or spirit". For that reason wildlife use by residents will be discussed in more detail under the heading of subsistence. The residents do enjoy watching wildlife and are keen observers. The knowledge of wildlife habits gleaned through hours of observation is helpful in the harvest of the animals, but at the same time it does provide entertainment. The fact that the village of Mekoryuk contains a number of bird houses indicates that the people enjoy having wildlife around. The impact that a wilderness classification will have on wildlife-oriented recreation of the residents can only be detrimental if the people are not allowed to travel by snowmachine to
where the wildlife is.

Nunivak offers a great potential for wildlife-oriented recreation to the nonresident and it is just a matter of time before the public becomes aware of the possibilities. For the most part, visitors will come to the island only in the summer. By hiring a resident guide with a boat for getting around the island, the visitor would be able to see and photograph vast seabird colonies, herds of reindeer, muskox and Native fish camps. In addition, the visitor could receive considerable enjoyment just beachcombing along the many miles of beautiful sand beaches. It is doubtful that visitors would be attracted to the refuge solely for the purpose of fishing, waterfowl or ptarmigan hunting in spite of the excellent existing opportunities. This type of recreation is more easily obtained in other areas of Alaska. However, persons coming primarily for other reasons may well avail themselves of these sports. There is also a potential for winter snowmachine trips to see reindeer and muskox.

A wilderness classification would have no effect or perhaps might enhance the wildlife-oriented recreational use by visitors in the summer, but could be a critical deterrent to winter visitors.

B. Economic

1. Subsistence and Commercial Use of Wildlife: Prior to World War II the residents relied almost exclusively on the island's wildlife resources for their subsistence. Miller, who conducted a range survey on the island in 1929 had the following to say about the Native subsistence economy: "These Natives are people of the sea. They live on the beaches and travel about
the shores in kayaks. Their fuel consists of beachwood which is very scarce about the island or of dried sphagnum moss pressed and dipped in seal oil. They catch and dry tomcods, herring, salmon trout, and salmon during the periods of their respective runs, and in the proper seasons they hunt seal ugruks and walruses. At times when walruses and seals are not obtainable they hunt waterfowl and occasionally get ptarmigans for their fresh meats".

The need of wildlife for subsistence has decreased from its former importance, but is still required as many Natives are unable to secure a cash income great enough to replace entirely the use of wildlife for food and clothing. Approximately only 20-25 persons in Mekoryuk have full-time employment with up to 16 additional people being employed part-time by the Reindeer Project. Even with the advent of food stamps, which has greatly increased their buying power, the annual income of the Natives is still not sufficient. (Average annual per capita income for the Kuskokwim Area in 1965 was $585.00. Alaska Review of Business and Economic Conditions, 1969, Volume VI, No. 3). For those who can afford white man's food, there is still a philosophy of "living off the land" coupled with the fact the taste of traditional foods is frequently preferred.

Fish are by far the most preferred food item in the subsistence diet, with salmon being the most important. In 1965 the average salmon catch per family was 450 fish. Based on this figure it is estimated that between 10,000 and 20,000 salmon are taken annually by the island's 40 families.

Other fish species utilized include tomcod, herring, Dolly Varden, flounder, and halibut. With the exception of a pilot halibut fishery at Mekoryuk
in 1966 all the fish caught are for personal use rather than for commercial purposes. The 1966 experimental halibut fishery produced a catch of 8,799 pounds and a gross sale of $2,265. This project was operated on a BIA grant and utilized BIA freezer and other facilities at Mekoryuk for little or no cost to the project. With a minimal overhead the project provided an average gross income of $175 for ten fishermen who fished an average of 6.2 days. Due primarily to a lack of interest of the fishermen along with marketing and transportation problems as well as reduced profits if the full overhead costs were assumed, the fishery was not continued.

Seals are the second most important wildlife resource used. Accurate records do not exist for the number of seals taken annually; however, a State report of fur buyers in 1966 indicates that 432 seal skins were purchased from Mekoryuk that year. This figure probably represents no more than half of the total take, since a number of skins are retained for use in clothing and many seals are taken when the skins are not prime and so are not sold.

Seal hunting goes on year-round, but most effort is expended in the spring when the seals are migrating northward through leads in the sea ice. Seal camps are established at this time on points of land where leads are known to occur most frequently. These camps may be a considerable distance from the village, such as the favored sites at Cape Mendenhall and Nash Harbor. Snowmachines are used to haul boats and camp gear to these sites where the hunters may stay for a few days to a week or more. Some hunters leave their boats near Mekoryuk and travel daily by snowmachine between their camp and Mekoryuk. A few walrus are harvested each year
when weather and ice conditions permit. Most of the animals taken are
used for food and the ivory for carving. One or two of the men offered
guided hunts for walrus but this business is now illegal under terms of
the Marine Mammal Protection Act.

Trapping currently does not approach its former importance. This is
due to several factors, namely, low fur prices and winter employment in
construction projects on the island during the past few years. Trapping
is primarily for white fox, although a few red fox and mink are taken. In
1966, when the trapping effort was higher than at present, 179 white fox
pelts were shipped from the island. White fox skins shipped in 1965
totaled 172. In 1966, the top trapper sold 44 white fox skins, for which
he received between seven and eight hundred dollars. For the past ten
years snowmachines have been used by trappers to run their traplines and
before that, air sleds were used.

Other items important in the subsistence diet include waterfowl, seabird
eggs, clams and berries.

The impact of a wilderness classification on the subsistence harvest of
wildlife may be detrimental to the people of Nunivak. If snowmachine
use is banned on the island, it could eliminate trapping and severely
hamper seal harvest.

2. Reindeer Industry: Since 1945, the Nunivak Island herd has been the
largest source of commercially-sold reindeer meat in Alaska. Except for
1948-49, when the Nunivak slaughtering plant was closed, approximately
one-half of the total amount of reindeer meat produced for annual sale comes from Nunivak.

The Bureau of Indian Affairs was responsible for the management of the herd from 1939 to 1970. In 1945 the BIA built a slaughtering plant at Mekoryuk. Until 1956 reindeer meat from Nunivak was used to supply Alaskan Native Service facilities. All meat up until that time had been shipped from the island via the BIA vessel NORTH STAR. In 1956 the ship discontinued stops at Seward and Sitka, which were major off-loading ports for several ANS schools and hospitals. In the same year the BIA initiated an agreement with the Alaska Department of Agriculture for inspection of Nunivak meat and increased sales to other retail markets.

During the period of BIA operation, the Nunivak reindeer industry was based on a make-work basis. This philosophy served its purpose of providing an economic base for the village of Mekoryuk, but resulted in a high-cost operation. During the period between 1963 and 1968 the labor costs averaged around $20/100 pounds of dressed meat compared to $1.50/100 pounds in meat-packing operations in other states. However, during the 1967 season the operation paid about $46,000 in wages to the Eskimo residents. As a result the island's people are far better off economically than people in other Delta villages. In addition to the sale of reindeer meat the industry obtains other revenue through the sale of skins and antlers. The latter are purchased for use as aphrodisiacs in the Orient.

The villagers also take about 300 deer a year for use of their own. This venison is the primary source of red meat. The skins are also used in the manufacture of clothing both for the resident and for sale to others.
In April 1970 title to the reindeer herd was turned over to the village of Mekoryuk and a Nunivak Island Reindeer Committee was established to provide technical guidance and consulting services in the management of the herd. At the time of the transfer a contract was prepared which contained the following points:

a. The herd is to be repaid to the U. S. Government beginning in 1973. The repayment is to be in kind, with not less than 1/15 of the population of the herd at the time of transfer being repaid in any one year, provided that at no time will repayment exceed 1/10 of the current population. The Government reserves the right to accept a smaller quantity in any one year.

b. Deer accepted for repayment will be for the purpose of establishing new Native-owned herds elsewhere in Alaska and for research and demonstration purposes. If there is no demand for new herds, animals can be accepted only for research and demonstration purposes.

c. All facilities are to remain the property of the BIA but made available to the village corporation by permit. These facilities are to be rehabilitated. If the program is considered successful by the Government, the property will be conveyed to the village no later than June 30, 1975.

d. Starting in fiscal year 1970 the Government will provide a fund of $160,000 for operations. For the next four years, $40,000 annually will be provided for education, training or agricultural assistance based on need.

e. The Bureau of Sport Fisheries and Wildlife is charged with making a range survey and report on conditions, carrying capacity of the range and
recommendations on improved range management practices required.

On transfer of the herd to the village corporation, the contract provided for an advisory committee of representatives from the village, the State of Alaska, and the BIA. Bureau representatives were not included, although the island is a refuge, the range is a Bureau responsibility, and Bureau files include more information on the herd's history and relation to the range than any other agency. No provision was made permitting the Bureau to restrict the size of the herd in range management, nor was any suggestion made that grazing fees might be appropriate, since they are required on all refuges and public lands in other states.

The most notable problems experienced by the village corporation in assuming management responsibility of the herd are deteriorating range conditions resulting in lower productivity, and increased mortality which has reduced the herd to approximately 4,000 head. Progress is being made, however. Management plans by the Bering Sea Reindeer Products Corporation include winter herding, culling of undesirable animals and construction of handling corrals around the island.

The reindeer industry would suffer greatly with a wilderness classification, since all winter herding, censusing, range surveys and harvesting are accomplished with snowmachines. The deer range throughout the island, with the exception of the higher interior mountains and nearly the entire island would have to be covered with snowmachines in order to manage the herd.

3. Muskox Hunting: As previously discussed, the muskox herd contains a surplus of adult males (214 males; 121 females - April 1972), due primarily
to a higher winter mortality of young and female animals. These excess bulls are a detriment to the herd as they consume forage required by more productive animals. Preservation of these animals has resulted in an unbalanced sex ratio and concomitant reduction in calf production. The bulls which are obviously surplus should be removed to assure the welfare of the island's muskox population.

Traditionally surplus wild animals have been removed from state- and federally-managed lands by reduction programs conducted or supervised by agency or general hunting seasons. A cropping program by Bureau personnel would be economically wasteful of a valuable resource and, judging from public reaction, a hunting season would be distasteful to some people.

Much of the unfavorable reaction to public hunting was generated by persons under the belief that muskox hunting is not "sporting." This is based on the highly-publicized habit of muskox forming a defense ring and standing to face their attackers. This is true only when the animals are cornered and all escape routes blocked. On Nunivak it has been observed repeatedly by refuge personnel that the animals will take flight at the first sign of danger. On the open tundra, where there is little cover for concealment, stalking a herd on foot or skis should prove very challenging. Furthermore, hunting on a wildlife refuge is very carefully regulated and supervised. For instance, aircraft may be completely banned and the use of snowmachines (which will be necessary) may be restricted to prescribed routes.

Economic benefits to the State from muskox hunting may be significant. These benefits would be particularly important to the residents of Nunivak who have only a limited means of gainful employment during the winter. Possible
monetary returns on the cropping of 40 trophy class bulls annually by resident and nonresident hunters are as follows:

<table>
<thead>
<tr>
<th>Return per Animal</th>
<th>Non-resident Hunters</th>
<th>Resident Hunters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licenses &amp; Trophy Fees</td>
<td>$1,000</td>
<td>$500</td>
</tr>
<tr>
<td>Hotel &amp; Restaurant, Anchorage &amp; Bethel</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>Air Fares, Anchorage to Nunivak and Return</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>Eskimo Guide on Nunivak</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Meals &amp; Lodging on Nunivak</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>Purchase of Eskimo Arts &amp; Crafts</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Taxidermy Costs</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Misc. Expenses &amp; Purchases</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Registered Guide</td>
<td>500</td>
<td>none</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,905</strong></td>
<td><strong>1,805</strong></td>
</tr>
<tr>
<td><strong>Total x 40 Bulls</strong></td>
<td><strong>$116,200</strong></td>
<td><strong>$72,200</strong></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>$188,400</strong></td>
</tr>
</tbody>
</table>

4. Tourism: As previously noted Nunivak has much to offer a visitor or photographer, but at the present time, few tourists have been attracted to Nunivak Island. However, publicity generated by a muskox hunt or promotion by the state, tour agencies, or airlines could result in an ever-increasing number of tourists and wildlife photographers. The airline serving Nunivak has proposed scheduling tours to the island. These tours would be primarily for the purpose of giving visitors an opportunity to see Eskimo life, reindeer
roundups and purchase arts and crafts. There is a possibility that these tours will include an overflight of the island to permit observation of muskox and reindeer herds. It is conceivable that if this tour is initiated, some visitors or their friends may wish to come back to spend time on the island. If the island receives wilderness classification, the resultant publicity may also attract visitors.

Currently the Bureau has no facility on the island to inform the visitor that the island is a national wildlife refuge or to acquaint them with the island's wildlife resources or Bureau goals. Considering the island's potential for attracting visitors, some facility should be constructed in the very near future.

5. Trends

a. Human population: Shortly before the turn of the century approximately 700 people inhabited Nunivak and lived in scattered villages around the island (Table 6). The population, after reaching a low of around 150 in the 1950's, increased steadily until the mid-60's when it reached a high of over 300. At that time, a low-cost housing project was started in Bethel which offered employment and on-the-job training. About 10 families moved to Bethel to take advantage of this opportunity, resulting in a loss of approximately 50 people. Some of these returned to Nunivak while others became residents of Bethel. Prior to this time, emigration off the island was smaller than the birthrate, but this is no longer true. This situation is generally true for most Delta villages where more and more people are moving to where they can find employment. Nunivak has a better economy than most villages in the area, so their loss may not be as great.
### Table 6. Location and Population of Villages on Nunivak Island in 1890.

<table>
<thead>
<tr>
<th>Village (1890)</th>
<th>Present Name or Location</th>
<th>Population (1890)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwigamiut</td>
<td>south of Cape Corwin</td>
<td>43</td>
</tr>
<tr>
<td>Koot</td>
<td>near Mekoryuk</td>
<td>117</td>
</tr>
<tr>
<td>Ingreamiut</td>
<td>Ingrimiut near Twin Mountains</td>
<td>35</td>
</tr>
<tr>
<td>Chuligimiut</td>
<td>between Ingrimiut &amp; Cape Etolin</td>
<td>32</td>
</tr>
<tr>
<td>Upper Chuligimiut</td>
<td>&quot;</td>
<td>30</td>
</tr>
<tr>
<td>Kahmiut</td>
<td>Ahikitook</td>
<td>40</td>
</tr>
<tr>
<td>Kinegnamiut</td>
<td>near Cape Mohican</td>
<td>76</td>
</tr>
<tr>
<td>Tunaghamiut</td>
<td>between Cape Mohican &amp; Cape Mendenhall</td>
<td>71</td>
</tr>
<tr>
<td>Kanagmiut</td>
<td>&quot;</td>
<td>41, 485</td>
</tr>
</tbody>
</table>

Total estimated population 700
However, it is doubtful if the island population will grow and it is more likely that it will decrease.

b. Economy: A cash economy is rapidly replacing the old subsistence way of life. It is doubtful, however, that it will ever completely supplant it for reasons previously stated. While less demand will be placed on the wildlife resources to provide food and clothing, the harvest may not decline at the same rate due to increased efficiency and ease provided by modern equipment, i.e., snowmachines, aircraft, outboard motors, and fishing gear. This equipment will require more cash and thus more hours on the job and less time in pursuit of wildlife.

With proper management and a little bit of luck the reindeer industry can continue to be a viable source of income. Previous methods of operations such as providing employment to anyone wanting to work will have to be discontinued in order to increase efficiency and reduce labor costs. In other words, the project will have to be conducted as a business rather than as a welfare project.

In some years muskox have been a major source of income to the island's residents. In the 1969 transplant, $9,000 was paid to Eskimo assistants. In addition to transplants, there is a good potential for the residents to earn money guiding and, indirectly, by providing food and lodging to hunters and photographers. Another source of income is through the gathering of muskox wool (qiviut) which is either sold raw or spun and knitted into a finished product. This cottage industry started about 5 years
ago and has continued to be a source of income with demand exceeding
supply.

Trapping is not currently an important source of income, but may be
from time to time, depending on the vagaries of the fur market. This
situation was also true of the sale of seal skins, which has now been
restricted by the Marine Mammal Protection Act. This Act, which provides
that hunting, killing, tanning or otherwise processing seal hides may
be performed only by Natives, has curtailed what market did exist. It
is possible that the Act may be amended to broaden legal activities.
However, in the case of Nunivak, seals are probably hunted as much for
food as for the monetary reward through the sale of skins. Hunting for
food is allowed by the Act to Natives.

c. Public Use: It can be expected that public use will increase as
more people become aware of Nunivak's unique qualities. Nunivak can
expect to attract several types of visitors. Tourists will come to see
the Eskimo way of life, reindeer roundups, to purchase arts and crafts,
and just to go somewhere different. People interested in wildlife,
including students, range managers, photographers, etc., will be
attracted by the island's variety of wildlife. The island's interesting
geological formation will attract geologists, and archaeologists and
anthropologists will be interested in the people and past cultures.
CHAPTER VIII
CONCLUSIONS

The 3.6-million-acre Nunivak National Wildlife Refuge constitutes a unique island ecosystem with many scientific, educational, recreational, aesthetic, and cultural values. It is the largest island refuge and second largest refuge in the National Wildlife Refuge System, and in most respects is a de facto wilderness. Because of remoteness and adverse weather conditions, it is seldom visited, although there is considerable potential for greater public use and enjoyment.

Current management is directed primarily at maintaining populations of muskox and reindeer at levels of maximum sustained yield, protecting the habitats of sea birds and other native wildlife, and assuring that the subsistence and recreational hunting and fishing rights of island Natives are honored in accordance with applicable state and federal regulations.

There are approximately 249 permanent residents on the island living in the village of Mekoryuk on the northeast coast. Most are Eskimos who, despite the white man's laws, consider Nunivak Island as belonging to them because of their occupancy since aboriginal times. They use much of the island and its adjacent marine waters for subsistence and recreational purposes and rely almost entirely on motorboats in the summer and snowmachines in winter for transportation. Snowmachines are also used in connection with reindeer herding as well as by refuge officials for conducting surveys and censuses.
The Native village of Mekoryuk, once a village corporation is formed under terms of the Alaska Native Claims Settlement Act of 1971, is entitled to select the equivalent of not more than 3 townships (69,120 acres) of surface estate within a block of 25 townships contiguous to their village. The Secretary of the Interior is also authorized to withdraw and convey to the appropriate Native Regional Corporation fee title to existing cemetery and historical sites. Upon application, the Secretary may also convey surface estate not to exceed 160 acres of land occupied by a Native as a primary place of residence on August 31, 1971.

Although the Alaska Native Claims Settlement Act of 1971 extinguished any existing inland and offshore aboriginal hunting and fishing rights, it is anticipated that island Natives will be slow to accept this as fact. Rather, they will no doubt continue their traditional subsistence hunting, fishing, and trapping activities, both on their own lands, once these are patented, and on the refuge, as much as they are doing at present and have done in the past.

Nunivak National Wildlife Refuge is currently managed by a two-man staff located at Bethel, 145 miles distant on the mainland. These two are responsible for 6 refuges in the western Alaska area, totaling about 6.8 million acres. The refuge program on all 6 areas is most immediately concerned with preservation and enhancement of their wildlife resources for maximum sustained benefit to people. The refuge managers seldom have the opportunity to visit Nunivak because of inadequate staffing and budgeting.
Although it has been determined by the Interior Department Solicitor that the Bureau has jurisdiction over all the tidelands within the refuge boundary, said boundary has never been precisely described. At the time of refuge establishment, it was identified merely by drawing a circle around Nunivak Island. In some instances, the boundary even extends beyond the 12-mile territorial limit. Until a legal determination and description of a true and accurate boundary is made, establishment of a wilderness boundary that includes the open sea would appear to be tenuous at best.

Additional complications to wilderness designation include the Soviet loading zone for commercial fishermen located within the refuge offshore waters. Little is known of Soviet use of this loading zone. Although there is only a 4-mile stretch of road on Nunivak now, the Alaska Department of Highways envisions the need for a road corridor around the entire island, which would further complicate wilderness designation.

The provision in Executive Order 5095 that "...the establishment of this reservation shall not interfere with the use of the island for lighthouse, military, or naval purposes..." would also appear to conflict with protection of the island's wilderness qualities. This stipulation clearly provides for military use of the refuge when deemed necessary.

Because of these aforementioned conflicts, it is proposed that the Nunivak National Wildlife Refuge not be designated a wilderness area in the National Wilderness Preservation System. The most serious conflict appears
to be between wilderness management and protection, and the use of snowmachines as the established means of transportation, for management of reindeer and muskox, subsistence hunting and fishing, and other social requirements of Nunivak's residents.

The following have been explored and should be considered as alternatives to the proposal.

Alternative 1. Propose the entire refuge for wilderness, except those lands eventually selected by the Natives under ANCSA, with the provision that the use of snowmachines will be allowed to continue. Use of snowmachines may be inconsistent with wilderness; however, they are an established means of winter transportation on the island. No other people other than Nunivak residents use the area during the winter months. This alternative will allow a time-and-use zoning of snowmachines and still provide wilderness protection to the refuge, yet will not cause a hardship on the residents who depend on such vehicles for subsistence activities.

Alternative 2. Propose the entire refuge for wilderness except those lands eventually selected by the Natives under ANCSA and prohibit the use of snowmachines. This alternative would provide a wilderness area free from any winter off-road vehicles, but would cause a severe hardship to the residents of Nunivak, since such vehicles are an established means of transportation and vital to their subsistence activities.
Alternative 3. Propose only the submerged lands, offshore rocks and islets and exclude the main island because of existing uses. This alternative would provide added protection to the important estuaries but would not include the entire island ecosystem. However, there would be little conflict with the current subsistence and recreational hunting and fishing by the local Natives with their snowmachines during winter months.

Alternative 4. Propose the submerged lands, offshore rocks, islets and those areas on the main island which are uniquely different from the rest of the island. These unique features would include the sand dunes on the south side near Duchikthluk Bay, the crater lake area surrounding Mount Roberts and the bird cliffs from Mikisagimiut to Dooksook Lagoon (Figure 7). This alternative would provide wilderness protection to only a portion of the refuge, with little effect on Native activities.

The sand dunes are the major wintering area for muskox. The bird cliffs support one of the larger bird rookeries in Alaska and also is a major muskox winter use area. The crater lake area would give added protection to the most unique portion of the islands unusual crater feature. This proposal would allow snowmachine use of most of the Natives traditional hunting and fishing areas on the island.
Figure 7. Locations of unique features outlined in Alternative Four.
Executive Order

NUNIVAK ISLAND RESERVATION
ALASKA

It is hereby ordered that Nunivak Island, west of Etolin Strait, off the coast of Alaska, located approximately in latitude 60° north, longitude 166° west from Greenwich, in Bering Sea, and located within the area segregated by the broken line upon the diagram hereto attached and made a part of this order, be and the same is hereby reserved, from settlement, location, sale, or entry, and from classification and lease under the provisions of the Act approved March 4, 1927 (44 Stat. 1432), entitled "An Act to provide for the protection, development, and utilization of public lands in Alaska by establishing an adequate system of grazing livestock thereon," and set apart for the use of the Department of Agriculture in conducting experiments in the crossing and propagation of reindeer and native caribou, for contemplated experiments in reestablishing the musk ox as a native animal of Alaska, and also as a preserve and breeding ground for native birds and wild game and fur-bearing animals for carrying out the purposes of the Alaska game law of January 13, 1925 (43 Stat. 730, U. S. C., Title 48).

The establishment of this reservation shall not interfere with the use of the island for lighthouse, military, or naval purposes, or with the construction of school houses, buildings, or other improvements by the Bureau of Education on Nunivak Island.

It is unlawful within this reservation (a) willfully to set on fire or cause to be set on fire any timber, underbrush, or grass; (b) willfully to leave or suffer fire to burn unattended near any timber or other inflammable material; (c) after building a fire in or near any forest, timber, or other inflammable material to leave it without totally extinguishing it; (d) to hunt, trap, capture, willfully disturb or kill any wild birds or take or destroy the nests or eggs of any wild birds, or willfully disturb or kill any game or fur-bearing animal, or any animal that may be introduced except under such regulations as hereafter may be prescribed by the Secretary of Agriculture and then only in accordance with the Alaska game law and regulations thereof with respect to wild birds and game and fur-bearing animals.

Warning is hereby expressly given to all persons not to commit any of the acts herein enumerated under the penalties prescribed by Sections 52, 53, and 84, as amended April 15, 1924, of the United States Penal Code, and the Alaska game law of January 13, 1925 (43 Stat. 730), or any other law applicable to the Territory of Alaska.

HERBERT HOOVER

THE WHITE HOUSE,
NUNIVAK ISLAND RESERVATION

ALASKA

Segregated by broken line and designated "Nunivak Island Reservation"

NUNIVAK ISLAND

RESERVATION

BERING SEA

DEPARTMENT OF THE INTERIOR
Ray Lyman Wilbur, Secretary
GENERAL LAND OFFICE
William Spry, Commissioner
EXECUTIVE ORDER

RESERVATION OF LANDS IN NATIVE VILLAGES FOR EDUCATIONAL PURPOSES

ALASKA

It is hereby ordered that pending survey and segregation by the General Land Office, tracts of land in the following described places in Alaska, upon which the Office of Education has erected school buildings, not to exceed forty (40) acres in each place, be, and they are hereby, reserved and set apart for the use of the Office of Education, subject to any valid claims thereto existing at the date of this order, viz:

<table>
<thead>
<tr>
<th>Place</th>
<th>Near Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akutan</td>
<td>54° 17'</td>
<td>165° 35'</td>
</tr>
<tr>
<td>Atka</td>
<td>58° 20'</td>
<td>174° 15'</td>
</tr>
<tr>
<td>Beaver</td>
<td>66° 29'</td>
<td>146° 55'</td>
</tr>
<tr>
<td>Belkofski</td>
<td>55° 10'</td>
<td>162° 5'</td>
</tr>
<tr>
<td>Buckland</td>
<td>68° 5'</td>
<td>161° 5'</td>
</tr>
<tr>
<td>Chanega</td>
<td>60° 45'</td>
<td>148° 5'</td>
</tr>
<tr>
<td>Diomede</td>
<td>65° 40'</td>
<td>169° 0'</td>
</tr>
<tr>
<td>Eek</td>
<td>60° 5'</td>
<td>162° 10'</td>
</tr>
<tr>
<td>Egegik</td>
<td>58° 55'</td>
<td>157° 30'</td>
</tr>
<tr>
<td>Galena</td>
<td>64° 50'</td>
<td>155° 5'</td>
</tr>
<tr>
<td>Goodnews Bay</td>
<td>59° 10'</td>
<td>161° 30'</td>
</tr>
<tr>
<td>Hamilton</td>
<td>62° 45'</td>
<td>159° 0'</td>
</tr>
<tr>
<td>Hooper Bay</td>
<td>61° 35'</td>
<td>165° 40'</td>
</tr>
<tr>
<td>Kaltag</td>
<td>61° 20'</td>
<td>158° 50'</td>
</tr>
<tr>
<td>Kulukak</td>
<td>57° 50'</td>
<td>159° 45'</td>
</tr>
<tr>
<td>Kuk Designed</td>
<td>57° 35'</td>
<td>156° 10'</td>
</tr>
<tr>
<td>Kasiluk</td>
<td>57° 30'</td>
<td>154° 30'</td>
</tr>
<tr>
<td>Kashegga</td>
<td>53° 25'</td>
<td>167° 0'</td>
</tr>
<tr>
<td>King Island</td>
<td>61° 58'</td>
<td>161° 1'</td>
</tr>
<tr>
<td>Kokrines</td>
<td>61° 55'</td>
<td>154° 50'</td>
</tr>
<tr>
<td>Kotlik</td>
<td>61° 0'</td>
<td>165° 20'</td>
</tr>
<tr>
<td>Koyuk</td>
<td>64° 50'</td>
<td>161° 30'</td>
</tr>
<tr>
<td>Koyukuk</td>
<td>65° 0'</td>
<td>157° 35'</td>
</tr>
<tr>
<td>Noatak</td>
<td>67° 40'</td>
<td>165° 0'</td>
</tr>
<tr>
<td>Nunivak</td>
<td>60° 40'</td>
<td>165° 40'</td>
</tr>
<tr>
<td>Old Harbor</td>
<td>57° 10'</td>
<td>152° 50'</td>
</tr>
<tr>
<td>Perry</td>
<td>55° 55'</td>
<td>159° 20'</td>
</tr>
<tr>
<td>Pilot Station</td>
<td>61° 55'</td>
<td>162° 55'</td>
</tr>
<tr>
<td>Quillingok</td>
<td>61° 45'</td>
<td>165° 0'</td>
</tr>
<tr>
<td>Quithlock</td>
<td>61° 10'</td>
<td>162° 5'</td>
</tr>
<tr>
<td>Selawik</td>
<td>66° 5'</td>
<td>163° 20'</td>
</tr>
<tr>
<td>Shagelik</td>
<td>62° 35'</td>
<td>159° 40'</td>
</tr>
<tr>
<td>Shaktoolik</td>
<td>61° 20'</td>
<td>161° 0'</td>
</tr>
<tr>
<td>Shungnak</td>
<td>66° 55'</td>
<td>156° 55'</td>
</tr>
<tr>
<td>Sleetmate</td>
<td>61° 40'</td>
<td>157° 10'</td>
</tr>
<tr>
<td>Stebbins</td>
<td>63° 30'</td>
<td>162° 25'</td>
</tr>
</tbody>
</table>

THIS IS A TRUE COPY OF THE ORIGINAL
<table>
<thead>
<tr>
<th>Place</th>
<th>Near Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetlin</td>
<td>63° 10'</td>
<td>143° 0'</td>
</tr>
<tr>
<td>Togiak</td>
<td>58° 50'</td>
<td>160° 20'</td>
</tr>
<tr>
<td>Tundra</td>
<td>60° 50'</td>
<td>162° 30'</td>
</tr>
<tr>
<td>Umnak</td>
<td>53° 25'</td>
<td>168° 10'</td>
</tr>
</tbody>
</table>

This order shall continue in full force and effect unless and until revoked by the President or by act of Congress.

HERBERT HOOVER

The White House,
March 4, 1930.
Executive Order

Nunivak Island Reservation Enlarged

Alaska

It is hereby ordered that Triangle Island and all small unnamed islands and rocks lying adjacent to Nunivak Island, Alaska, and all lands under water appurtenant thereto, located approximately in latitude 60° N., longitude 160° W. from Greenwich, in Bering Sea, and lying within the boundary indicated by the broken line upon the diagram attached hereto and made part of this order, be, and the same are hereby reserved and set apart for the use of the Department of Agriculture as a refuge and breeding ground for wild birds and game and fur-bearing animals, subject to existing valid rights.

These islands are hereby added to and made part of the Nunivak Island Reservation, Alaska, and shall be subject to all provisions of law, regulations, and orders governing said reservation only in so far as the same apply to their use for wild-life-refuge purposes.

HERBERT HOOVER

The White House,
October 22, 1930.

[No. 5470]
ENLARGED
ALASKA
Segregated by broken line and designated
"Nunivak Island Reservation"

DEPARTMENT OF THE INTERIOR
Ray Lyman Wilbur, Secretary.
GENERAL LAND OFFICE
C.C. Moore, Commissioner.
CHANGING THE NAMES OF CERTAIN FEDERAL WILDLIFE REFUGES
BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION
WHEREAS certain areas of land and water in the United States, its Territories, and its insular possessions have been reserved and set aside from time to time as refuges and breeding grounds for native birds, migratory waterfowl, wild animals, and other forms of wildlife, on which it is unlawful for any person to hunt, trap, capture, willfully disturb, or kill any bird or wild animal of any kind whatsoever, to take or destroy the nests or eggs of any wild bird, or to occupy or use any part of such reservations or to enter thereon for any purpose, except as permitted by law or by rules and regulations of the Secretary of the Interior, in order that the conservation and development of the natural wildlife resources may contribute to the economic welfare of the Nation and provide opportunities for wholesome recreation to the citizens of the United States; and
WHEREAS some of the States are setting aside areas of land and water for similar purposes, such action by the States being furthered by the act of Congress approved September 2, 1937 (50 Stat. 917), which provides that the United States shall aid the States in wildlife-restoration projects; and
WHEREAS it is fitting and desirable that the names of such Federal areas should distinguish them from projects of the States or from preserves under private ownership;
NOW, THEREFORE, I, FRANKLIN D. ROOSEVELT, President of the United States of America, do proclaim that the names of the Federal wildlife refuges listed below are hereby changed as indicated:

<table>
<thead>
<tr>
<th>Alaska</th>
<th>Alaska</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleutian Islands Reservation</td>
<td>*4 *4 Aleutian Islands National Wildlife Refuge</td>
</tr>
<tr>
<td>Bering Sea Reservation</td>
<td>*5 *5 Bering Sea National Wildlife Refuge</td>
</tr>
<tr>
<td>Bogoslof Reservation</td>
<td>*6 *6 Bogoslof National Wildlife Refuge</td>
</tr>
<tr>
<td>Chamisso Island Reservation</td>
<td>*7 *7 Chamisso National Wildlife Refuge</td>
</tr>
<tr>
<td>Forrester Island Reservation</td>
<td>*8 *8 Forrester Island National Wildlife Refuge</td>
</tr>
<tr>
<td>Hazen Bay Migratory Waterfowl Refuge</td>
<td>*9 *9 Hazen Bay National Wildlife Refuge</td>
</tr>
<tr>
<td>Hasy Islands Reservation</td>
<td>*10 *10 Hasy Islands National Wildlife Refuge</td>
</tr>
<tr>
<td>Nunivak Island Reservation</td>
<td>*11 *11 Nunivak National Wildlife Refuge</td>
</tr>
<tr>
<td>Saint Lazaria Reservation</td>
<td>*12 *12 Saint Lazaria National Wildlife Refuge</td>
</tr>
<tr>
<td>Semidi Islands Wildlife Refuge</td>
<td>*13 *13 Semidi National Wildlife Refuge</td>
</tr>
<tr>
<td>Tuxedni Reservation</td>
<td>*14 *14 Tuxedni National Wildlife Refuge</td>
</tr>
</tbody>
</table>

(1938 P.A. p. 257)
WITHDRAWING PUBLIC LANDS FOR SCHOOL PURPOSES; PARTIALLY REVOKEING EXECUTIVE ORDER OF JANUARY 7, 1933, EXECUTIVE ORDER NO. 5095 OF APRIL 15, 1929, AND DEPARTMENTAL ORDER OF JANUARY 24, 1936

By virtue of the authority vested in the President by Section 1 of the Act of June 25, 1910, c. 421 (36 Stat. 847; 43 U.S.C. 141) and otherwise, and pursuant to Executive Order No. 10555 of May 25, 1952, and the Act of May 31, 1938 (52 Stat. 503; 48 U.S.C. 353a), it is ordered as follows:

Subject to valid existing rights, the following described public lands in Alaska are hereby withdrawn from all forms of appropriation under the public-land laws, including the mining and the mineral-lease laws, and reserved under the jurisdiction of the Bureau of Indian Affairs, Department of the Interior, for school purposes:

SADOWA [60640]

Beginning at a point on the beach of Bering Sea on the north side of St. Lawrence Island in approximate latitude 63°42' N., longitude 170°25' W., from which the north-eaet corner of the school building bears south, 160 feet and west, 220 feet, thence southerly, 400 feet to a point on the east side of a cove; northwesterly, 760 feet to a point on the beach; north, 260 feet to a large boulder on the beach of Bering Sea; easterly, 760 feet along the beach to the point of beginning.

The tract described contains approximately 6 acres.

MOSOYUK [65037]

Beginning at a point from which the northeast corner of the Alaska Native Service school building bears South, 85 feet, in approximate latitude 60°23' N., longitude 160°12' W., thence east, 21 feet 3 inches; south, 450 feet; west, 650 feet; north, 450 feet; east, 510 feet 3 inches to point of beginning.

The tract described contains 5.6 acres.

The Executive order of January 7, 1933, reserving Saint Lawrence Island for a school site; Executive Order No. 5095 of April 15, 1929, establishing a wildlife refuge on Nunivak Island; and the Departmental order of January 24, 1936, temporarily reserving lands for school purposes, are hereby revoked so far as they affect the above-described lands.

OMNE LEWIS

Assistant Secretary of the Interior.

JUNE 28, 1935.

[Public Land Order 1177, 79 Stat. 1482; Pub. L. 74-550; filed, July 12, 1935; 8:16 a.m.]
Federal Register Notice

Published: 4/15/66 Vol.: 31 No.: 74 Page: 5950

PL No.: 3527
Date PL signed: 4/21/66

Public Land Order 3527;
[Petitанс 029852]

ALASKA

Withdrawing Land for Bureau of Indian Affairs for School Purposes: Releasing Prior Withdrawals Wholly or in Part

By virtue of the authority contained in the act of May 26, 1888 (22 Stat. 396; 68 U.S.C. 59) and 31 Stat. 1156, as amended, hereinafter referred to as the act of May 26, 1888, and the act of July 1, 1928 (5 U.S.C. 59), all lands in the State of Alaska are hereby withdrawn from sale to the public under the mining laws, and under the internal improvements act, and reserved for school purposes:

1. Tanana, 
Lot 2, U.S. Survey 0482.
Containing 218 acres.

2. North Pole.
Lot 1, U.S. Survey 0485.
Containing 363 acres.

Lot 1, U.S. Survey 0483.
Containing 2.19 acres.

U.S. Survey 0472.

5. Doo, 10 acres.
U.S. Survey 0479.

U.S. Survey 0474.

7. Anchor, 10 acres.
U.S. Survey 0471.

8. Sandown Dry.
Lot 1, U.S. Survey 0480.
Containing 3.01 acres.

Lot 2, U.S. Survey 0481.

10. Atlin Village.
U.S. Survey 0482.

The areas described aggregate 45.77 acres.

1. Public Land Orders No. 1277 of June 28, 1935; No. 1316 of September 10, 1935; No. 1150 of March 6, 1936, and the Departmental Order of July 3, 1935, withdrawing lands for school purposes, are hereby revoked so far as they affect lands in the areas described in paragraph 1 of this order.

2. The primary object of this order is to release lands, in terms of the public
MEMORANDUM

To: Regional Director, Bureau of Sport Fisheries and Wildlife, Portland, Oregon

From: Area Director, Bureau of Indian Affairs
       Juneau, Alaska

Subject: Transfer of BIA School Withdrawal

Reference is made to your request of July 26, 1968 for the transfer of our school property at Nash Harbor on Nunivak Island to your Bureau.

Executive Order No. 5239 dated March 4, 1930, covers the withdrawal of a number of school sites for use by our Bureau, including U.S. Survey 2033, containing 3.33 acres at Nash Harbor. We have determined that our school buildings and the land withdrawal at Nash Harbor are no longer required for use by our Bureau.

In accordance with 40 U.S.C. 483 (c), Part 205.10.3(2) of the Departmental Manual and authority delegated by the Secretary of the Interior's Order No. 2330 and by Section 313(4) of our Commissioner's Order No. 551, U.S. Survey 2038, containing 3.33 acres, including the improvements located thereon, is hereby transferred to the Bureau of Sport Fisheries and Wildlife for use in connection with the Nunivak National Wildlife Refuge.

[Signature]

Active Area Director
Memorandum

To: Regional Solicitor, Anchorage

From: Associate Solicitor, Territories, Wildlife & Claims

Subject: Nunivak Refuge and ESFW Jurisdiction over Surrounding Tidelands

We have reviewed your memorandum of July 13, 1972, with attached material, and we are in agreement with your opinion that the Nunivak Island Reservations included the tidelands.

There is no question that the United States claimed sovereign title to such lands at the time of Executive Order 5095, dated April 15, 1929. There seems little question of this whether or not the tidelands were specifically reserved. However, Executive Order 5470, dated October 22, 1930, did make such reservation specific by the language:

... and all lands under water appurtenant thereto ... and lying within the boundary indicated by the broken line upon the diagram attached here . . .

The only reason for this language would appear to be to create a unified area, including tidelands, for the refuge purposes stated. As such, it was not affected by the Submerged Lands Act, 43 U.S.C. 1301, which specifically excepted all lands expressly retained by or ceded to the United States when a State entered the Union, and any rights the United States had in lands at such time, and lands actually occupied by the United States under claim of right. The Statehood Act, 72 Stat. 339, 341, Sec. 5(a), specifically excluded all land and water previously withdrawn. The land here involved had been withdrawn for the refuge, including the tidelands, and still remains a part of the refuge.
Our review of *United States v. Alaska*, 423 F.2d 764, does not change the foregoing opinion.

C. Brewster Chapman

C. Brewster Chapman,
Associate Solicitor
Territories, Wildlife & Claims
File: 28739

SPECIAL USE PERMIT

Date: March 2, 1969

The Fish and Wildlife Service, for the consideration and under the conditions and requirements appearing on the reverse side hereof and hereinafter mentioned which are made a part hereof grants to

Department of the Army

(Name), of Anchorage, Alaska, hereinafter referred to as the permittee, the right to use approximate 32 acres of land (located

in the Village of Naknek) in full payment for such use or privilege; (c) a total fee of $________ in installments as follows: $________ down payment, and $________ payable $________, down payment, and balance in installments as follows:

Special conditions:

1. This permit is issued subject to clearance by the Alaska Native Service for non-conflict with existing or planned installations.

2. The Alaska National Guard shall require compliance on the part of all employees, contractors and agents who are present on the Refuge as a result of this permit, with all Federal laws and regulations applicable to national wildlife refuges.

Attached is a copy of Section 36.21-27: 50 C.F.R.—Special Regulations for the Naknek National Wildlife Refuge.

3. Adequate sanitary facilities will be provided in the building to prevent the creation of a health hazard in the Village of Naknek.

The undersigned hereby accepts the above permit and the right to exercise the privileges granted, subject to the terms, covenants, obligations, and reservations, expressed or implied, therein.

Signature

Issuing officer

This Regional Director
Description of tract requested in Special Use Permit #23737 and attached hereto.

A tract of land on Nunivak Island, Second Judicial Division, State of Alaska, at approximate Latitude 60° 23' N, Longitude 166° 12' W, bounded and described as follows:

BEGINNING at the SE corner of Reindeer Cold Storage Building; thence N 80° W 45 feet; thence S 22° W 175 feet to the true point of beginning for this description; thence continuing S 22° W 140 feet; thence N 60° W 100 feet; thence N 22° E 140 feet; thence S 60° E 100 feet; to the true point of BEGINNING, containing 0.32 acres, more or less.

As an aid to location, the siting team has calculated the south wall of the Cold Storage Building as running N 80° W, the same as the initial course therefrom.
This Cooperative Agreement made and entered into under
the authority contained in Section 401 of the Act of June 15, 1935
(49 Stat. 383), by and between the Fish and Wildlife Service,
United States Department of the Interior, hereinafter termed the
Service, and the Department of Aviation, Territory of Alaska,
hereinafter termed the Territory, WITNESSETH:

WHEREAS, the Nunivak National Wildlife Refuge, Alaska,
is administered by the Service for the purposes for which it was
reserved and set apart by Executive Order No. 5095, dated April 15,
1929, namely as a preserve and breeding grounds for native birds
and mammals, and for the propagation of reindeer, caribou, and
musk ox; and

WHEREAS, the Territory is desirous of using the hereinafter
described lands of the Nunivak Refuge for the development,
operation, and maintenance of an air navigation facility and such
supplementary features as may be necessary for the benefit of
private, commercial and governmental aircraft operations, and

WHEREAS, the Service wishes to extend full cooperation to
the Territory and has determined that the use of the hereinafter
described lands for the development, operation, and maintenance of
an air navigation facility would not be incompatible with the
administration and operation of the Nunivak National Wildlife
Refuge, and

WHEREAS, it is mutually agreed by and between the Service
and the Territory that it is desirable to make the lands required
by the Territory available to it under the provisions on this
Cooperative Agreement;

NOW, THEREFORE, it is mutually agreed by and between the
parties hereto that the Service hereby grants permission, subject
to the following stipulations, to the Territory to utilize the
Following described lands of the Nunivak Refuge:

Legal Description: Mekoryuk Landing Strip and Access

Road Right-of-Way

Commencing at a monument title USO and GS "Mekoryuk,"
thence N 11° 20' E a distance of 1,050 feet to a point on the
centerline of a proposed road, with a 150 foot right-of-way
from this point to the beginning of the airfield property
limits described as N 42° 20' E a distance of 420 feet, thence
N 63° 50' W a distance of 420 feet, thence N 86° 55' W a distance
of 820 feet, thence N 72° 55' W a distance of 630 feet, thence
S 59° 30' W a distance of 126 feet, thence N 59° 40' W a dis-
tance of 462 feet, thence S 89° 65' W a distance of 437 feet,
thence S 69° 40' W a distance of 415 feet, thence S 71° 31' W
a distance of 1,585 feet, thence S 0° 17' W a distance of 636
feet, thence S 16° 07' W a distance of 1,237 feet, thence S 50° 26' W a distance of 2,838 feet, thence S 73° 56' W a dis-
tance of 1,404 feet, thence N 42° 37' W a distance of 488 feet, thence
N 74° 12' W a distance of 1,140 feet thence N 68° 22' W a dis-
tance of 1,060 feet to the point of beginning of airfield
property limits, thence N 25° 25' E a distance of 277 feet,
thence S 69° 35' W a distance of 9,200 feet, thence N 23° 25' W
a distance of 2,500 feet, thence N 66° 35' E a distance of
9,200 feet, thence S 23° 25' E a distance of 2,223 feet to the
point of beginning.

The above described land contains 574.6 acres more or less.
1. The above described lands of the Nunivak Refuge shall not be used except by permission of the Wildlife Administrator of the Service at Juneau, Alaska, for any purpose other than the installation, operation, and maintenance of an air navigation facility and related activities.

2. The Territory shall require compliance on the part of all employees, contractors, and agents of the Territory of Alaska who are present on the refuge as a result of the provisions of this agreement with all Federal laws and regulations applicable to national wildlife refuges.

3. Consistent with the existence of the air navigation facility, the use of the lands of the Service hereby authorized shall always be subject to the dominant use of the said premises by the Service as a national wildlife refuge, and the Territory shall not do or suffer to be done by any of its employees, agents, or contractors any act which may interfere with the above-stated intent and purposes of the premises.

4. This Cooperative Agreement is effective during the period from June 1, 1956, to December 31, 1976, and may be terminated by agreement of the parties hereto. If at any time during the continuance of this agreement the air navigation facility shall cease to be used as such, the Territory shall have the right within two (2) years from such cessation, to remove any structures which it may
have placed on the premises. Unless otherwise agreed to by the
parties hereto, any structures not removed within said 2-year period
shall become the property of the Fish and Wildlife Service.

5. The Territory will furnish the Service with a map or
chart showing insofar as practicable the location of all structures
and facilities which it may erect or install, including but not
limited to roads, runways, buildings, structures, and utility lines
such as water, sewer, electric, telephone, etc.

6. This agreement is executed with the understanding and
upon the express condition that the Service be and hereby is
relieved of any and all responsibility and/or liability for any and
all damages to the persons or property of whatsoever kind which
may occur by reason of or be in any way attributable to the con-
struction, use, maintenance, and/or operation of the said facility,
or for any other act of the Territory while exercising the authori-
zation herein contained.

7. The authorization herein contained is subject to dis-
cretionary revocation by the Director of the Service for failure to
comply with the herein contained conditions and requirements.

[Signature]
Director, Fish and Wildlife Service

Date JUL 24 1956
AMENDMENT TO
COOPERATIVE AGREEMENTS
Between
FISH AND WILDLIFE SERVICE
and
TERRITORY OF ALASKA
NUNIVAK NATIONAL WILDLIFE REFUGE
ALASKA

The Cooperative Agreement made and entered into under
the authority contained in Section 401 of the Act of June 15, 1935
(49 Stat. 383), by and between the Fish and Wildlife Service, United
States Department of the Interior, and the Department of Aviation,
Territory of Alaska, is hereby amended on page 3, paragraph 4 as
follows:

4. This Cooperative Agreement is effective during the
period from June 1, 1956, to December 31, 1981, and may be terminated
by agreement of the parties hereto. If at any time during the con-
tinuance of this agreement the air navigation facility shall cease
to be used as such, the Territory shall have the right within two (2)
years from such cessation to remove any structures which it may have
placed on the premises. Unless otherwise agreed to by the parties
hereto, any structures not removed within said 2-year period shall
become the property of the Fish and Wildlife Service.

[Signature]
Acting Director, Bureau of Sport Fisheries
and Wildlife

Date MAY 12 1958
Appendix 12

MANAGEMENT OBJECTIVES AND POLICY

Dunivak Muskox
(February, 1962)

The objectives of the Bureau of Sport Fisheries and Wildlife Refuge Branch in the management of the Dunivak muskox herd are as follows:

1. To develop and maintain a nucleus herd of muskox for restocking and restoring the muskox to former native range in Alaska and for education, animal husbandry, and such other requirements as may be determined by the Bureau and the State of Alaska.

2. To preserve a unit of environment and a stocking of muskox in the national interest as a representation of a rare and vanishing species formerly native to the United States.

Animals surplus to the nucleus herd on the Dunivak National Wildlife Refuge may be made available for the following purposes listed in approximate order of priority.

1. State and Federal restocking programs.
2. Scientific purposes.
3. Domestication experiments by established and qualified institutions.
4. Public display and education.
6. Sale to private individuals for domestication purposes.
7. Commercial utilization as a phase of the Dunivak Development Project designed to benefit the welfare of the people of Dunivak Island.
The proposed schedule of utilization at this time is as follows:

A. When population reaches 250 (the Nunivak herd is currently in this stage with a population of approximately 300 and an annual calf production of 60-70).

Permit annual removal of not to exceed one-half of the annual increment or 20 animals per year for:

a. Restocking
b. Public institutions for experimental purposes
c. Public ecological gardens
d. Public museums

Both parties recognize the need for basic information relative to muskox-range relationships on Nunivak Island for a proper evaluation of desired levels of stocking. In addition possible competition between muskox and reindeer for vegetative components of the range should be investigated. In view of these research needs both agencies will cooperate in planning a muskox-range investigation and will support the initiation of such a study before the present herd reaches 500 animals.

B. When population reaches 500

Permit annual removal of not to exceed annual increment or 50 animals for:

a. (1, 2, 3, 4 above)
b. Stock for private domestication as may be determined by the State of Alaska.
c. Permit hunt for trophy purposes and/or food for residents of Nunivak.
c. When population nears 750

Reappraise use of range by muskox versus reindeer in terms of human needs by Nunivak natives. Determine course of action to limit herd to 750 by 1 through 5 above and general hunting.

This agreement will remain in effect from the date executed until amended through agreement by both parties or by written request of withdrawal by either party.

Approved:

[Signature]
Walter Hulensa
Commissioner
Alaska Department of Fish & Game

[Signature]
Regional Director

[Signature]
Bureau of Sport Fisheries & Wildlife

Date: 2/7/62

Date: 2/8/62
Memorandum

To: Associate Supervisor, Alaska Wildlife Refuges
   Bureau of Sport Fisheries and Wildlife, Anchorage

From: Chief, Division of Lands and Minerals Program
      Management and Land Office

Subject: Right-of-Way Application F-12541

Enclosed is a copy of a right-of-way application with map filed by Alaska Village Electric Cooperative for lands on Nunivak Island in the village of Mekoryuk. The right-of-way is for electrical facilities to provide power for the village of Mekoryuk.

All of Nunivak Island lies within Executive Order 5095, which withdrew the lands for a wildlife refuge. We would appreciate receiving your comments and objections, if any, to the granting of this right-of-way. If you have no objections please advise us of any special stipulations or conditions which you feel should be included in the grant to protect your withdrawal.

Enclosures 2
   Encl. 1 - Cy R/W Apln.
   Encl. 2 - Status Plat

Bill Rhodes
Alaska Village Electric Corp
2/79-3547
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
State Office
511 Corliss Street
Anchorage, Alaska 99501

Date: May 26, 1979

DECISION
RIGHT-OF-WAY GRANTED

Details of Grant

Serial number of grant P-12541

Name of grantee Alaska Village Electric Cooperative, Inc.
997 Tudor Road
Anchorage, Alaska 99502

Map showing the location and dimensions of grant:

Map designations Nakoryuk Distribution (Order Order No. 3-31)

Date filed January 22, 1979

Permitted use by grantee Power Plant Site


Regulations applicable to grant:

Code reference 43 CFR 2234.1, 2234.4-1 and 43 CFR, Part 17.

Date of grant May 26, 1979

Expiration date of grant

Rental: N/A

Amount: N/A

When payable by grantee: N/A
Terms and Conditions of Grant

Pursuant to the authority vested in the undersigned by Order No. 701 of the Director, Bureau of Land Management, dated July 23, 1964 (29 FR 10526), as amended, a right-of-way, the details of which are shown above, is hereby granted for the public lands involved 1/, subject to the following terms and conditions:

1. All valid rights existing on the date of the grant.

2. All regulations in 43 CFR 2234 as more specifically set forth in the attached terms and conditions.

3. Filing of proof of construction within years from date of the grant, subject to the attached stipulations which are made a part hereof by reference.

4. Others:

Julianne M. Gibbons
Chief Lands Adjudicator

Enclosures
Encl. 1 - Map
Encl. 2 - ASO 2234-1
Encl. 3 - ASO 2234-2
Encl. 4 - Stipulations

1/ For the purpose of this grant, public domain lands include those reserved or withdrawn for specific purposes, entered, selected, occupied and/or settled, and leased.
Alaska Area
6917 Seward Highway
Anchorage, Alaska 99502

October 2, 1972
LA-807-Alaska
Nunivak NWR

Mr. Jack M. Spake
Central District Engineer
5700 Tudor Road
Anchorage, Alaska 99503

Dear Mr. Spake:

Enclosed is an original and four copies of the executed Easement for a Highway Right-of-Way covering your Nekoryuk Project RSP-58-0204(1). A finding of no objection to the 4 (4) statement was outlined to you in Deputy Assistant Secretary of Interior Lyone letter of September 22. As pointed out in this letter and also our letter of August 21, consideration should be given to archaeological sites if any are found.

Please remember that the Easement is also contingent upon your Department obtaining the necessary Corp of Engineer permits for the material sites. This Easement follows the same basic format used in granting the Kenai RR (Sterling Highway) document.

Please note that we have added the approval for the use of up to five (5) acres at the airstrip road terminus to provide for vehicle turnaround and aircraft parking. The necessity for this construction is outlined in stipulation no. 17.

Please return the original and two (2) executed copies to us for our records. We would also appreciate four (4) copies of the maps for our records.

Sincerely,

Gordon W. Watson
Area Director

Attachments

JHS: pja
cc: EBS
Refuge: Executed copies of document will be provided
CJR (Bethel) when received.
Realty Portland
EASEMENT

for

Highway Right-of-Way
Nunivak National Wildlife Refuge

THE SECRETARY OF THE INTERIOR, by his authorized representative, the Alaska Area Director, Bureau of Sport Fisheries and Wildlife, in accordance with applicable authorities, and regulations published December 19, 1969, 50 CFR Part 29.21, for and in consideration of the sum of No Dollars hereby grants to the State of Alaska, Department of Highways, herein designated as the Grantee, a perpetual easement for highway right-of-way purposes, over, across, in, and upon lands of the United States located within the boundaries of the Nunivak National Wildlife Refuge.

The areas herein described contain a total of 38.026 acres, more or less, as shown on maps and Tract Description entitled Mekoryuk Airport to Mekoryuk [EMP-RS-0204(1)]. Said right-of-way is approximately 3.27 miles long and varies in width from 30-40 feet within the village to 100 feet outside the village. Approval is also granted for the use of up to 5.0 acres at the airstrip terminus to provide for vehicle turnaround and aircraft parking.

By accepting this easement the Grantee agrees to the following terms and conditions:
1. To comply with State and Federal laws applicable to the project within which the right-of-way is granted, and to the lands which are included in the right-of-way, and lawful existing regulations thereunder. The design and construction of all highway projects situated on this right-of-way will be in accord with the applicable provisions of Title 50, United States Code—covering rights-of-way granted on lands within the National Wildlife Refuge System and Title 23, United States Code—Highways, and amendments; the Regulations for the administration of Federal Aid for highways, and amendments, and established procedures for Federal Aid projects, including the requirements of the Federal Highway Administration, Bureau of Public Roads Policy and Procedure Memorandum 80-5 and subsequent instructional memorandums on the Federal Aid to Highways Act and the Environmental Impact Act of 1969 for the protection or improvement of parks, picnic areas, scenic view sites, camp grounds and other outdoor recreational and historical resources, and the construction specifications of the State Highway Department as approved by the Bureau of Public Roads for use on Federal-Aid projects. All highway maintenance on the lands described in this right-of-way will be the responsibility of the Alaska State Highway Department.
2. The Manager of the Nunivak National Wildlife Refuge, herein after designated as the project manager, will be provided an opportunity to review plans relative to effects, if any, that the new highway project as planned will have to assure adequate protection and utilization of the land traversed by the right-of-way and adjoining land under administration by the Bureau of Sport Fisheries and Wildlife. Those features of design, construction, and maintenance of the highway facility and of use of the right-of-way that would have effect on the protection and utilization of land within the Refuge are to be mutually agreed upon by the Refuge Manager and the Grantee by conference or other communication during the preparation of the plans and specifications for the construction project, and the plans shall be revised, modified, or supplemented to meet the approval of the project manager, or when deemed appropriate, supplemented by written stipulation between the Alaska Area Director and the Grantee before being placed in effect.

3. To protect and preserve soil and vegetative cover, and scenic and esthetic values of the Refuge on the right-of-way outside of the actual highway construction limits. To clear and keep clear the lands within the right-of-way to the extent and in the manner directed by the project manager in charge; and to dispose of all vegetative and other material
cut, uprooted, or otherwise accumulated during the construction and maintenance of the project in such a manner as to decrease hazard to fire, disease and public safety, and also in accordance with such special instructions as the project manager may specify.

4. To prevent the disturbance or removal of any public land survey monument or project boundary monument unless and until the applicant has requested and received from the project manager approval of measures the applicant will take to perpetuate the location of aforesaid monuments.

5. To rebuild and repair such roads, fences, structures including culverts, and trails as may be destroyed or injured by construction or maintenance work and upon request by the project manager, to build and maintain necessary and suitable crossings for all roads and trails that intersect the works constructed, maintained, or operated by the Grantee, his agents or assigns under the right-of-way.

6. To pay the United States the full value for all damages to the lands or other property of the United States caused by him or his employees, contractors, or employees of the contractors, and to indemnify the United States against any liability for damages to life, person or property arising from the occupancy or use of the lands under the right-of-way, except where a right-of-way is granted
hereunder to a State agency which has no legal power to assume such a liability with respect to damages caused by it to land or property, such agency in lieu thereof agrees to repair all such damages.

7. In the event of non-compliance with the terms and conditions herein contained, the Alaska Area Director will notify the Grantee in writing of the corrections needed, and the Grantee shall have a period of 60 days from the date of said notice to complete corrective action. However, in the event of extenuating circumstances such as adverse weather conditions, or other compelling reasons, the Alaska Area Director may grant an extension of time which in his judgment is reasonably necessary. In the event of termination of an easement, permit or portion thereof for non-compliance, non-use, or abandonment, a written notice of termination will be furnished to the Grantee.

8. To restore the land to its original condition to the satisfaction of the project manager, so far as it is reasonably possible to do so upon revocation and termination of the right-of-way, unless this requirement is waived in writing.

9. To keep the project manager informed at all times of the names and addresses of the principle representative employed by the State responsible for administration of all portions of the highway right-of-way lying within the Nunivak National Wildlife Refuge.
10. That in the construction, operation, and maintenance of the project, he shall not discriminate against any employee or applicant for employment because of race, creed, color, or national origin and shall require an identical provision to be included in all sub-contracts.

11. That the allowance of the right-of-way shall be subject to the express condition that the exercise thereof will not unduly interfere with the management, administration, or disposal by the United States of the land affected thereby, and that the Grantee agrees and consents to the occupancy and use by the United States, its grantees, permittees, or lessees of any part of the right-of-way not actually occupied or required by the State of Alaska for the purpose of the granted rights or the full and safe utilization thereof.

12. That the right-of-way herein granted shall be subject to the express covenant that any facility constructed therein will be modified or adopted if such is found by the Alaska Area Director, to be necessary, without liability or expense to the United States, so that such facility will not conflict with the use and occupancy of the land for any authorized works which may hereafter be constructed thereon under the authority of the United States.

13. That the right-of-way herein granted shall be for the specific use described and may not be construed to include
the further right to authorize any other use within the right-of-way unless approved in writing by the Alaska Area Director.

14. The easement herein granted is limited to use of the described right-of-way and the space above and below the established grade line of the highway gravel surface or pavement for the sole purposes of construction, operation, and maintenance of a highway.

15. Entry to and performance of all of the conditions permitted herein will be subject to the advance approval of the project manager.

16. The State will prepare in cooperation with the project manager, a landscape and erosion control plan with the objective of protecting, restoring or enhancing the roadside landscape, protecting soil, and protecting or reestablishing vegetative cover. Such plans shall, when appropriate, provide for rehabilitation of vegetation on cuts, fills, and other areas damaged as a result of highway construction, maintenance or operation, and for terraces, drainage, waste disposal areas, soil replacement and other related requirements necessary to achieve this objective.

17. Construction plans are to be expanded to include a combination of aircraft and vehicle parking as well as vehicle turnaround at the junction of said road and airstrip. This will eliminate a serious safety hazard between vehicles and airplanes as
well as to eliminate the aesthetic problems of barrels, machinery, airport maintenance equipment stored or parked indiscriminately on the adjacent tundra.

By granting this easement the Bureau of Sport Fisheries and Wildlife recognizes that an old road is located within the boundaries of the Refuge between the airport and the village. The rights of the United States in administering said Refuge within any portion of the right-of-way granted herein for non-highway purposes shall not be exercised when such use would be inconsistent with the provisions of Title 23 of the United States Code, the Bureau of Public Roads regulations issued pursuant thereto, or would interfere with the free flow of traffic or impair the full use and safety of the highway.

In consideration of the mutual benefits cited herein the Area Director agrees to allow the State Highway Department, at no cost, the use of sufficient gravel pit areas as designated on said map within the Refuge necessary for the proper construction, maintenance, and rehabilitation work on the highway. Said free use of gravel and rock material by the State however is subject to the following special terms and conditions:

1. All of said material removed will be used only on the road right-of-way herein designated unless specifically authorized in writing by the Refuge manager.

2. All future material sites will be located out of sight of the highway, at locations approved by the project manager.
Entrance roads to said material sites other than those now existing, will be blocked by the State when not in use in a manner effectively restricting access by the public.

3. Prior to prospecting for or constructing access roads to any new material sites the State will obtain a special use permit from the Refuge manager.

4. All material sites presently located along the highway no longer needed by the State will be rehabilitated by the Department of Highways in a manner satisfactory to the project manager. Said rehabilitation work in most cases will require sloping, seeding and fertilizing.

In witness whereof, I have hereunto set my hand this _______ day of __________________, 1972.

THE UNITED STATES OF AMERICA

BY

Alaska Area Director
Bureau of Sport Fisheries & Wildlife

ACKNOWLEDGEMENT

The above instrument together with all conditions thereof, is hereby accepted this _______ day of __________________, 1972.

BY

State of Alaska
Department of Highways
CERTIFICATE OF RIGHT-OF-WAY COMPATIBILITY

WHEREAS, the Bureau of Sport Fisheries and Wildlife has received an application from the Department of Highways, State of Alaska, for the road right-of-way located on the Nunivak National Wildlife Range between the village of Mekoryuk, Alaska, and the Mekoryuk airport, and

WHEREAS, this Bureau is in the process of issuing a permit or easement for this right-of-way under the authority contained in the National Wildlife Refuge System Administrative Act of October 15, 1966 (80 Stat. 926; 16 USC 668dd) as amended, and

WHEREAS, Section 4(d)(2) of this act requires a determination "that such uses are compatible with the purposes for which these areas are established".

I, THEREFORE, now certify that this non-programmed use of the subject area is compatible with the purpose for which the land was acquired and it is determined that the granting of this right-of-way will not have a significant impact on the quality of the environment.

Date: May 19, 1972

Calvin Zutrink
Refuge Manager

Date: July 7, 1972

Area Supervisor, Division of Refuges

Date: June 22, 1972

Area Director
Table 1. Climatological data for Nunivak Island, Alaska. (U.S. Weather Bureau, Anchorage, Alaska)*

<table>
<thead>
<tr>
<th>Month</th>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>J</th>
<th>J</th>
<th>A</th>
<th>S</th>
<th>O</th>
<th>N</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily maximum</td>
<td>17.1</td>
<td>17.4</td>
<td>21.1</td>
<td>27.6</td>
<td>38.8</td>
<td>49.6</td>
<td>54.5</td>
<td>54.6</td>
<td>49.5</td>
<td>39.8</td>
<td>29.9</td>
<td>19.6</td>
</tr>
<tr>
<td>Daily minimum</td>
<td>3.8</td>
<td>3.7</td>
<td>7.3</td>
<td>17.0</td>
<td>28.9</td>
<td>37.5</td>
<td>43.4</td>
<td>45.2</td>
<td>41.1</td>
<td>30.5</td>
<td>20.2</td>
<td>7.6</td>
</tr>
<tr>
<td>Monthly mean</td>
<td>10.5</td>
<td>10.5</td>
<td>14.2</td>
<td>22.8</td>
<td>33.9</td>
<td>43.6</td>
<td>48.9</td>
<td>49.9</td>
<td>45.3</td>
<td>35.2</td>
<td>25.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Precipitation (inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean rainfall</td>
<td>0.84</td>
<td>1.90</td>
<td>1.17</td>
<td>0.70</td>
<td>0.59</td>
<td>0.77</td>
<td>1.25</td>
<td>2.34</td>
<td>2.07</td>
<td>2.01</td>
<td>1.34</td>
<td>1.02</td>
</tr>
<tr>
<td>Mean snow and sleet</td>
<td>10.6</td>
<td>9.1</td>
<td>9.5</td>
<td>4.5</td>
<td>2.6</td>
<td>t**</td>
<td>0.0</td>
<td>0.0</td>
<td>t</td>
<td>2.2</td>
<td>7.0</td>
<td>8.9</td>
</tr>
</tbody>
</table>

* Based on an 18 - 19 year summary.

** Trace, an amount too small to measure.
MOLLUSKS OF NUNIVAK ISLAND, ALASKA

collected and identified by Rae Baxter

<table>
<thead>
<tr>
<th></th>
<th>live intertidal</th>
<th>live subtidal</th>
<th>dead shells from beach</th>
<th>dead subtidal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PELECYPODS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardita crebricostata</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Clinocardium californiense</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>C. nuttallii</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macoma balthica</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>M. borta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. lama</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Modiolus modiolus</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musculus discors</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mya arenaria</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>M. truncata</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Mytilus edulis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panomya ampla</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protothaca staminea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serripes groenlandicus</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Siliqua alta</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Spisula polynyma</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Tellina lutea</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Yoldia myalis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| <strong>GASTROPODS</strong>   |                 |               |                         |               |
| Acmaea &quot;scutum Complex&quot; | +           |               |                         | +             |
| Amphissa columbiana |                 |               |                         | +             |
| Beringius beringi  |                 |               |                         |               |
| B. kennicottii     |                 |               |                         |               |
| Boreotrophen pacificus |               |               |                         | +             |
| Buccinum sp.       |                 |               |                         |               |
| Cancellidae G. sp.? |                 |               |                         | +             |
| Colus spitsbergensis |               |               |                         |               |
| Crepidula grandis  |                 |               |                         |               |
| Cyclichna attensa  |                 |               |                         | +             |
| C. occulta         |                 |               |                         |               |
| Littorina sitkana  | +               |               | +                       |               |
| Margarites pupillus|                 |               |                         |               |
| Margaritopsis grosveneri | +       |               |                         |               |
| Natica aleutica   |                 |               |                         | +             |
| N. clausa          |                 |               |                         | +             |</p>
<table>
<thead>
<tr>
<th>GASTROPODS (cont.)</th>
<th>live intertidal</th>
<th>live subtidal</th>
<th>deal shells from beach</th>
<th>dead subtidal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neptuna heros</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. ventricosa</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Piliseus commodus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polinices groenlandica</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. nanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. pallida</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solariella micraulax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tachyrhynchys erosum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thais luna</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichotropis bicarinata</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. borealis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. insignis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Turridae&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Turridae&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velutina plicatilis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volutopsis castaneus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PETROMYZONTIDAE - Lampreys
See freshwater fishes.

SQUALIDAE - Sharks
Dogfish shark - Squalus acanthias
Sleeper Shark - Somniosus pacificus

RAJIDAE - Rays and Skates
Black Skate - Raja kinaeaidji
R. interrupta
Breviraja pernifera
B. aleutica

CLUPEIDAE - Herrings
Pacific Herring - Clupea harengus

ALEPOCEPHALIDAE - Slickheads
Erichtho salmonum

STERNOPTYCHIDAE - Light fishes
Cyclothone nigrodon

ARGENTINIDAE - Deep Sea Smelts
Smooth Tongue - Leuroglossus stibius
Pacific Blacksmelt - BathyURA pacificus
Alaska Blacksmelt - B. aleuticus

SALMONIDAE - Salmon and Trout
See freshwater fishes

OSMERIDAE - Smelts
Capelin - Mallotus villosus
Rainbow Smelt - Osmerus cernulens
Eulachon - Thaleichthys pacificus
Pond Smelt - Hypomesus olidus

MYCTOPHIDAE - Lantern fishes
Lampenstius leucosarbus
L. horincensis
L. mnnochir

ALEPISAURIDAE - Lancetfishes
Alepisaurus borealis

ANTOPTERIDAE - Daggertooths
Anotopterus pharo

SYNAPHOBRANCHIDAE

NOTACANTHIDAE
Polyacanthonotus challengeri
CORYPHAENOIDIDAE - Rattails

<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coryphaenoides</td>
<td>lepturus</td>
</tr>
<tr>
<td>C.</td>
<td>cinereus</td>
</tr>
<tr>
<td>C.</td>
<td>spinulosus</td>
</tr>
<tr>
<td>C.</td>
<td>suborbitalis</td>
</tr>
<tr>
<td>C.</td>
<td>clarki</td>
</tr>
<tr>
<td>C.</td>
<td>firmisquamis</td>
</tr>
</tbody>
</table>

GADIDAE - Cods

- Antimora rostrata
- Saffron Cod - Plecanthus gracilis
- Walleye Pellock or Whiting - Thelazara chalcogrammus
- Polar Cod - Borcogadus saida

MELAMPHAIDAE - Bistcales

- Melampaeas lugubris
- Melampaeas cristiceps

BOTHIDAE - Lefteyed Flounders

- Pacific Sanddab - Citharichthys noridus

PLEURONECTIDAE - Righteyed Flounders

- Arrowtooth Halibut - Atheresthes stomias
- Pacific Halibut - Hippoglossus stenolepis
- Flathead Flounder - H. olosodon
- H. robustus
- Rock Flounder - Lepidopsetta bilineata
- Muddab - Limanda cooper
- Limanda prococeida
- Alaska Plaice - Pleuronectes quadrituberculatus
- Arctic Flounder - Lepidopsetta glacialis
- Stary Flounder - Platichthys stellatus
- Slippery Flounder - Microstomus pacificus
- Longfin Flounder - Glyptocephalus sordidus

ANOPLOPOMATIDAE - Sablefishes

- Sablefish (Blackcod) - Anoplopoma fimbria

HEXAGRAMMIDAE - Greenlings

- Atka Makerel - Pleuronectes monopterygius
- Alaska Greenling - P. octogrammus
- Whitespotted Greenling - P. stelleri
- Terpup - P. lagoccephalus
- Rock Greenling - P. superciliosus

OPHIDONTIDAE - Lingcods

- Lingcod - Ochiodon elongatus

SCORPAENIDAE - Rockfishes

- Shortspine Channel Rockfish - Sebastolobus alaskanus
  - Sebastodes polymorphus
- Silvergray Rockfish - S. brevispinis
- Blue Rockfish - S. mystinus
- Black Rockfish - S. melanops
Dusky Rockfish - *Sebastes ciliatus*
Redstripe Rockfish - *S. prorizer*
Pacific Ocean Perch - *S. alutus*
Dark-blotched Rockfish - *S. crameri*
Blackgill Rockfish - *S. melanostomus*

COTTIDAE - Sculpins

*Remphocottus richardsonii*
*Theconeterus aleuticus*
*Dasycottus setiger*
*Psychrolutes paradoxus*
*Furcilla cyrinus*
*Helicotrachelus vilosus*
*Ulica bolini*
*Nlepsias bilobus*
*B. cirrhous*
*Neauichthys pribilovius*
*Nucypris dicercaus*
*E. claviger*
*E. lucasi*

Coastrange Sculpin - *Cottus aleuticus*

Slimy Sculpin - *Cottus cornutus*

*Trislops forficata*
*T. metopias*
*T. scepticus*
*T. pingell*
*T. macellus*
*Sternias xenostothus*
*Hemilepidotus zapus*
*H. hemilepidotus*
*H. jordani*
*Melletes papilio*
*Icelinus borealis*
*Archaulus biscriatus*
*Steigistrum beringianum*
*Icelus spiniger*
*I. canaliculatus*
*I. spatula*
*I. vicinalis*
*I. uncinalis*
*I. scutiger*
*Stelicottus xenogrammus*
*Gymnocanthus distillator*
*G. tricuspid*
*G. galeatus*

Deepwater Sculpin - *Myxocephalus quadricornis*
*M. niger*
*Megalocottus platycephalus*
*Phallocottus obtusus*
*Microcottus sellaris*
*Porocottus quadrifilis*
*P. bradfordi*
*Nesticelus profundorum*
Thyrisicus anoplus
Arteediellus minyanthus
A. pacificus
A. uncinatus
A. scaber
Oligocottus maculosus
Clinocottus embryum
C. acuticeps
Sigmistes caudus

AGONIDAE - Sea Poachers
Hypsagonus quadricornis
Occhiodictyum
Pallasina barbata
Pararitote leptomynchus
P. frenatus
S. acipenserinus
Asterothea alaskana
A. infrapinata
A. pentacantha
Rathversonus nigripinnis
Aspidophoroides olriki
A. bartoni

LIPARIDAE - Liparids
Liparis ratteri
L. callyodon
L. floris
L. microaspisphorus
L. cyclopus
L. bostolensis
L. gibbus
L. cyclostigma
L. megacephalus
L. mulchellus
Polytera beringiana
P. greeni
Carenactus estenes
C. simus
C. rollis
C. bowersianus
C. attenuatus
C. phasma
C. cypselurus
C. furcellus
C. opisthotremus
C. ostentum
C. colletti
Temodoris candida
Crysalithys cyclospinus
Tyrinichthys minviiremus
Paralinaria dactylosus
P. holomelas
E. ulochir
Pholichthys dolichogaster
P. laeta
P. ornata
P. gilli
1. From Wilimousky, N. J. 1958. Provisional Keys to fishes of Alaska. Marine fishes commonly found in brackish or fresh water are indicated by an asterisk (*).
Birds of the Nunivak National Wildlife Refuge

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>abundance</th>
<th>(x)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common loon</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Yellow-billed loon</td>
<td>uncommon</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Arctic loon</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Red-throated loon</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Red-necked grebe</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Slender-billed shearwater</td>
<td>common</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Fulmar</td>
<td>uncommon</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Pelagic cormorant</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Red-faced cormorant</td>
<td>unknown</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Whistling swan</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Cackling goose (minima)</td>
<td>common³</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Canada goose (taverneri)</td>
<td>common³</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Black brant</td>
<td>abundant³</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Emperor goose</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>White-fronted goose</td>
<td>uncommon</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Snow goose</td>
<td>common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallard</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Pintail</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Green-winged teal</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Greater scaup</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Oldsquaw</td>
<td>*common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Harlequin duck</td>
<td>abundant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steller's eider</td>
<td>*uncommon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common eider</td>
<td>*abundant</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>King eider</td>
<td>*common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectacled eider</td>
<td>*uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>White-winged scoter</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Surf scoter</td>
<td>common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common scoter</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Common merganser</td>
<td>rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-breasted merganser</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sharp-shinned hawk</td>
<td>rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gyrfalcon</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Willow ptarmigan</td>
<td>*common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Rock ptarmigan</td>
<td>*uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sandhill crane</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Semipalmated plover</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Mongolian plover</td>
<td>rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golden plover</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Black-bellied plover</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Ruddy turnstone</td>
<td>common</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Black turnstone</td>
<td>uncommon</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Common snipe</td>
<td>uncommon</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Whimbrel</td>
<td>uncommon</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Bristle-thighed curlew</td>
<td>common</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Relative maximum abundance during period of residence
2 Nesting species
3 High abundance during spring or fall migration with low nesting density
<table>
<thead>
<tr>
<th>Species</th>
<th>Status abundance</th>
<th>(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spotted sandpiper</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Wandering tattler</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>Knot</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Rock sandpiper</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Sharp-tailed sandpiper</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Pectoral sandpiper</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Baird's sandpiper</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Dunlin</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Long-billed dowitcher</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>Western sandpiper</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Bar-tailed godwit</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Sanderling</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Red phalarope</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Northern phalarope</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Pomarine jaeger</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Parasitic jaeger</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Long-tailed jaeger</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Glaucous gull</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Glaucous-winged gull</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Slaty-backed gull</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Mew gull</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Black-legged kittiwake</td>
<td>abundant</td>
<td>x</td>
</tr>
<tr>
<td>Sabine's gull</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Arctic tern</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Aleutian tern</td>
<td>uncommon</td>
<td>x</td>
</tr>
<tr>
<td>Common murre</td>
<td>abundant</td>
<td>x</td>
</tr>
<tr>
<td>Thick-billed murre</td>
<td>abundant</td>
<td>x</td>
</tr>
<tr>
<td>Pigeon guillemot</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Parakeet auklet</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Crested auklet</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Horned puffin</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Tufted puffin</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Snowy owl</td>
<td>uncommon-common</td>
<td>x</td>
</tr>
<tr>
<td>Short-eared owl</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Yellow-shafted flicker</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Horned lark</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Tree swallow</td>
<td>uncommon</td>
<td>x</td>
</tr>
<tr>
<td>Common raven</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Black-capped chickadee</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Gray-cheeked thrush</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Mountain bluebird</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Wheatear</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Arctic warbler</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Middendorffi warbler</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Mountain accentor</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Yellow wagtail</td>
<td>uncommon</td>
<td>x</td>
</tr>
<tr>
<td>Water pipit</td>
<td>common</td>
<td>x</td>
</tr>
</tbody>
</table>

1 Relative maximum abundance during period of residence
2 Nesting species
* Resident through most of the year
<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>( x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese water pipit</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Orange-crowned warbler</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Yellow warbler</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Northern waterthrush</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Wilson's warbler</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Bullfinch</td>
<td>rare</td>
<td></td>
</tr>
<tr>
<td>Gray-crowned rosy finch</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>Common redpoll</td>
<td>uncommon</td>
<td>x</td>
</tr>
<tr>
<td>Savannah sparrow</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>Slate-colored junco</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>Tree sparrow</td>
<td>uncommon</td>
<td></td>
</tr>
<tr>
<td>White-crowned sparrow</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>Golden-crowned sparrow</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>Lapland longspur</td>
<td>abundant</td>
<td>x</td>
</tr>
<tr>
<td>Snow bunting</td>
<td>common</td>
<td>x</td>
</tr>
<tr>
<td>McKay's bunting</td>
<td>common</td>
<td></td>
</tr>
</tbody>
</table>

1Relative maximum abundance during period of residence
2Nesting species
## Principal Salmon Spawning Streams

<table>
<thead>
<tr>
<th>Name</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dooksook</td>
<td>Red (King)</td>
</tr>
<tr>
<td>Dahloongamiut</td>
<td>Chum</td>
</tr>
<tr>
<td>Kiyakyaliksamiut</td>
<td>Chum</td>
</tr>
<tr>
<td>Chakwakamiut</td>
<td>Chum, Pink</td>
</tr>
<tr>
<td>Binjoaksamiut</td>
<td>Chum, Pink</td>
</tr>
<tr>
<td>Machagamiut</td>
<td>Chum</td>
</tr>
<tr>
<td>Duchikimiut</td>
<td>Chum, Pink</td>
</tr>
<tr>
<td>Kyagamiut</td>
<td>Chum</td>
</tr>
<tr>
<td>Difjakamiut</td>
<td>Chum</td>
</tr>
<tr>
<td>Ikongimiut #1</td>
<td>Chum</td>
</tr>
<tr>
<td>Ikongimiut #2</td>
<td>Chum</td>
</tr>
<tr>
<td>Kewigimiut</td>
<td>Chum</td>
</tr>
</tbody>
</table>

* Species observed in July survey. Many of these rivers probably have silver salmon runs in August and September.
GEOLOGIC REPORT

NUNIVAK ISLAND AND CLARENCE RHODE NATIONAL WILDLIFE REFUGES and ADJACENT AREAS,

U. S. Fish and Wildlife Service
Anchorage, Alaska

Prepared: October 13, 1972
By:

Gerald Ganopole
Consulting Geologist
Anchorage, Alaska
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>Nunivak Island</td>
<td>3</td>
</tr>
<tr>
<td>GENERAL GEOLOGY</td>
<td>3</td>
</tr>
<tr>
<td>STRATIGRAPHY</td>
<td>4</td>
</tr>
<tr>
<td>Cretaceous Sediments</td>
<td>4</td>
</tr>
<tr>
<td>Cretaceous Igneous Rocks</td>
<td>5</td>
</tr>
<tr>
<td>Tertiary Sediments</td>
<td>5</td>
</tr>
<tr>
<td>Quaternary Sediments</td>
<td>6</td>
</tr>
<tr>
<td>Old Deposits</td>
<td>7</td>
</tr>
<tr>
<td>Young Deposits</td>
<td>7</td>
</tr>
<tr>
<td>Quaternary Volcanics</td>
<td>8</td>
</tr>
<tr>
<td>MINERAL RESOURCES</td>
<td>9</td>
</tr>
<tr>
<td>Coal</td>
<td>9</td>
</tr>
<tr>
<td>Petroleum Possibilities</td>
<td>10</td>
</tr>
<tr>
<td>REFERENCES UDED</td>
<td>13</td>
</tr>
<tr>
<td>Plate Geologic Map</td>
<td></td>
</tr>
</tbody>
</table>
ABSTRACT

The report area includes Nunivak Island and most of the so-called Bethel Basin, a lake-pocked area of very low relief that lies between Kuskokwim Bay and the Yukon River delta adjacent to the central west coast of Alaska. The area is primarily covered by unconsolidated alluvial deltaic deposits overlying Tertiary and/or Cretaceous bedrock. Cretaceous sediments are exposed in outcrop areas bordering the basin to the east. Some Quaternary aged volcanics are found in the southern half of the report area and Nunivak and Nelson Islands were formed mainly by these volcanics.

With the exception of some very thin non-commercial coal beds, there are no known minerals of economic value within the area. The discovery of commercial mineral deposits within the area is unlikely. Although petroleum possibilities appear marginal, the entire basin area including much of the Clarence Rhode Refuge is considered prospective and will eventually merit additional exploratory drilling. Because of its volcanic nature, Nunivak Island does not appear to have petroleum possibilities.
INTRODUCTION

The Clarence Rhode Refuge lies within the physiographic province known as the Yukon-Kuskokwim Lowland formed mainly by a lake-dotted marshy plain containing typical tundra vegetation. Between 30 to 50 percent of the lowland area is lake surface. Many of the larger of these thaw lakes have scalloped shorelines and were probably formed through the coalescence of smaller lakes. Except in the proximity of the larger lakes, most of the area is underlain by permafrost to depths of an estimated 50 to over 100 feet.

The Yukon River is in the process of building a delta into the Bering Sea while the Kuskokwim River engulfs in a subsiding marine estuary system. This land subsidence is very evident in the Kuskokwim area.

The Kusilvak Mountains rise to 2,450 feet, the highest elevation in the area. Relative relief in the lowlands is about 10 feet.

The climate of the region is more maritime than continental and average temperatures range from -52° in January to 90° in June. Wind velocities of over 70 m.p.h. often accompany northeast storm winds in the winter and southeast storm winds in the summer. Annual precipitation averages 19 inches, the wettest month being August. Snowfall averages about 60 inches per year.
Except for some small areas of glacial deposits in the Askina Mountains adjacent to Cape Romanzof, the entire remaining delta area has not been glaciated.

Nunivak Island

Nunivak Island is one of several islands on the Bering Sea continental platform. It is composed of basaltic lava flows that are essentially undissected. Roberts Mountain at 1,675 feet is the island's highest point. Somewhat domeshaped, the island's higher parts are near the center with volcanic cinder cones rising above the central plain elevation of about 500 feet. On the west coast, bluffs rise abruptly from the sea to elevations of 100 to 200 feet. On the east coast, the rise is more gradual and beach bluffs are under 50 feet. The island is tundra-covered and contains many small lakes.

GENERAL GEOLOGY

The Yukon-Kuskokwim delta region is mostly covered by deltaic, flood plain and eolian deposits. Lava flows and small cinder cones are present with most of them occurring in the southern portion. Most of the upland areas of both Nelson and Nunivak Islands are capped by basaltic volcanic rocks. No eruptive centers are known to occur on Nelson Island, but Nunivak Island does have several recognizable volcanic cones and craters.
Underlying the deltaic deposits, locally, is a non-marine Tertiary sequence which in turn overlies graywacke-type Cretaceous sandstone and shale. The underlying Cretaceous rocks appear in outcrop northeast of the Bethel Basin on the north side of the Yukon River and along the east side of the basin. A great thickness of rocks were deposited in the Yukon-Koyukuk geosyncline in the middle part of the Cretaceous system. In outcrop, these rocks are generally complexly deformed, partially metamorphosed and cut by numerous intrusive bodies.

**STRATIGRAPHY**

**Cretaceous Sediments**

The oldest sedimentary rocks that outcrop in the area (Ks) are a dense, hard graywacke-type sandstone and siltstone that contains a few thin coal beds. The sandstone is poorly sorted and contains pebble conglomerates. It is composed primarily of volcanic rock fragments with minor amounts of quartz and feldspar. The rocks of Cretaceous age on Nelson Island are formed mainly of siltstone and are estimated to be as much as 5,000 feet thick.

Based on the general lithology and the presence of carbonaceous material, the origin of the Cretaceous sequence appears to be partially marine, but mostly littoral marine and non-marine. These rocks are older than the granodiorite pluton intruded into them.
Cretaceous Igneous Rocks

The grandiorite pluton (Ki) that crops out in the Scammon Bay area appears to underly a total area of up to 1,400 square miles. The granodiorite is light gray and medium to coarse grained. Intersection of vertical and horizontal sets of fractures has locally produced rectangular blocks 2 to 4 feet wide and thick and 10 to 20 feet long. This pluton has been age dated at approximately 78.7 million years, equivalent to Late Cretaceous time.

The small outcrops of altered andesitic flows and volcaniclastic rocks found north of the Yukon River (KJv) are probably as old as Early Cretaceous and may be as old as mid-Jurassic. The exposures appear as volcanic conglomerates with well rounded pebbles and cobbles in porphyritic and amygdaloidal lava.

Tertiary Sediments

Although the Tertiary depositional basin existing in the area is not evident in outcrop, much of the sediments eroded from interior Alaska throughout Tertiary time have passed through or have been discharged into the basin. The presence of the Tertiary sequence was confirmed by a Pan American exploratory well, discussed later, which encountered approximately 6,500 feet
of non-marine siltstones and sands with thin coal seams. The formation was loosely consolidated in contrast to the underlying dense Cretaceous sandstones and shales.

Possibilities for Tertiary coal-associated dry gas accumulations are present throughout the basin and petroleum possibilities, although more remote, also exist. Petroleum source rocks might be present in underlying older sediments, or in postulated marine facies of Tertiary age located in coastal areas or in offshore waters.

Quaternary Sediments

The surficial Quaternary deposits of the area have been divided into (Qo) Old Alluvial Deposits and (Qy) Young and Recent Alluvial Deposits. This division is based more on the evolution or geomorphic stage of development of the delta region rather than major lithological differences. The thickness of these unconsolidated sediments varies from 0 to probably over 1,000 feet in the central areas and probably very much thicker in the present delta areas.

Although some of the deposited materials were derived from local isolated bedrock areas, most of the sediments were transported from interior Alaska to the delta area by the Yukon and Kuskokwim Rivers.
Areas mapped as Old Deposits (Qo) include:

(1) Old alluvial deposits of silt and fine sand to gravel and coarse sand and stabilized sand dunes. These generally form the higher parts of the terraces throughout the area and the colluvial deposits near the mountains. The age of these deposits range from Pleistocene to Recent.

(2) Old flood plain and delta deposits of silt, sand and bog deposits in former channels of the Yukon River, generally higher in elevation than present flood plain areas. These deposits range from Pleistocene to Recent but are generally younger than the old alluvial deposits which occur at still higher elevations.

(3) Old beach deposits of silt and sandy silt which form long ridges between 5 to 20 feet above sea level and are separated from pre-existing old flood plain and delta deposits by low scarps.

Areas of Young Deposits (Qy) include the following:

(1) Young flood plain and delta deposits which form the present delta of the Yukon River. These are primarily composed of silt and fine sand.
(2) Young beach deposits of silt and sand deposited primarily by ocean currents. These deposits are generally barren of vegetation.

The alluvium deposits (Q) in the southern portion of the mapped area have not yet been studied in sufficient detail to differentiate between Old or Young deposits.

Quaternary Volcanics

Numerous small cinder cones to large basaltic lava flows are found in the central and southern portions of the area. This area is part of the discontinuous volcanic belt that extends from the eastern Seward Peninsula southward to Nunivak Island and possibly the Pribilof Islands.

Nunivak Island is composed primarily of volcanic flows and polygonal columnals appear in most of the seacliffs. There are also many cinder cones on the island.

Nelson Island is capped by olivine basalt lava flows which locally overly Cretaceous sandstones. The source of the volcanics was probably from adjacent areas as no dikes or vents have been noted on the island.
MINERAL RESOURCES

Although a slight amount of mineralization is associated with the few intrusive plutonic rocks, there are no known mineral deposits of any present commercial value throughout the entire area. No volcanic associated hydrothermal products of value are known to exist. A report of "zinc ore" found in the Kuzilvak Mountains several years ago has never been confirmed. The Kuzilvak Mountains are in the north central portion of the mapped area and lie outside of the boundaries of the game refuges. It is unlikely that deposits of commercial minerals will be discovered in the area.

Coal

Thin non-commercial coal seams have been found in three locations in the area, all within the Cretaceous sandstone sequence: the north coast of Nunivak Island near Dahtkit Cove, the north coast of Nelson Island between Chinit Point and Killinupak Mountain, and in Kangirlvar Bay on Nelson Island near Nunakolak. A small amount of coal amounting to perhaps a few tons has been mined from the locality on the north coast of Nelson Island, outside the boundaries of the game refuge. Although very minor amounts of local coal have been used, fuel requirements of the entire area are supplied from driftwood and imported petroleum products.
Petroleum Possibilities

The thick Cretaceous and older rock sequences which border the Yukon-Kuskokwim lowlands to the north and east are composed mostly of dense and impermeable sediments having extremely poor petroleum reservoir characteristics. These rocks are believed to underly the alluviated areas and can be considered as the basement horizon. While the characteristics of the Cretaceous rocks are such as to nearly preclude the formation of oil accumulations within them, they do have some potential as a source for oil that might accumulate in a more favorable overlying sequence.

Following the 1957 major oil discovery from Tertiary aged sediments on the Kenai Peninsula in south central Alaska, the Bethel Basin was regarded as another potential area of Tertiary deposition, although no Tertiary aged rocks or oil seeps are exposed in the entire basin. Nearly the entire central area from Kuskokwim Bay northward to the Yukon River was subsequently leased by many different oil companies under Federal oil and gas lease regulations. A minor amount of surface geophysical work was performed and the leasing and exploratory activity culminated with the drilling of a well by Pan American Petroleum Corporation located in Section 34, T.7N., R.78W., Seward Meridian, 11 miles east of Baird Inlet. The well was abandoned on September 1, 1961.
at a total depth of 14,910 feet. Although the well discovered a non-marine Tertiary basin, no oil shows were reported and only minor, coal-associated, methane gas shows were noted.

The well section was as follows:

0 - 630 Quaternary, unconsolidated alluvial sediments.

630 - 7,040 Tertiary, non-marine siltstone, sand, thin coal seams.

7,040 - 14,910 Cretaceous, argillaceous sandstones and nearly slaty shales.

A formation test from the Cretaceous interval 9,368 - 9,406 recovered only a small amount of salty water.

After the abandonment of the well, nearly all of the leases in the basin were dropped and there was virtually no petroleum activity in the area until the Prudhoe Bay oil discovery in 1968. The surge of interest generated by the Arctic Slope discovery spread to the Bethel Basin area and again several hundred thousand acres in Federal leases were filed upon. Various land freezes have prevented the issuance of further oil and gas leases by the Bureau of Land Management in this area and all the leased applications are in a suspended status.

The main areas under lease application at present include the southern portion of the basin between the Kuskokwim River and the Baird Inlet and the northern coastal area from about Scammon Bay northward to include the delta area of the Yukon River.
Petroleum possibilities in the area may be summarized as being remote, but still worthy of further exploratory drilling. The most likely areas for initial effort would be the south coastal areas between Kuskokwim Bay and the Etolin Strait and the coastal areas of the Yukon Delta. Both of these prospective areas include large portions of the Clarence Rhode Refuge.
REFERENCES USED


Mr. Gordon W. Watson  
Alaska Area Director  
Bureau of Sport Fisheries and Wildlife  
U. S. Department of the Interior  
6917 Seward Highway  
Anchorage, Alaska 99502

Dear Mr. Watson:

Mr. Robert Pavitt has requested that this agency reply directly to your letter inviting participation in wilderness reviews of the Aleutians Islands, Clarence Rhode, Hazen Bay and Nunivak Island National Wildlife Refuges.

Basically it is imperative that proposals for any wilderness areas provide for surface transportation corridors so that our population centers may be served at a future date as resources will allow. The enclosed maps outlining the existing wildlife refuges show general corridors as presently exist and as will be needed in the future as we now envision them. These locations can be considered by no means definite at this time nor are they intended to be comprehensive in scope.

In addition to those shown, Federal-aid highway projects for construction of highway links between the villages and their airports are presently active at Hooper Bay and at Mekoryuk. Also not shown because of the map scale, are active Local Service Roads and Trails projects at Tanunak, Nightmute, Toksook Bay, Scammon Bay and Mekoryuk.

Undoubtedly future needs will become better defined in the months ahead as our work in cooperation with the Federal State Land Use Planning Commission progresses. In the meantime please let me know if you desire any additional information.

Our comments upon review of your draft report will be furnished through Mr. Pavitt's office.

Sincerely,

[Signature]

B. A. Campbell
Commissioner of Highways

cc: Robert Pavitt
NEEDED TRUNK ROUTES
ADDITIONAL SUPPLEMENTAL ROUTES
EXISTING TRAILS
NATIONAL WILDLIFE REFUGES
AVIATION CENTER

LEGEND

HARES CAY NATIONAL WILDLIFE REFUGE
CLARICE CAY NATIONAL WILDLIFE REFUGE

[Map with various locations and routes marked]
Mekoryuk located at Cape Corwin is the only village on the island. The reindeer corral and slaughter house are in the lower left.
Abandoned village of Nash Harbor near the west end of the island. The village was occupied until the mid 1940's.
Crater lakes also reveal Nunivak volcanic origin.
Lava flows in the mountainous areas were formed by volcanic action.
Numerous old village sites are visible throughout the island. Most were located at the mouths of streams and rivers.
Willows that grow along some of the rivers and streams represent the tallest vegetation on the island.
Extensive sand dunes stretch along the southern coast. These areas are important winter range for muskox.
Muskox were transplanted on Nunivak during the summer of 1935.
Muskox feeding on the windswept ridge of Twin Mountain. These windswept areas are the only food source during the winter months.
The sea cliffs near Ingri Butte contain the largest concentration of nesting seabirds on the island.
Arctic fox are the most sought after furbearer on the island. The airsled has been replaced by snowmachines as a means of transportation.
Snowmachines are used during muskox transplant operations.
Shelter cabins have been constructed at various locations around the island.
Reindeer provide the primary source of employment and income on Nunivak. Roundups are conducted twice a year and animals are dehorned, castrated, and a percentage slaughtered.
The people living on Nunivak rely on the fishery resource as a means of subsistence. Processing fish is usually conducted by the entire family.