AKM-1973- Aleutian Islands Wilderness Study Report

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

WILDERNESS STUDY REPORT

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

April 1973

Table of Contents

List of Figures

List of Tables

CHAPTER I

INTRODUCTION

Establishment

The Aleutian Islands National Wildlife Refuge was established as the Aleutian Islands Reservation on March 3, 1913, by Executive Order No. 1733, signed by President William H. Taft. Subsequent Executive Orders and Public Land Orders have altered the status and boundaries of the Refuge so that it now includes all of the Aleutian islands west of a line drawn through False Pass, encompassing Amak Island, Sea Lion Rocks, and Sanak Island group, except for the following islands: Akun, Akutan, Sanak, Tigalda, Umnak, Unalaska, Sedanka, and all but 195 acres of the southern end of Amaknak Island in Unalaska Bay. Portions of some refuge lands are affected by military withdrawals and contain overlapping jurisdictions between the Bureau of Sport Fisheries and Wildlife and the Department of Defense. These include; about 100 acres for lighthouse purposes at Cape Pankof on Unimak Island, the Scotch Cap and Cape Sarichef lighthouse withdrawals on Unimak, the eastern 1,900 acres of Ugamak Island for lighthouse purposes, about 61,000 acres on Adak Island for naval purposes, and about 1,800 acres on Attu Island for an aid-to-navigation facility. Additional alterations of the refuge boundary are pending, waiting land selection by the Aleut village corporations under provisions of the Alaska Native Claims Act of 1971. Total Refuge acreage is 2,720,430 acres, all of which qualify for study under the Wilderness Act, Public Law 88-577.

The Aleutian Islands National Wildlife Refuge is being considered under three different proposals. First of all, the Cape Krenitzin Peninsula,

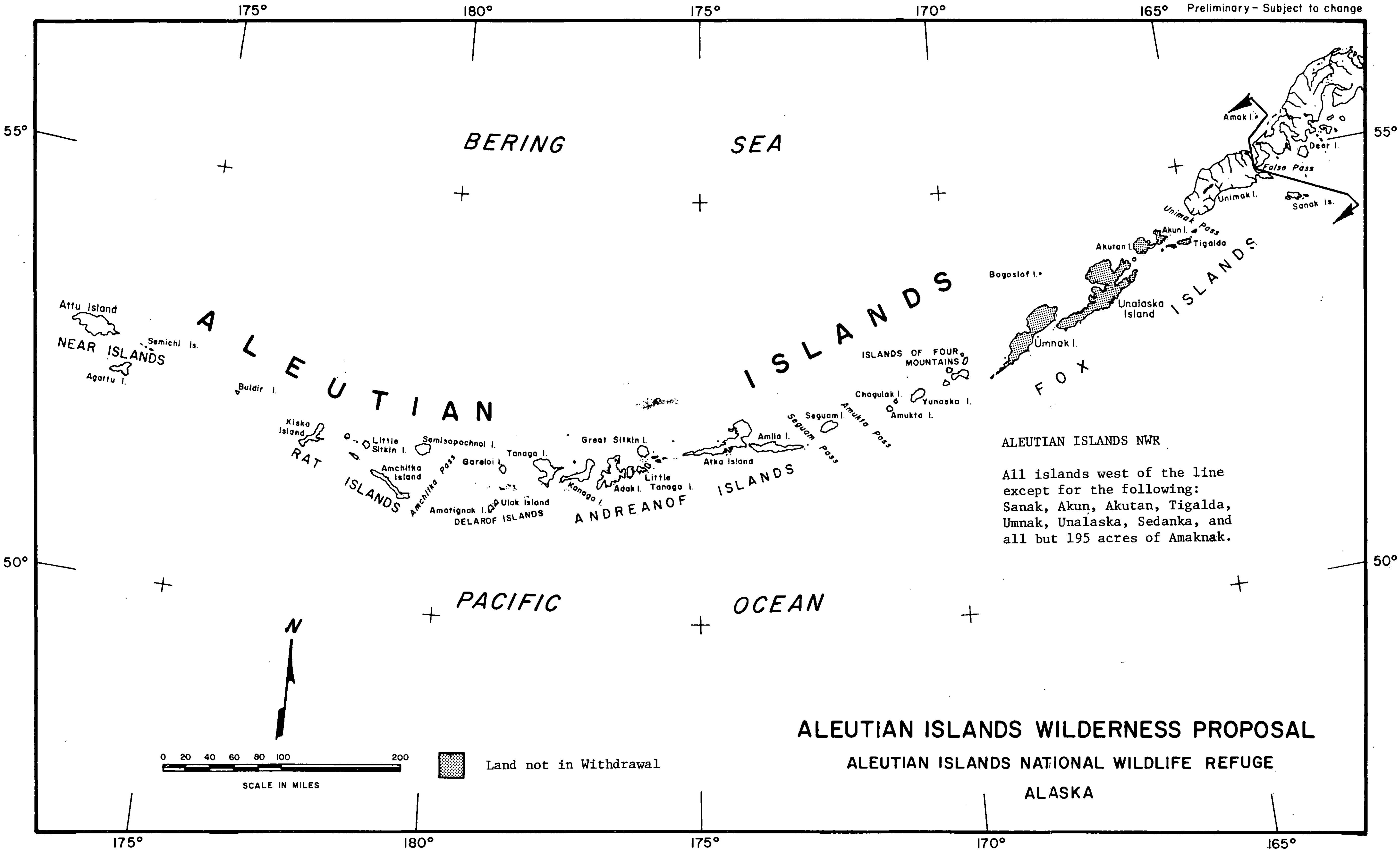


Figure 1. Map of the Aleutian Islands National Wildlife Refuge

which is a 1,451-acre area and presently a geographical and ecological extension of the Alaska Peninsula, is being considered within the Izembek Wilderness Proposal. At the time of the establishment of the Aleutian Islands National Wildlife Refuge, Cape Krenitzin was separated from the mainland by a narrow channel. However, this channel has since filled in and connected the Cape to the Alaska Peninsula. Because of this it was considered under the Izembek Proposal. Unimak Island is being treated separately as the Unimak Wilderness Proposal because of its unique flora, fauna, and geological similarity to the Alaska Peninsula rather than to the remainder of the Aleutian Islands. The remainder of the Aleutian Islands National Wildlife Refuge except for the southern 195 acres of Amaknak Island have been considered separately and are the subject of this proposal.

Location

The Aleutian Islands form an island chain separating the North Pacific Ocean and the Bering Sea. They extend in an arc from the Alaska Peninsula westerly about 1,100 miles. The eastern most point, Amak Island, lies approximately 645 miles southwest of Anchorage, Alaska's largest city. The western most island, Attu Island, stands approximately 500 miles from the Kamchatka Peninsula of Asia, and less than 300 miles from U.S.S.R's Commander Islands. Map coordinates for the chain are 54° 51' north, 163° 22' W. for the east end and 52° 55' N., 172° 24' E. at the west end. Refuge Headquarters are located at Adak Naval Station on Adak Island, nearly midway in the chain.

General Description

The Aleutian Islands are a chain of mountains surmounting the crest of a submarine ridge approximately 1,400 miles long 20-60 miles wide, and 12,000 feet high above the sea floor on either side. They are a westward extension of the Alaska Peninsula, lying within the Alaska-Aleutian physiographic province of Alaska, the Arctic life-zone of North America and the Pacific earthquake zone. The North Pacific forms the southern boundary and the Bering Sea the northern boundary. The Aleutians are thought to have appeared as islands as early as 8,000 years ago when the surrounding seas rose. Part of which are considered to be part of the former Bering Land Bridge which linked North America with the Eurasian continent. The chain is broken into the following named groups extending from east to west; Fox (includes Krenitzins), Islands of Four Mountains, Andreanofs (includes Delarofs), Rat, and the Near Islands.

Having been part of the Bering Land Bridge the flora and fauna is composed of species from both North American and Asian continents, with many plant species being composites. The chain is treeless except for a few spruce introduced by the Russians in 1805 and by the Americans during WW II. These trees are found only in those areas where both parties were concentrated. Vegetation mostly consists of low growing Arctic-Alpine species which are dominated by the heath family. Shrub forms occur only on Unimak and Attu Island. The adjacent cold, clear marine waters contain large growths of marine vegetation which represent an important food source for the countless numbers of seabirds and marine mammals that inhabit the area.

The eastern Aleutians have a fauna typical of the Alaska mainland and the western islands have Asiatic features. Olaus Murie described the Aleutians as a "melting pot for fauna elements from two continents not yet reaching an equilibrium". A total of 183 avian species and races have been recorded for the Aleutian Islands and the adjacent waters. Of special significance are the large numbers of colonial seabirds and the endangered Aleutian Canada goose which nests only on tiny Buldir Island. Four species of marine mammals inhabit the adjacent waters and frequent the island rocks and beaches. The islands also supply the life needs for numerous land mammals. Species composition and density varies significantly from island to island, depending on the size and location within the chain.

Adjacent waters also contain large populations of food fish which are harvested primarily by foreign fishing fleets from Japan, Russia, and South Korea. Four of the five species of Pacific salmon; sockeye, coho, pink, and chum spawn in Aleutian streams. The King salmon is found in offshore waters but not as a spawning species. The Aleutians were once home to about 16,000 Aleuts but they were severely decimated following the Russian discovery of the islands in 1741. Presently only six villages exist in the Aleutian chain, those being Atka, Nikolski, Unalaska, Akutan, False Pass, and Paulof Harbor. Only Atka and False Pass are within the Refuge boundary.

Other human habitations within the Aleutians are principally military establishments, those being on Attu, Shemya, Amchitka, Adak, and Cape Sarichef on Unimak Island. Those islands in the Aleutians that are not within the boundaries of the Aleutian Islands National Wildlife Refuge are managed as public domain and administered by the Bureau of Land Management.

Climate

The Aleutian Islands have a maritime climate which is characterized by persistantly overcast skies, frequent, often violent, cyclonic storms that cross the Northern Pacific Ocean and the Bering Sea, and high winds. Weather can be very local, with conditions of fog, low ceilings, precipitation, and clear weather all encountered in a distance of a few miles. It is thought by many that no other area in the world has weather that is worse than the Aleutian Islands.

The summer months of July and August are affected by the Pacific high pressure system which is located approximately south of the chain. During these months, the High lies on the periphery of the Aleutians and the air reaching the chain usually has traversed a great distance of open ocean to the southward where temperatures are warmer than the water surface in the Aleutian group. When the air reaches the islands, the cooling effect of local ocean surfaces results in the formation of widespread fog and low stratus clouds during these summer months. A large amount of rainfall occurs during this period, although the frequency of storms is lower during the summer than the winter season.

During the winter months, the air reaching the chain normally flows out to the Siberian high pressure system. After flowing across the colder areas to the north or northeast of the group, the air reaches slightly warmer open water areas in the vicinity of the chain, causing frequent, severe storms. Storms occur during all seasons but are most severe and numerous during the winter months. These winter storms are characterized by gusty winds, rain and snow, or rain mixed with snow. Between the storms, however, the chain experiences some of its better weather.

Temperatures, year-round, are cold but not normally severe due principally to the moderating effect of warm water transported into the area by the Japanese current. Seasonal and diurnal temperature extremes are generally confined to narrow limits as shown by the following:

Recording Station	Max. Daily	Min. Daily	Mean Annual
Cold Bay	42.6	37.9	38
Dutch Harbor	44.6	36.2	41
Adak	44.8	36.5	41
Amchitka	42.0	36.0	39
Shemya	41.1	35.7	39
Attu	42.5	35.6	39

Winter lasts six to nine months and frost can be expected every month except possibly July and August. Below-zero temperatures are rare and occur only in the extreme eastern Fox Group. The islands are normally free from ice, although the ice pack reached as far south as Cape Sarichef during the winter of 1971-72.

Although the temperature range is narrow and above freezing, the important factor in the Aleutians is the chill factor. The occurrence of strong winds and temperatures below 40°F makes this an important consideration.

The predominate forms of precipitation are rain and snow. Besides heavy frontal precipitation, during the winter cold air masses move from Asia, behind cold fronts, over the warm water of the North Pacific causing frequent snow showers. Due to relatively warm winter temperatures, the snow accumulation rarely exceeds 1 to 2 feet in depth. Strong winds accompanying snowfall commonly produce periods of low ceilings and reduced visibility due to blowing and drifting snow. During the summer months, the Pacific High, south of the chain, spreads warm, moist air over cooler waters, producing extensive rain and fog.

Cloudiness dominates the Aleutian Region throughout the year. Shemya is overcast 80 percent of the year with an average of six clear days per year. An average of 81 days of heavy fog occurs annually. At Cold Bay, the cloudiness averages about nine-tenths sky cover the year around. Measurable precipitation occurs, on the average, more than 200 days per year. The shortest day at Cold Bay is 7 hours and 7 minutes long and the longest day is 17 hours and 27 minutes, however because of the persistent cloud cover, the actual solar radiation reaching the earth is greatly restricted. Because of this, the seasonal periods are difficult to define and are generally late as compared with regions of similar latitude. Vegetative growth does not begin until late May or early June, and Fall generally arrives in late September or early October. The U.S. Weather Bureau (1965) reports a minimum of a 41-day season lag for the Aleutians.

Table 1. CLIMATIC DATA SHEET FOR THE ALEUTIAN ISLANDS

Weather Station	Temperature Max	Temperature Min	Temperature Avg	Precipitation (inches) Total Avg	Precipitation (inches) Avg Days Precip	Precipitation (inches) Avg Snowfall	Winds Avg	Winds Mean Direction	Winds Max	Period of Data Averages
Cold Bay	78	-13	38	34	210	51	17 mph	SSE	73 mph	1931-1960
Cape Sarichef (Unimak)	-	-	-	-	-	-	-	-	100+ mph	-
Dutch Harbor	72	+13	41	58	-	81	-	-	-	1947, 1951-1954
	80	+08	41	60	-	79	-	-	-	1927-1945
Fort Glenn (Umnak-East)	68	+08	39	51	230	53	-	-	-	1945-1950
Nikolski (Umnak-west)	64	+11	38	41	-	34	-	-	-	-
Atka	77	+12	41	67	230	60	-	-	82 mph	1879-1949
Adak	75	+03	41	68	-	98	12 mph	WSW	109 kts	-
Amchitka	65	+15	39	36	198	70	21 kts	E	100 kts	1922-1952
Shemya	63	+15	39	29	210	60	19 mph	WSW	128+ mph	1931-1960
Attu	77	+15	39	56	219	91	-	-	100+ mph	1946-1967

U. S. Weather Bureau and U. Navy Hydrographic Office. ____. Climatological and oceanographic atlas for mariners. Vol. II, North Pacific Ocean. U. S. Govt. Print. Off., Wash.

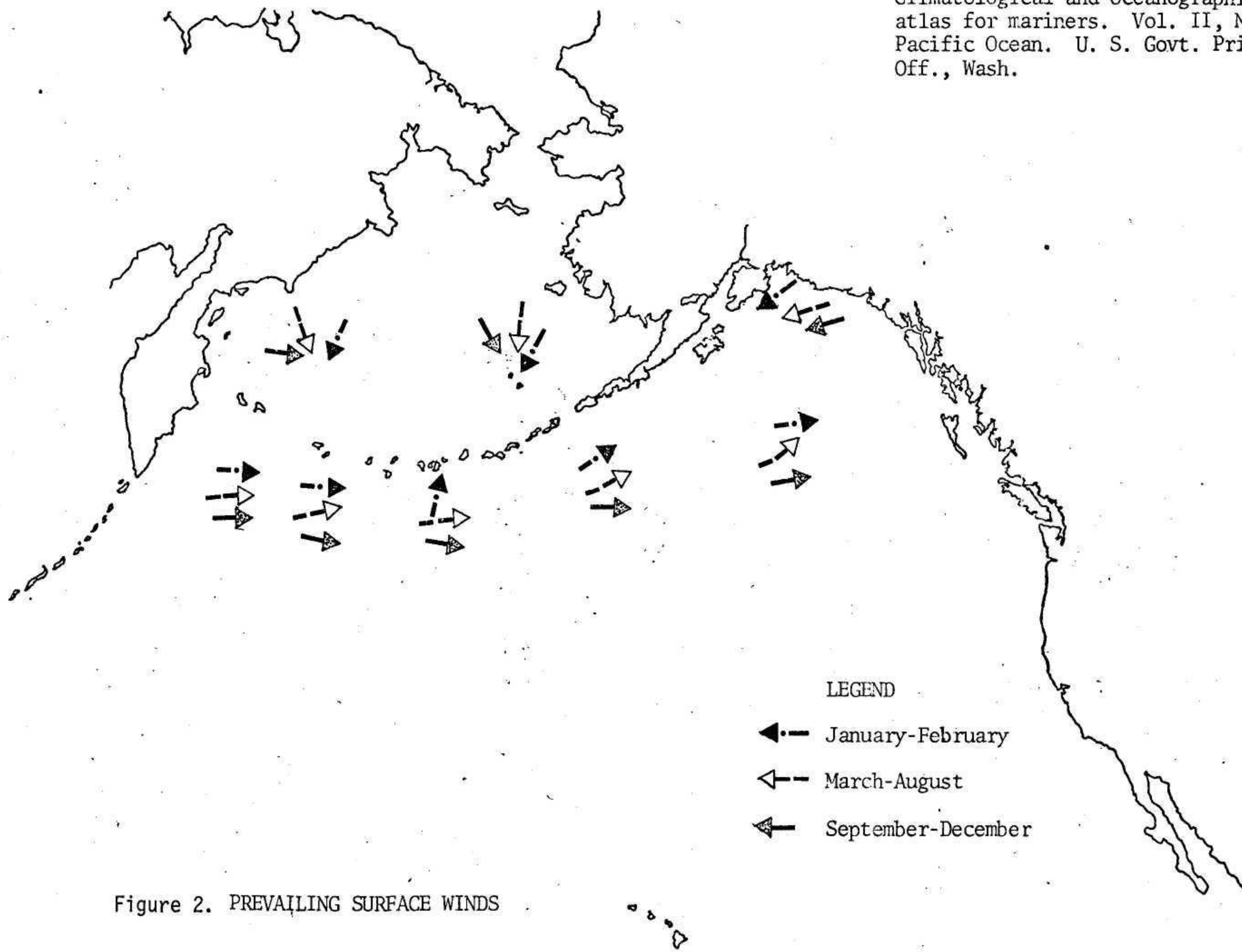


Figure 2. PREVAILING SURFACE WINDS

U. S. Weather Bureau and U. S. Navy Hydrographic Office. 1961. Climatological and oceanographic atlas for mariners. Vol. II, North Pacific Ocean. U. S. Govt. Print. Off., Wash.

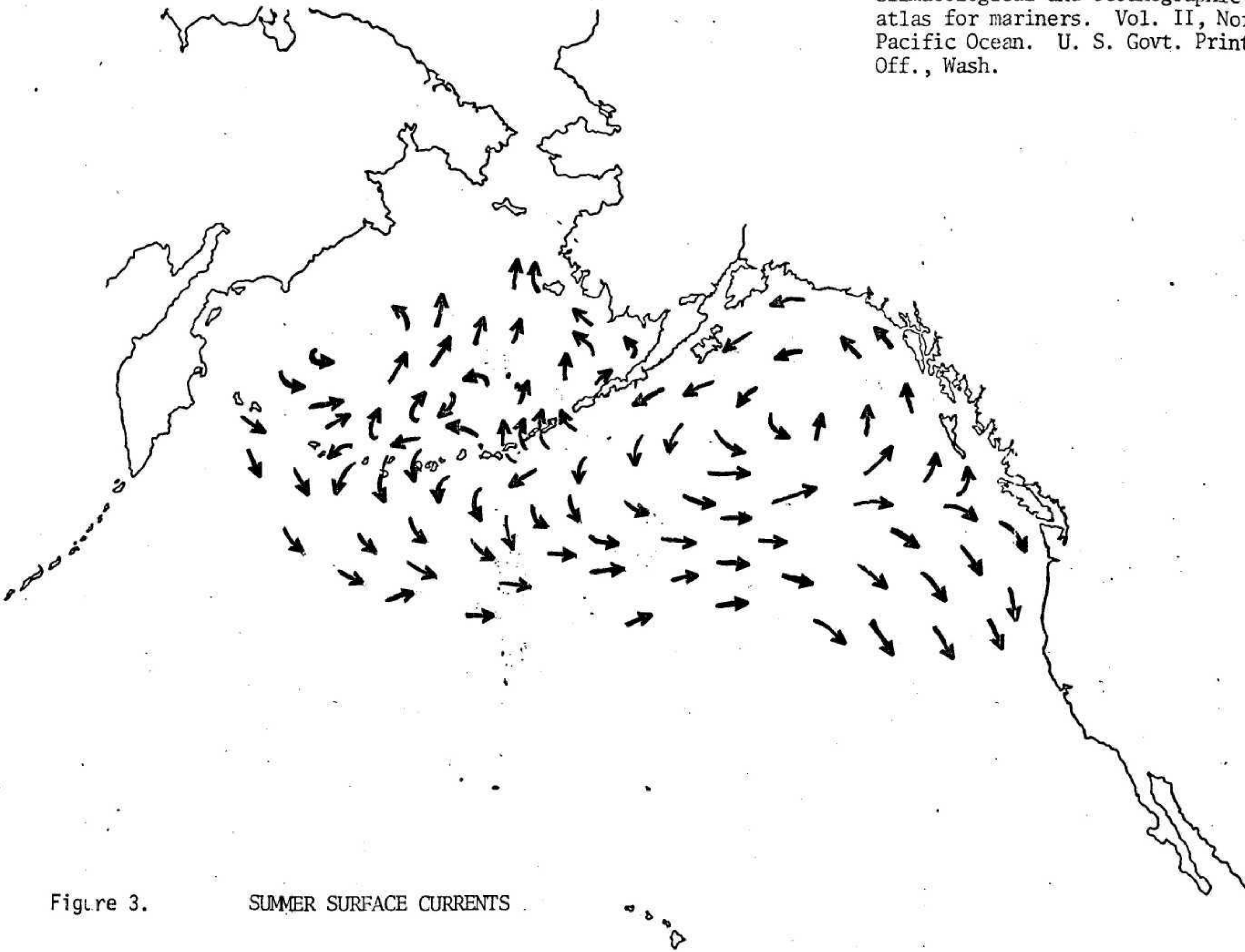


Figure 3. SUMMER SURFACE CURRENTS

U.S. Weather Bureau and U.S. Navy Hydrographic Office. 1961. Climatological and oceanographic atlas for mariners. Vol. II, North Pacific Ocean. U.S. Govt. Print. Off., Wash.

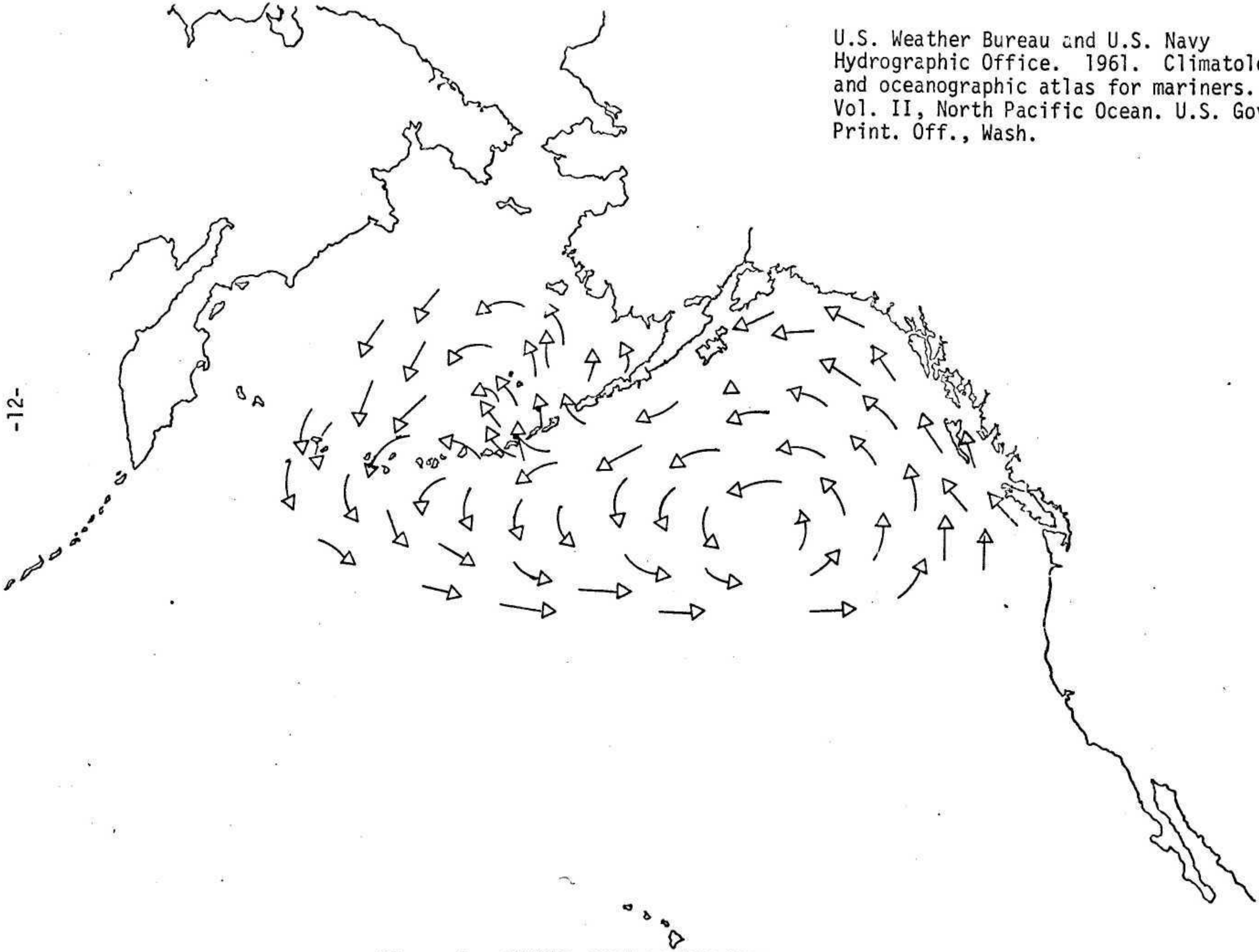


Figure 4. SUMMER SURFACE CURRENTS

The winds that sweep the Aleutians generally result from the strong pressure gradient between the Pacific High and the frequent cyclonic storms crossing the North Pacific and Bering Sea. Winds of high velocities are common with annual averages of 19 mph at Shemya, 12 mph at Adak and 17 mph at Cold Bay. Maximums in excess of 100 mph have been recorded, with Shemya experiencing an estimated 139 mph (estimated only because the wind recorder could record only up to 128 mph). Calm conditions at Shemya are experienced only about 2.5% of the time. Winds of gale force may come from any direction at any time of the year.

Refuge Management Objective's

The Refuge was established as a preserve and breeding ground for native birds, for the propagation of reindeer and furbearing animals, and for the encouragement and development of the fisheries. Management investigations conducted over the past sixteen years have resulted in the refinement of Refuge goals as follows:

1. To maintain at above minimum recovery levels all native species normally associated with the environments found on the Refuges--more specifically, to protect and preserve populations of colonial nesting birds, marine mammals, and other wildlife indigenous to the Aleutian Islands and their adjacent waters.
2. To assure the survival in a natural state of each of this Nation's plant and animal species--more specifically to restore the Aleutian Canada goose and sea otter populations to former ranges and levels of abundance.

3. To contain all lands or networks of lands of national significance whose benefits to the public can best be achieved by the distinctive competence of the National Wildlife Refuge System--more specifically to preserve watersheds which contribute materially to the production of salmon stocks.
4. To seek out, identify, designate, preserve, and appropriately use sites and objects on refuges that are recognized to have esthetic, historic, geologic, archeologic or scientific values.
5. To raise to optimum levels the kinds, range, amount, and quality of wildlife and wildlands--orientated recreation--more specifically, to manage game populations on Adak Island as a harvestable resource.
6. To establish and preserve in a natural state selected areas for reference observation, scientific study, and/or specialized public use, and in which the major ecological communities in the system are represented.

CHAPTER II

PHYSICAL CHARACTERISTICS

The Aleutian Islands National Wildlife Refuge extends approximately 1,100 miles westward from Amak Island, False Pass, and the Sanak Group on the eastern end to, and including Attu Island. Over 200 islands constitute the Chain. Ninety-two of the larger Refuge islands total about 2,688,929 acres, with over 2,707 miles of coastline. The smaller Refuge islands make up the remaining 31,068 acres for a total of 2,720,430 acres. For a comparison of coastline, the 1971 World Almanac lists Alaska as having 33,904 miles of coastline and the southern states (Atlantic, Gulf of Mexico, Pacific) having 53,677 miles. This means that the Aleutian Islands Refuge contains at least 8 percent of the total Alaskan coastline and 5 percent as much coastline as the southern "48" states.

Amak Island

The easternmost island of the Aleutian National Wildlife Refuge is Amak Island. It lies about 10 miles north-northwest of Cape Glazenap on the Alaska Peninsula. It is of volcanic origin, with shorelines varying from gravel to boulder beaches on the southern side of the island to steep bluffs and precipitous cliffs on the northwest-northern side of the island. Included with Amak Island are the Sea Lion Rocks, an exposed rock 94 feet high, with a southern slope used quite extensively as a sea lion rookery.

Sanak Island Group

The Sanak Islands are the most southwesterly group of islands along the Alaska Peninsula and are considered to be part of the Aleutian Islands.

Table 2.

SUMMARY OF APPROXIMATE ACREAGE AND SHORELINE MILEAGE
FOR THE ALEUTIAN ISLANDS NWR

Island Group	Island	Acreage	Average Shoreline (miles)
SANAK	Caton	4,414	15.0
	Elma	716	6.0
	Clifford	372	5.1
	Long	1,480	25.4
AMAK	Amak	2,893	7.9
FOX	Ugamak	3,200	14.1
	Aiktak	307	3.3
	Kaligagan	273	2.4
	Avatanak	9,114	27.5
	Poa	307	1.7
	Rootok	3,345	11.1
	Unalga	6,895	16.8
	Egg	205	2.9
	Amaknak	2,082	15.7
	Hog	137	2.4
	Ogangen	683	5.1
	Kigul	137	1.5
	Anaiuliak	307	4.1
	Samalga	1,024	9.7
	Adugak	171	2.4
	Vsevidof	478	4.5
FOUR MOUNTAINS	Uliaga	2,321	7.6
	Kagamil	10,342	17.4
	Chuginadak	42,257	46.2
	Carlisle	10,718	16.1
	Herbert	13,790	19.0
E. ANDREANOF	Yunaska	43,520	38.6
	Chagulak	2,082	7.1
	Amukta	12,425	17.9
	Seguam	52,292	41.0
	Amlia	112,640	142.2
	Atka	261,905	294.7
	Koniuji	273	2.9
	Salt	444	2.9
	Egg	102	1.7
	Sadatanak	239	2.8
	Sagchudak	546	3.7
	Bolshoi	137	2.5
W. ANDREANOF	Kasatochi	717	5.7
	Oglodak	785	4.8

Island Group	Island	Acreage	Average Shoreline (miles)
E.ANDREANOF (Cont.)	Ikiginak	580	1.7
	Tagalak	3,516	14.3
	Ulak	205	2.5
	Igitkin	4,710	19.4
	Chugul	4,301	16.9
	Anagaksik	102	3.3
	Umak	9,796	28.3
	Kanu	853	5.8
	Great Sitkin	39,219	43.4
	Tagadak	649	4.5
	Aziak	341	3.8
	Tanaklak	853	5.8
	Asuksak	410	3.0
	Chisak	137	2.0
	Little Tanaga	17,852	60.3
	Kagalaska	29,355	62.3
	Adak	180,941	211.7
	Elf	649	8.8
	Island N. of Elf	205	-
	Crone	239	4.7
	North	137	2.0
	Dora	239	5.0
	Argonne	102	2.3
	Staten	239	2.8
	Ringgold	273	3.7
	Bobrof	1,980	8.2
	Kanaga	91,716	114.6
	Tanaga	128,000	130.5
DELAROF	Ilak	307	2.8
	Skagul	956	5.9
	Ogliuga	2,389	9.1
	Kavalga	3,618	13.8
	Unalga	512	3.7
	Gareloi	16,964	19.4
	Ulak	7,646	18.4
	Amatignak	8,533	16.2
RAT	Semisopochnoi	56,013	40.0
	Amchitka	75,878	106.5
	Little Sitkin	15,701	21.7
	Davidof	819	6.3
	Khvostof	614	4.1
	Segula	8,192	15.9
	Rat	6,861	19.6
	Little Kiska	1,843	9.7
	Kiska	69,598	89.5
	Buldir	4,915	12.0

Island Group	Island	Acreage	Average Shoreline (miles)
NEAR	Agattu	55,535	70.5
	Shemya	3,447	13.4
	Nizki	1,707	11.8
	Alaid	1,468	9.4
	Attu	223,812	152.6
	TOTAL (91 Islands)	1,691,102	2,429.7
Remaining unnamed island, rocks, and reefs above the mean high tide level		29,617	unknown
Other			
Unimak Island (Unimak Wilderness Proposal)		998,260	265.0
Cape Krenitzin (Izembek Wilderness Proposal)		1,451	12.0
	GRAND TOTAL	2,720,430	2,706.7

All but Sanak Island proper is within the Refuge boundary. This group of islands covers an area 20 miles long and 10 miles wide; it consists of 2 large islands, Sanak and Caton and numerous small islands and rocks. All are treeless. Sanak Island is dominated by Sanak Peak, 1,740 feet high and the 787 foot peak 1.5 miles northwestward of Sanak Peak. A ridge rising to 200 feet is on the eastern side of the mountain mass, but the remaining land area in the group is quite low in comparison, being over 100 feet high on the northern side and decreasing to less than 40 feet high among the southern islands. Caton Island at the easternmost part of the Sanak Group is low, rolling, and grass covered. The beaches are composed of rock ledges or boulders and gravel. Steep and prominent bluffs dominate the northwest side, and the eastern and southern sides are low, fringed with rocky ledges.

Fox Island Group

The Fox Islands are the easternmost group of the Aleutian Islands. They extend approximately 290 miles westward from the Alaska Peninsula. The easternmost island is Unimak and the westernmost is Samalga. The main islands are: Unimak, Ugamak, Tigalda, Avatanak, Akun, Akutan, Sedanka, Unalga, Unalaska, Umnak, and Samalga islands. All islands except for Akutan, Akun, Sanak, Tigalda, Umnak, Unalaska, Sedanka and the northern part of Amaknak islands are within the Aleutian Islands National Wildlife Refuge. The islands are principally mountainous in nature, with lowlands occurring on Unimak and Umnak. The islands from Unimak Pass to Akutan Pass are subgrouped into the Krenitzin Islands.

Unimak is the first and largest island of the Aleutian Islands. Containing approximately 1,000,000 acres, this beautiful island is dominated by the active Shishaldin Volcano, a classical cylindrical cone rising to 9,978 feet, the highest mountain in the Aleutians. Shishaldin's neighbor, Isanotski, known locally as Ragged Jack, is an outstanding example of the awesome splendor created by the combined forces of volcanism, glaciation, and winds of gale force. The central portion of the island is made up of this line of volcanoes along with the recently active volcanic section at the southwestern portion of the island. The center portion is interrupted only by the blue waters of the volcanic lake, Fisher Caldera. The Bering Sea side of Unimak consists of rolling heath, interspersed with many lakes, streams, and marshes. The Pacific side is dominated by ash flats and rises more rapidly to the mountainous center of the island than does the Bering side. Unimak is separated from the Alaska Peninsula by 1 7/8 miles at Kabuch Point by the Isanotski Strait, also by 6 7/8 miles between Cape Krenitzin and Chunak Point at the entrance of Bechevin Bay into the Bering Sea. The northern side of the island is dominated by relatively flat, sandy beaches, backed by grassy bluffs. Much of the mountainous portion of the island has been deeply eroded by streams, glaciers, and frost action. Ice fields and small glaciers do occur around Round Top, Isanotski, Shishaldin, Westdahl and Faris Peaks. The Bering Sea lowland is a gently sloping plain rising gradually from the sea either to merge imperceptibly with the mountain slopes or, in places, to intercept them sharply. The lowland is continuous throughout the north side and ranges from 5 to more than 12 miles in width. The surface of this lowland is generally less than 300 feet above sea level and is characterized by a dense growth of vegetation;

many rounded hills and numerous lakes, streams and marshes. The shorelines are commonly sandy and backed by low bluffs cut into grass covered sand dunes. A small part of the coastline is quite rugged and mountainous, with rock-bound and cliff-type shores. Narrow, boulder beaches lie at the foot of the rock cliffs, and sand beaches are found along the coastal lowlands and at the head of some bays and coves. Unlike most of the other Aleutian Islands, Unimak possesses several long streams, many of them slow-flowing, on the northern, western and southern sides.

Ugamak Island lies nearly 14 miles due south of Scotch Cap on Unimak and is the easternmost of the Krenitzin Islands. It is about 4 1/2 miles long and 1/2 to 1 mile wide, with a sharp peak 1,[illegible]42 feet high at the eastern end and a 905 foot knob near the middle of the island. The narrow beaches are sand, clay and cobblestone, strewn with boulders and jagged rocks and backed by steep cliffs 50 to 1,000 feet high.

Tigalda Island is on the south side of Ugamak Strait, about 5 miles southwest of Ugamak. It is approximately 11 miles long in an east-west direction and 3 miles wide. It has six mountain ridges 1,000 to 1,600 feet high trending northwest and separated by low valleys. The western end of the island is relatively low.

West of Tigalda is mountainous Avatanak Island. It measures 9 miles long by 2 miles wide at the eastern end and averages less than 0.8 mile in width at the western end. The middle of the island is a depression, containing the only lake, with slopes gently reaching peak elevations of 1,635 and 1,276 feet on the east and west ends respectively. Many extreme irregularities exist in this island's topography. Other than the mid-point of the island, the coastline is ringed by steep bluffs, rocks and kelp.

Rootok Island is the westernmost island on the southern side of Avatanak Strait. It is 3 by 2.2 miles in extent. The island's most prominent features are its twin peaks, 1,545 and 1,532 feet high and 600 yards apart in an east-west direction. A continuous cliff dominates both the northern and southern sides of the island; it is broken only by small valleys slightly eastward of the two peaks. The base of the bluffs contains rock and cobblestone beaches. This island, like others in the Krenitzin Group has a marine terrace 3-8 fathoms deep around its periphery.

Akun Island lies approximately 23 miles southwest of Unimak and is the northernmost of the Krenitzin Group. It measures about 12 miles long and is very irregular in shape, since it is nearly divided in two at Akutan Bay and Lost Harbor. The island is high, mountainous and very rugged, particularly in the northern part where it reaches a peak elevation of 2,685 feet at Mount Gilbert, a semi-active volcano. Shorelines consist of vertical cliffs and rocky headlands.

Largest of the Krenitzin Group, Akutan Island lies about 9 miles northeast of Unalaska, and is separated from the latter by Akutan and Unalga Passes. The island is very mountainous and rugged. The volcanically active Akutan Peak, 4,244 feet high, rises to the highest point in the Krenitzin Group. The village of Akutan lies in Akutan Bay 2 miles inside Akutan Harbor. Shorelines are similar to those of neighboring Akun.

Unalga Island is separated from Unalaska by Unalga Pass. This island is relatively low compared to the neighboring islands. The highest point is a rounded hill of 707 feet, and the eastern end of the island is a flat-topped hill 145 feet high. The shoreline is precipitous with rocky beaches.

Unalaska Island is one of the larger islands of the Fox Group. It is about 67 miles in length along the axis of the chain. Extremely mountainous and rugged, it is covered by snow during much of the year at the high elevations. The coastline is irregular and is broken by numerous bays and coves, three being particularly deep: Unalaska Bay, Makushin Bay and Beaver Inlet. The active Makushin volcano, 6,680 feet high, dominates the northern part of Unalaska and is the highest point on the island.

Sedanka Island is close to the southeastern end of Unalaska Island, separated by the narrow, deep Udagak Strait. It is quite mountainous with numerous peaks separated by deep valleys generally running northwestward. The highest peak is 2,130 feet in the southwestern part of the island. The outer coast is broken by bays and coves and is separated by bold, rocky headlands.

Third largest of the Aleutian Islands, Umnak Island is about 65 miles in length and 12 miles in breadth. Mount Vsevidof, an inactive volcano 6,920 feet high, is the peak summit of the island and is located southwestward of the center of the island near the western shore. Mount Okmok, located in the northern part of Umnak Island, is an enormous crater 7 miles across. Dense smoke may be visible from various parts of this crater.

The elevation of Mount Tulik on the northeastern rim of the crater is 4,111 feet, and on the opposite side of the crater lies a sharp peak 3,519 feet high.

Bogoslof Island, part of the Bogoslof National Wildlife Refuge, lies in the Bering Sea approximately 25 miles north of Umnak Island. This Refuge was designated the "Bogoslof Wilderness" by Public Law 91-504, dated October 23, 1970. Recent volcanic formations and eruptions have ranged the topographic features several times. According to existing records, eruptions have occurred in 1796, 1883, 1906, 1910, and 1923 to 1927; however it is probable that there have been other eruptions of which there is no record. Presently it consists of one main island and a rocky islet known as Fire Island. The main island, known as Castle Island because of a castle shaped rock on it, is about 1 mile long and 1/2 mile wide extending in a northwesterly and southeasterly direction. The southern end of the island terminates in a low, black sand spit which is presently a haul-out for sea lions. On the northwestern part of the island are fissures which emit steam occasionally. Fire Island is an irregular rock 225 feet high, 220 yards long and 100 yards wide and is located approximately 1/4 mile northwest of the main island. It is a steep, rocky island and almost connected with the main island by a rocky ledge which uncovers at low tide.

Samalga Island lies about 2 miles southwest of Cape Sagak on Umnak Island. It is a long and narrow island, about 4 miles long and 1/2 mile wide at the widest part. The high-water mark is strewn with rocks, small boulders and occasional stretches of sandy beaches. Back of the shoreline, the terrain rises abruptly in bluffs. The interior is flat and completely covered by grass. The entire island is fringed with a rocky ledge which uncovers at low tide, extending 100 yards to 1/2 mile offshore. On the southwest end of the island, this ledge becomes a long, extensive reef stretching west-southwest along the prolonged axis of the island for nearly 2 miles.

Islands of Four Mountains

This group of volcanic islands lying westward of the Fox Group and eastward of the Andreanof Group comprises the following islands: Uliaga, *Kagamil*, Chuginadak, Carlisle, Herbert, Amukta, Chagulak, and Yunaska (U.S. Board on Geographic Names, 1963). This group is located about 16 miles from Samalga Island and measures about 18 by 25 miles in extent. These islands are quite high and snow-capped, with the snow remaining throughout the year. The volcanoes are the classical cylindrical shield cones. Except for occasional sandy beaches in shallow bights, the coastlines are either sea-worn lava flows or rock-covered and backed by grass-covered bluffs.

Uliaga Island is the northernmost and smallest of the Four Mountain Group. It consists of one central mountain cone, with a few prominent spurs. On the slopes are several spire-like rocks. The peak rises to 2,910 feet with two points, one sharp and the other flat, larger and slightly lower. The northwest side of the mountain is quite steep and greatly eroded. A serrated ridge protrudes from the south side of the mountain and the southern of the three peaks on this ridge is very prominent.

Between Uliaga and Chuginadak islands lies Kagamil Island. A large mountain in the center of its southern half rises to 2,920 feet in height with a circular crater on its northwest siae. Steep sea bluffs give way to gently sloping areas of tundra which change abruptly to steep, rocky slopes near the center of the island. A number of active fumaroles exist near the southeastern end of the island. The hills in the northern part culminate in a 1,640 foot peak, which is close to the northern shore. The two largest valleys are on the eastern side of the island. The northernmost valley is flat with some grass-covered bluffs and is drained by two small streams.

Chuginadak Island is the largest of the islands in the Four Mountain Group. It consists of two mountain masses divided by a low, windswept valley lying across a very narrow neck of land. The low area of the valley contains some grassland interspersed with areas of lava flow, cinder and ash patches and conical cinder hills. The eastern portion of the island is an area of rugged terrain formed by a group of eroded volcanic peaks, the highest being 3,840 feet. Numerous valleys and ridges descend to the rocky bluffs bordering the shoreline. The peaks are almost constantly cloud-covered and are, according to records, covered by snow nearly the year around. The lower levels have a vegetation of thick grass, primarily *Calamagrostis*, while the higher altitudes are barren rocks and lava ash. Many prominent interior waterfalls are seen around the eastern portion of the island. The coastline of the eastern portion of the island is indented by many coves and bights. Numerous large boulders and rocks are found along the shoreline. The western section of Chuginadak Island consists of the tall, symmetrical shield cone known as Mt. Cleveland. This active volcano rises to over 5,680 feet in height. The sides are streaked by a series of lava flows, many of them quite recent with intervening grass patches on the slopes, primarily on the south side. Because of the heat from volcanic activity, this mountain tends to lose snow more rapidly than the other high mountain peaks. There are no waterfalls on this island and probably fresh water only after a rainfall, as it appears that the lava flows are so porous that no stream of water from the melting snow reaches the shoreline. The coastline is more regular on the eastern portion of the island, and the kelp beds bordering the shores of the western portion are less extensive.

Located about 1 1/5 miles northwest of Chuginadak, Carlisle Island is a single extinct volcanic shield cone 5,280 feet high. The island is somewhat circular in shape, with a diameter of approximately 4 miles. The upper portion of the mountain is generally snow-covered with lower slopes of dark lava, and below approximately 1,500 feet they are covered with grass and tundra. The lower slopes flatten out, generally terminating in rocky cliffs or steep bluffs with a rocky coastline. The westernmost point of the island is a relatively flat, oblong plateau approximately 1,000 by 1,400 yards, with an average elevation of about 160 feet. The only fresh water stream on the island may be found flowing on the southeast side about one mile south of a fox trapping cabin.

The most southwestern of this group is Herbert Island. It is separated from Chuginadak by 3-mile-wide Chuginadak Pass. This island is composed of one mountain appearing as a truncated cone. The truncated section is the rim of a crater about one mile in diameter. The highest part is its southern rim, 4,235 feet in height. The northern side of Herbert Island appears fairly flat, although the shoreline of the island is deeply eroded and quite abrupt. The southern and western sides are marked by yellow scars on the crest. The island is generally covered with tundra, and the lower slopes are regular and in some places quite gentle.

Yunaska is about 14 miles southwest of Herbert Island. It is a volcanic island divided into 2 parts by a flat valley with gentle slopes. From the sea bluffs, back of the shoreline, to the base of the mountains, the island is mostly grass-covered below 1,000 feet, especially in the lower flats where the grass is extremely thick. There are few beaches. A large crater about 2 miles at its greatest diameter is in the eastern portion of the island. This appears to be fairly recent in volcanic activity. The highest point on this crater's rim is 1,968 feet on the northwest side. This crater is surrounded by various conical and ridge-like hills, interspersed with small craters and lava flows, indicating its great fiery activity in the past. Within the larger crater is a small nested cone of 1,804 feet which has its own small crater. The prominent lava flow extends from the southwest rim of the larger crater for about 1 mile south, although it doesn't reach the shoreline. The cliffs along the southern portion of the island are honeycombed with caves, lava tubes and marked with many ridges and arches. Near the northeastern shore of the island is a prominent saddle-shaped peak approximately 1,066 feet high at the highest point. The central part of the island is a tundra-covered valley composed of flats, occasionally interrupted by small hills and knolls.

The western portion of the island contains the highest point, 3,119 feet in height. It appears to be a dormant or extinct volcano somewhat eroded, with remnants of craters on the side and about its base. A low bluff extends along most of the western coastline, and south of it are higher bluffs, rising 300-600 feet in places. The shoreline around the island is rugged and has many off-lying rocks and pinnacles.

Chagulak lies about 10 miles west of Yunaska and 3 miles northeast of Amukta. It is a steep, volcanic island having a sharp peak 3,750 feet high. It has extremely rugged slopes marked by a series of sharp, descending, rocky ridges marked by numerous pinnacles that terminate in rock cliffs at or near the shoreline. It is uninhabited except by a great number of birds. There are no good landing places on this island. It is steep on all sides, with very few rocks or off-lying reefs. The shore is for the most part composed of large boulders, vertical cliffs and outlying rocks. The northern shoreline is very rugged with precipitous, rocky cliffs.

Amukta Island has a dormant volcanic cone with a crater at its summit, the highest point on the rim is 3,463 feet at the western end. The volcano is closer to the northern shore of the island, where its slopes descent directly to the shoreline. The base of the mountain cone proper is at the 1,000 foot level, and to the east and west the lower slopes reform into spurs, hills, and some ridges. Near the northeastern shore is a prominent cinder cone 1,486 feet high. Amukta is mostly covered with lava and cinders. Some grassy areas exist along the west side near the beachline, in the area south of the cone and on the ridge forming the southeast peninsula. The northeast shore of Amukta is, in general, composed of lava bluffs or large rocky beaches. The western shore consists of high bluffs, meeting the slopes of the nearby ridges. Almost the entire coastline of this island is fringed with detached rocks and ledges of various descriptions.

Andreanof Island Group

This island chain lies between the Islands of Four Mountains, to the east, and the Rat Island Group, to the west, and extends nearly 310 miles from Amukta Pass westward to Amchitka Pass. The main islands are Seguam, Amlia, Atka, Great Sitkin, Umnak, Little Tanage, Kagalaska, Adak, Kanaga, Bobrof, Tanaga, Gareloi, Ogliuga, Kavalga, Skagul, Ilak, and Amatignak Islands. Included in the Andreanof Group, on the western end, but subtitled the Delarof Islands, are the islands of Gareloi, Unalga, Kavalga, Ogliuga, Skagul, Ilak, Ulak and Amatignak Islands. Numerous smaller islands do occur throughout this group, but because of size, only the larger islands will be briefly described.

An excellent example of volcanism, Seguam has numerous lava flows and dormant craters. The Island consists of two mountainous sections separated near the center by a cinder covered saddle. Pyre Peak dominates the western end at 3,458 feet and an unnamed crater at the eastern, about 2,768 feet in height. The sides of the Island are steep with many peaks and pinnacles close to the shoreline. Several landing areas exist although shoals are at the principal Island points. Other than these the shoreline consists mostly of eroded lava flows.

Amlia Island is about 16 miles southwest of Seguam Island on the west side of Seguam Pass. It is about 40 miles in length along its east-west axis and has a width of about 8 miles. There are a few small lakes on the island, but the most distinctive feature is a chain of sharp peaks extending the length of the island. Peak elevation is 2,020 feet, with two others reaching 1,900 feet. The coastline is slightly indented along both sides forming many bays and bights. Sandy beaches are limited to the aforementioned areas. Bold headlands mark the intervening coastline.

Separated from Amlia by Amlia Pass, Atka Island is 10 miles wide by 50 miles long along its east-west axis. It is the largest island of the Andreanof group. The most distinctive landmark on the island is Korovin Volcano, which rises to a height of 4,852 feet and is located 3 miles inland from the northern end of the island. Several peaks extend along the interior of Atka Island somewhat similar to Amlia. These vary in elevation to heights of 3,200 feet. The coastline of this island is indented with many excellent anchorages, bays and coves. The most commonly used is Nazen Bay, on the east coast just north of Amlia Pass. This is also the location of the small Aleut village of Atka. Most of the island points are bold headlands rising 300 to 400 feet, then ascending more gradually to peaks further inland. The area is treeless, covered with vegetation to about 1,000 feet above which there is little vegetation. As a rule, the heads of the bays are low bluffs with sand and gravel or small boulder beaches, back of which lie valleys going into the interior of the island.

Kasatochi Island is located 10 miles to the northwest from Cape Kigun on Atka Island. Kasatochi is an extinct volcanic crater rising to approximately 1,038 feet, with a lake in the caldera of the volcano. The south and southeast sides of this island are covered with grassy slopes, the west and southwest sides are high rocky bluffs, all sides having rocky shorelines.

Koniuji Island is 14 miles northeastward from Cape Kigun on Atka. It, too, is volcanic and all sides, except the south and southeast, are extremely sheer and precipitous, rising to two summits of 880 feet and 760 feet. The slopes on the south side are grass-covered; the northwest end of the island is a low, flat, rocky point about 200 yards long. The shoreline is precipitous and rocky.

Oglodak Island is about 4.5 miles west of Cape Kigun on the westernmost point of Atka Island. Oglodak is 1.3 miles long and 0.7 mile wide. This island is extremely steep and mountainous. The shores are precipitous and rocky, fringed with off-lying islets and rocks.

The next island, Ikiganak, is one mile west of Oglodak, it consists of a cone-shaped mountain 871 feet high. The island is 700 yards in diameter, with detached islets at the eastern and western ends. The shores are steep, rocky and fringed in places by off-lying rocks.

Tagalak is about 6 miles west of Ikiganak Island. It is mountainous, roughly triangular in shape, and about 3.2 miles long by 2.5 miles wide. From the eastern point of this island, a chain of small rocky islets ringed by kelp extends to the east about 2.7 miles. The highest peak on this island is 1,783 feet in height. The shorelines in general are steep and rocky with a few small beacnes. The shoreline in most places is fringed by detached rocks.

Chugul Island is 4.5 miles long from northwest to southeast, and about 2.5 miles wide from north to south. The highest summit reaches approximately 1,700 feet. Many small lakes and streams occur on the island. The coast is generally steep, rocky, but there are some sandy beaches at the heads of the indentations.

About 1 mile northwest of Chugul, is Igitkin Island which measures 5.5 miles long and is extremely narrow. It is roughly divided into 2 parts connected by a low isthmus. Aside from the isthmus, the island is mountainous and rocky. The coastline is generally steep and rocky and edged with small islets and detached rocks.

The next island is Great Sitkin, approximately 27 miles westward of Atka. The dimensions are 10 miles long and approximately 15 miles wide. It is roughly circular in shape. The island is volcanic and extremely mountainous, the highest summit being an active volcano approximately 5,740 feet high. Much of the shoreline on this island is steep and rocky, but there are considerable stretches of sandy beach. There are some off-lying rocks and islets, both exposed and covered. Two large indentations exist on the island, Sand Bay on the southwestern side and Yoke Bay on the southeastern side.

The next island, Ulak, lies about 2.3 miles east of the eastern extremity of Great Sitkin Island and about 2.5 miles north of Igitkin. It is essentially a barren rock, about 1 mile long, 0.2 mile wide, and at the highest point 688 feet high.

Kanu Island is approximately 995 feet high, 1.5 miles long and 1 mile wide, and lies about 0.5 mile southwest of Tagadak Island. It is rocky and mountainous, with steep, rocky shorelines, except on the west side where there is a sand and gravel beach. The coastline is ringed with a great number of rocks and reefs, supporting an abundant kelp population.

Little Tanaga Island is located immediately east of Kagalaska Island. It is quite irregular, about 8 miles long and 7 miles wide. Two long bays separated by a narrow isthmus nearly cut the island into two parts. It is very rocky and mountainous, the highest peak being 1,747 feet high. Several streams and small lakes are found on the island. The coastline if fringed with reefs, islets, and detached rocks; the shorelines are steep and rocky.

Kagalaska Island is typical of the group in that it is extremely rugged and mountainous. The highest peak, located in the northwestern section, is 2,331 feet high. Dimensions of the island are 8 miles long by 5 miles wide. The shorelines again are steep and rocky except on the west coast, where there is a more gradual slope which becomes steeper inland. Brief stretches of sand and gravel beach can be found, backed by vertical cliffs. The coastline is clear except for the south and southeast portions and part of the north coast, these being fringed by many small islets and detached rocks. Several lakes and streams can be found on the island.

Considered to be the most important of the Andreanof Group, Adak Island is irregular in form, measuring about 30 miles long and 20 miles wide at its widest point. This island is extremely mountainous, rugged and quite beautiful, having numerous small bays and indentations. Mount Moffit, an extinct volcano, is 3,900 feet high and is located at the northwest end of the island. It is the island's highest point. Grass-covered on the lower levels, numerous lakes and small streams abound on the island. The eastern coast of Adak is bordered by steep bluffs and rocky cliffs; it has numerous islands, rocks, and reefs that lie close to the shoreline.

Next we have Kanaga Island, which is located immediately west of Adak Island across Adak Strait. This island extends 18 miles north to south and 28 miles east to west and has a maximum width of 7 miles, being roughly right-angled in shape. The northern part of the island is dominated by the cone-shaped Tanaga volcano that rises directly from the water on the northern edge to approximately 4,416 feet. There are several lesser peaks south of the volcano from which the land slopes down to the rolling tundra-covered hills of the southern portion of the island. The hills average from 100 to 600 feet in elevation, and are covered by numerous streams and small lakes. The coastline of Kanaga Island along the west side is fringed by kelp beds, small islands and rocks. The northern coast is quite steep, with precipitous cliffs ringed by numerous small islets and rocks.

Located 6 miles northeast of Cape Sudak on Tanaga Island is Bobrof Island more than 2 miles long and almost 2 miles wide. Other than on the north side the remaining shoreline is quite rocky and precipitous, with steep sides rising abruptly to Bobrof Volcano, 2,420 feet in elevation. A prominent cylindrical black lava peak at the northern point of the island is connecte… to the base of the volcano by a low, grassy area.

Tanaga Island is separated from Kanaga by Kanaga Pass, which is slightly less than 4 miles wide at its narrowest part. This island is irregular in shape, with the greatest north-south length of 20 miles and the east-west length of 23 miles. As with Kanaga Island, the northern section of the island is high and mountainous, with a peak elevation of 5,197 feet, while the southern portion is low, with an interspersion of many streams and small lakes. The north shoreline has precipitous, rocky cliffs and steep slopes which rise to the interior mountains. The other shorelines are rocky cliffs and reefs with several shore pinnacles, except for the beaches in Tanaga Bay and a few other places. The south coast and much of the east coast of Tanaga, as on Kanaga, are fringed with detached rocks and reefs.

Tanaga Pass separates Tanaga Island and the Delarofs, being 13 miles wide at the narrowest point. The Delarofs are a group of 9 islands and several small islets and rocks, covering an area of 38 miles north-south and 33 miles east-west. All of the Delarofs except for Amatignak and Gareloi are relatively low, flat islands: from a distance they appear as table tops.

The easternmost of the Delarofs is Ilak Island which has an elevation of 188 feet. The top slopes gently from east toward the western portion of the island. The shoreline is typical of this group in that it is surrounded by detached islets, rocks and reefs.

Shagul and Ogliuga Islands, located 2.5 to 7 miles west of Ugidak Island, are encircled by many rocks, reefs, and kelp beds. During the Second World War an emergency landing field was established on this island. The abandoned airfield, several of the buildings, and tower still exist.

Ugidak Island is the easternmost of a chain of four islands in the central part of the Delarof Group. It is 75 feet high and is small and rocky. Tag Islands are a group of small rocky islets approximately 3 miles southwest of Ugidak. All these islands are relatively flat, and appear as table top islands.

Ten miles westward of Ugidak, Kavalga Island is 5 miles long, with a width, at its widest point, of 1.5 miles. The highest point is 315 feet. A prominent mile-long headland at the western end of the island is 180 feet high and is connected to the mainland by a low gravel beach. The shores are ringed. Kavalga, as with most of these islands, is completely covered with vegetation and the shores are fringed with prominent rocks and reefs.

Unalga Island is the westernmost of the central Delarof Group. It is approximately 240 feet high, covered with vegetations, rimmed with steep bluffs, and flat on the top. The shoreline is surrounded with rocks and reefs, and like the remainder of the central Delarofs, is excellent sea otter habitat.

Northernmost of the Delarof Group is Gareloi Island, which differs substantially from the central Delarofs. It is 20 miles westward of Tanaga, is almost circular and measures 5 miles in diameter. It is an active volcanic crater, appearing as a single cone rising from the sea to an elevation of 5,160 feet. The land slopes steeply to the summit, except on the northwestern side where the slopes are a bit more gradual. The island consists of lava flows, eroded lava, and ashes. The lower slopes and valleys are covered with grass and tundra in places. The shorelines have steep cliffs with rocks and boulders at the base. Boulders, pinnacles and rocks extend around the shoreline, and there is a heavy fringe of kelp around the island.

Ulak Island, immediately north of Amatignak Island, is one of the southern islands in the Delarof Group. The island is irregular in shape and is quite flat. It measures 6 miles long and 3 miles wide at its center, with a peak elevation of 531 feet. Numerous rocks and islets border this island, and reefs are extremely common.

The southernmost island of the Delarofs and the Aleutian Chain, Amatignak lies approximately 70 miles east of Amchitka Island. Nitrof Point is the most southern point in Alaska being within 40 miles of the Seattle-Yokohama sailing course. The island is relatively small, measuring 6 miles long by 4 miles wide. The island is mountainous, once covered by glaciers, with sharp ridges and trough-like valleys. Peak elevation is 1,690 feet. The shorelines are rugged, precipitous with numerous detached rocks. The western coastline is quite broken with many prominent pinnacle rocks, steep cliffs, and small coves. The Delarofs are separated from the Rat Group by Amchitka Pass, which has a width of at least 50 miles and depths ranging from 49 to 1,000 fathoms.

Rat Island Group

The Rat Islands extend from Amchitka Pass westward nearly 180 miles to Buldir Island. Included are Semisopochnoi, Amchitka, Rat, Little Sitkin, Segula, Kiska, Buldir, and several small islands (U.S. Board on Geographic Names, 1963). The Group is mountainous except for the eastern section of Amchitka which is relatively flat.

Semisopochnoi Island, the most northeastern island of this group, lies about 27 miles north of Amchitka. Its area of about 78 square miles forms a nearly complete circle, with the length and width about 12 and 10 miles respectively. This is an extremely rugged, mountainous island with peaks and ridges from 1,200 feet to over 4,000 feet high. Most of the peaks and cones on Semisopochnoi have deep craters, all of volcanic origin. The shoreline is almost entirely steep cliffs or bluffs ringed with a narrow, rough boulder beach. Kelp is continuous around the shoreline. Fenner Valley, surrounded by precipitous mountain ridges contains Fenner Lake, which is 300 feet above sea level. This valley, the most prominent feature of the island, is drained by Fenner Creek.

The largest of the Rat Islands, Amchitka, measures 40 miles long and averages 4.5 miles wide, with the island's axis lying in a northwest-southeast direction. It is divided into two physiographic types, the eastern lowlands and western mountains. The eastern lowlands are relatively flat, with an interspersion of many small lakes and streams. Elevations vary from below 100 feet to 500 feet. The western section of the island is mountainous, with peaks rising to the 1,200-foot level. The coastline is irregular and ringed with numerous rocks, reefs, and extensive kelp beds.

Little Sitkin Island lies 32 miles west of Semisopochnoi Island, having a north-south length of 5.5 miles and an east-west length of about the same distance. The interior of this island is extremely rugged and quite mountainous, with only the lower slopes covered with vegetation. There are two prominent peaks on the island, one 3,897 feet high in the northeastern section and the other 1,960 feet in the southern section. Numerous streams are found on the island, but there are no lakes or ponds. The coastline is quite bold, rocky, and precipitous, with a fringe of kelp.

Twelve miles northwest of Amchitka is Rat Island, measuring about 9 miles long and 2 miles wide. Topography is a tableland with a mountainous center along the longitudinal axis. Peak elevation is 1,127 feet. The tableland is interspersed with shallow lakes and ponds. Streams are small and short. The coastline is mostly rock, with precipitous headlands varying to sheer rock cliffs. The northern coast has many small rocks and reefs.

Seven and one half miles north of Rat Island is Davidof Island, irregular in shape, with a north-south length of 2 miles and a maximum width of 0.7 mile. The highest point in the southern part is 1,074 feet, and the northern portion is 922 feet. It is a mountainous island with the projecting easterly point of the island marked by a prominent cone-shaped, grayish-tan summit surrounded by numerous rocks and reefs.

Khvostof Island lies 1 mile northwestward of Davidof and is 1.5 miles long and 0.8 mile wide. The interior is rugged and mountainous and the highest point is 780 feet in the western part. Davidof and Khvostof are the remains of a breached submerged caldera.

Segula Island lies 10 miles northwest of Rat Island on the north side of Rat Island Pass. This island is 4 miles long north and south, and 3.6 miles wide east and west. It has a lone crater-topped mountain rising to 3,784 feet. The coastline is rugged with many rocks and reefs.

Kiska Island is considered the most important of the Rat Islands because of its well-sheltered anchorage. It measures about 22 miles long and varies in width from about 1.5 to 6 miles. The island is very rugged and mountainous, with the northern end of the island dominated by the active Kiska Volcano. The crater of this volcano has two summits, the higher and most westerly being 4,004 feet high. Immediately south of the volcano is a low valley about 2 miles wide, which contains several saltwater lakes. This valley extends nearly across the island from east to west. Flat-topped, boulder-strewn ridges rising to over 1,000 feet occur between the lake area and Kiska Harbor. A low, narrow pass cuts across the island from the southwest corner of Kiska Harbor to a small bight on the west coast. South of this pass, the southern portion of Kiska Island consists of sharp, rugged ridges 1,500 to 1,700 feet high, extending to the south-western corner of the island. Ridges are quite precipitous on the western side, but they slope gradually on their eastern sides to the shoreline of Vega Bay. The valleys and lower slopes of the island are covered with vegetation while the higher elevations are generally bare and strewn with boulders. The shores of Kiska are mostly rocky and steep, bordered in many places by small islets and rocks. There is kelp fringe around most of the island. Kiska Harbor and Vega Bay are the two principal indentations on the coastline.

Buldir Island is an isolated island lying between Kiska Island and the Semichi Islands and is the westernmost of the Rat Group. In the past, this island has formed an excellent mariner's land mark for the western Aleutians. The highest point of the island is 2,150 feet high, and the island measures 4 miles long and 2 miles wide. It is quite rugged and mountainous. There are two lesser summits on the island at 2,013 feet and 1,768 feet on the northeastern end. High, steep landslides dominate the eastern end and the southwestern corner. Shorelines in general consist of cliffs rising from the water's edge or a narrow rock and sand beach. A chain of rocks and conspicuous islets extends 1.2 miles northwestward from Buldir. The outermost of these is 442 feet high and dome-shaped. At the eastern end of the island are several groups of rocks, the farthest being about 0.3 mile offshore.

Near Island Group

The Near Island Group is the final and most western group of the Aleutian Islands National Wildlife Refuge. The U.S. Board on Geographic Names (1963) defines this area as extending from the Ingenstrem Rocks westward about 95 miles to Peaked Island just off Cape Wrangell on Attu Island. Included with this group are the Semichi Islands, Attu, and Agattu Islands.

The Semichi Islands are Shemya, Nizki and Alaid. Shemya is the easternmost of the group and lies about 65 miles west-northwest of Buldir Island. Alaid Island, the westernmost of the Semichis, is about 16 miles east-southeast from Attu. Nizki lies immediately between Shemya and Alaid Islands. This group trends west-northwest over a distance of approximately 11.5 miles. The islands have numerous lakes with rocky shorelines, short sand beaches are found on all three islands, and rocks and reefs are common as far as one mile offshore.

Shemya Island measures about 3.8 miles long by 1.8 miles wide, sloping gradually from sea level on the south to a rounded bluff 250 feet high on the northern side of the island. A number of prominent rocky islets exists around the shoreline of Shemya, the highest being 56 feet high and 0.7 mile off the northeastern coastline of Shemya. Nizki Island measures 3 miles long by 1 mile wide. It is connected to Alaid by a sand spit that disappears at various times due to tidal action. The island is level and low-lying with the high point at 165 feet, which is lower than either Shemya of Alaid. Alaid Island measures 3 miles long and about 1 mile wide. The eastern portion of the island is rolling tundra, and the westernmost is composed of four hills, two of which are over 600 feet high.

Westernmost of the Aleutians, Attu Island measures 15 miles wide by 42 miles in length. It contains many bays and long inlets. This island is extremely mountainous, quite rugged, having practically no flat areas. The most level area occurs in Massacre Bay. The northern coast of Attu is quite precipitous and rugged. Large numbers of offshore rocks and reefs are common, lying less than half a mile offshore. Cape Wrangell is the westernmost point of the island and of the Aleutian Islands. The Cape consists of a string of rocky, rugged islets about 150 feet high, reaching out from a mountainous ridge. The ridge is bold and steep with a summit of about 1,800 feet.

Twenty-two miles southeast of Attu is Agattu Island. It is the second largest of the group and the most southerly of the Near Islands. Agattu is roughly triangular in shape with the north shore, or base of the triangle trending in a west-southwesterly direction. The north shore is about 19 miles in length, the southerly shoreline 16 miles, and the easterly 11 miles. The island is similar in terrain, vegetation, and the shoreline to the other islands in the Aleutians. Mountain peaks 1,992 feet high are adjacent to the east half of the north shore, and 2,080 feet across from the southwestern shore. The southern-southeastern portion of the island is made up of hills and plateaus, giving the appearance of a flat tableland, and interspersed with numerous valleys and shallow lakes. The shoreline is rocky, precipitous, and ringed with many inshore pinnacles, or sea stacks. Commonly found are boulder or pebble beaches at the heads of most of the bights. Some sand beaches do exist.

CHAPTER III

WILDERNESS STUDY OBJECTIVES

The Wilderness Act of September 3, 1964 (Public Law 88-577), directs the Secretary of the Interior to review all roadless islands and all areas of 5,000 acres or more within the National Wildlife Refuge System for consideration for inclusion as units of the National Wilderness Preservation System. Within ten years after the effective date of the Act, the Secretary is to report to the President of the United States his recommendations as to the suitability or non-suitability of each island or area. In defining wilderness, the Act also permits review of roadless areas of fewer than 5,000 acres that are of sufficient size to make preservation and use in an unimpaired condition practical.

The primary objective of this study was to evaluate the suitability or non-suitability of the Aleutian Islands National Wildlife Refuge or portions thereof, excluding Unimak, for consideration as wilderness. Unimak Island is being treated as a separate wilderness proposal. More specifically, the study was designed to:

1. Clearly delineate and describe those islands and/or areas within the Refuge that have wilderness qualities, as defined in the Wilderness Act.

2. Clearly delineate and describe those islands and/or areas within the Refuge that do not have wilderness qualities, as defined in the Wilderness Act.

3. Determine whether establishing all or part of the Refuge as wilderness would be within and/or 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 portions thereof were established as wilderness.

CHAPTER IV

HISTORY

The people native to the Aleutian Islands are known as Aleuts. They are of Eskimoid origin and are believed to have crossed the Bering Sea land bridge late in the Pleistocene (inter-glacial) period of approximately 10,000 to 15,000 years ago, somewhat after the American Indian crossed the same route. The Aleut and Eskimo languages are related but are mutually unintelligible. Although their cultures are basically similar they have been adapted to different environments.

McCartney and Turner (1966) note that at least 8,000 years ago coastal people from Asia drifted along the southern perimeter of the Bering Land Bridge to its southwest corner, now known as Umnak, and over the next several thousand years, drifted further west to the end of the 1,100-mile chain of the Aleutian Islands.

McCartney (1972) summarized the known information concerning the Prehistoric Period (ca. 6000 BC--AD1741). "The oldest known cultural remains were discovered on Anangula (Ananuiliak Island) just north of Nikolski Bay, Umnak Island. There a large encampment site is found to date to ca. 6,000 BC. Anangula at that time was at the southwestern tip of the Alaska Peninsula when sea level was lower than present. The opportunity for both marine and terrestrial subsistence was available. The occupants possessed a distinctive core and blade stone industry which is unlike any later stone industry found in the islands. This artifact collection shares many traits with Japanese and other Asiatic assemblages."

"The fate of the Anangula people is unknown. The site was occupied for probably less than a century and then abandoned when a heavy cover of volcanic ash rained down over the area. The thick ash layer presumably killed the local fauna and flora upon which the Anangula inhabitants depended."

"A 4,000+-year gap follows the Anangula occupation before evidence of man in the chain is again dated. By about 2,000 BC, the eastern Aleutians, and presumably the entire chain, was occupied by maritime Aleuts. Their principal remains are small-to-large midden sites comprised of shell, urchin, bone, and artifactual detritus. Favorable sites were seasonally occupied for hundreds to thousands of years with practically no sequential gaps."

"Because of geographic isolation, few marked cultural discontinuities have been recognized in the midden sequence from 4,000 years ago to the historic period. Cultural continuity is found evidenced in practically all sites investigated. Radiocarbon dates cluster at about 2,000-1,500 BC for Chaluka midden at Nikolski Village, Umnak Island. This site is one of the oldest in the eastern area and has been almost continuously occupied ever since its initial occupation. Some cultural influences filtered out the chain from the Alaska Peninsula but the area most affected is the eastern end of the archipelago."

"Almost no horizontal discontinuities in culture from island group to island group have been specified because of the limited amount of archeological analysis completed for Aleutian collections. Attenuation of the ancient population along the long island chain restricted contact between islands. Contact between neighboring island populations was more predictable than between groups separated by hundreds of miles of island passes and dangerous voyages. The Near Islands appear to be the most distinctive because of their extreme isolation at the tip of the chain. But differences exhibited there are only stylistic and superficial when compared to the strong common cultural base in which they shared."

"Villages were always built on the seacoast. Certain land plants were utilized for food but the villagers' staples came from the sea in the form of sea mammals, fish, sea birds, sea urchins, and mollusks. Clothing was made from the skins and intestines of sea mammals, boats were covered from the same source, and implements and building materials were of bone, stone, and driftwood. Skin boats and open water utlization opened the marine zones beyond the shore to the islanders. Another geographic advantage of the chain was ready access to migrating sea mammals and birds passing through this archipelago filter, augmenting the resident marine life and avifauna."

"The 4 major shore habitats available include: a) beaches as hauling spots for pinnipeds and sites for washed-up whales; b) intertidal reefs or flats where crustaceans, mollusks, echinoderms, and various seaweeds occur; c) stream mouths where salmon run annually; and d) precipitous cliffs where birds and their eggs are found. The Aleut favored 3 water habitats; a) inshore shallow areas for netting gish or where fish lines could be used from shore; b) deeper, offshore areas for line fishing from boats and sea mammal hunting; and c) marine or inland lake waters for hunting waterfowl."

"Hunting implements from the midden sites of the past several millenia include bone projectile points for harpoons, darts, lances and arrows--some with flaked or ground stone points, loose shafts for toggle harpoon heads, socketed foreshafts and clubs. Fishing implements include simple and compound fishhooks, and various line or net weights. Collecting/digging tools include bone picks and spatulate heads hafted to handles. Wood-and boneworking tools include wedges, hafted adze heads with ground stone blades, drills with stone tips, bone knife handles for hafting flaked or ground stone knife blades and scraper blades, and scoria and pumic abraders or smoothers. Skin preparation implements include ground slate ulu blades hafted to handles, various flaked stone knives, bone awls and punches, needles and cutting or trimming tablets. Miscellaneous household implements include whale vertebra and wooded bowls, bone and wooden spoons and scoops, needle cases, stone lamps, grinding slabs and rubbing stones for preparing ocher powder and other materials, and tabular stone griddles. Decorative items include bone, ivory and jet labrets, spools, pins, and pendants, carved bone chains, animal effigies, and other finely-made decorative pieces of unknown function."

With the passes of the Chain acting as barriers, two distinct dialects came into being, i.e. the Unalaskan of the eastern Aleutians and Alaska Peninsula, and the Atkan of the central and western Aleutians. The Chain and the Alaska Peninsula had a total pre-Russian population estimated at between 15,000 and 25,000 (Petroff). The Aleuts were truly people of nature because their subsistence activities and orientation to time were based upon the seasons, weather, tide levels, motions of the sea, movement of animals, and the productivity of sea.

On June 4, 1741, two Russian ships under the command of Captain-Commander Vitus Bering sailed on a voyage of exploration from Kamchatka, Siberia (Bancroft). It was this expedition that touched upon several points in Alaska, notably the Aleutian Islands, and brought back to Russia several hundred skins of sea otter, fur seal, and fox. When news of this reached the Siberian fur hunters (called Promyshlenniki), there began a forty-year reign of terror and depredation that reduced the Aleuts to virtual slavery, exterminated the Steller's sea cow, and seriously depleted the populations of sea otter in the Aleutians and Commander Islands. By 1831 there were Aleuts present on only 16 islands and the total population was less than 2,000.

This period was followed by the establishment of a trading company that ultimately came under management of Alexander Baranof. The Company's function was not simply a matter of overseeing a job and keeping accurate accounts. In a large measure they represented the Czar in far-off St. Petersburg. Theirs was the problem of adjusting the views of ecclesiastics (for the Orthodox Church sent its emissaries to Russian America) with the ambitions of a lusty people in contact with an aboriginal group that had a totally different moral code. They had to equate the needs of all these people and the requirement of making a profit, and then absorb the frequent losses of ships bringing supplies from Siberia or returning with valuable cargoes of furs. The Company became faced with the effects of uncontrolled hunting of sea otter and fur seal, necessitating the practice of limited management of these resources. Meanwhile, the ships of other nations entered the highly competitive sea otter trade (Colby). Altogether it was a remarkable and colorful period in history.

Russian's growing interest in disposing of her American colony coincided with the United States' interest in acquiring the territory, and in 1867, the U.S. purchased Alaska for $7,200,000 (Gruening, 1954). In the Chain, sea otter hunting remained the major economic activity until the end of the century (Applegate, 1893). However, the fur resource continued to be plundered and by 1910 the sea otter and fur seal were near extinction. An international convention in 1911 between the United States, Great Britian, Japan, and Russia regulated the taking of fur seal and prohibited the killing of sea otters. The American government's first interest in Alaska was the Pribilof Islands and their fur seal rookeries. The islands were staffed and became an employment source for the Aleuts from the Chain. On March 3, 1913 President Taft reserved and set apart the Aleutian Islands Reservation, now the Aleutian Islands National Wildlife Refuge, as a preserve and breeding ground for native birds, for the propagation of reindeer and fur bearing animals, and for the encouragement and development of the fisheries.

Alaska grew as a commercial center with American Administration and Dutch Harbor became a major resupply and refueling station for vessels bound to Bristol Bay and Bering Sea. Unalaska briefly boomed during the Nome gold rush in the early 1900's as thousands of prospectors passed through Unalaska enroute to Nome. Unalaska declined as a commercial center in the 1920's when oil replaced coal as ship's fuel and the Dutch Harbor coaling station was abandoned.

During the period of 1910 and 1947 extensive use was made of the Aleutian Islands for fox-farming. Most of the fox produced were the blue phase of the Arctic fox, but some reds and a few silvers were also bred. This fur enterprise brought many hundreds or thousands of dollars to the fox farmers, but it was terminated by the late 1940's due to a decline in fur prices. The remaining fox, in some instances, became an obstacle to the management of certain wildlife species such as the Aleutian Canada goose. Fox prices began a decline in the 1930's and with the simultaneous decline of whaling activity, the Aleutian's economic value deteriorated.

The advent of World War II stimulated a rapid development of military facilities in the Aleutians. A phase of this war, the Aleutian Campaign, was conducted largely within the Aleutian Islands Refuge. Following a carrier attack on Dutch Harbor and Unalaska on June 3 and 4, 1942, the Japanese forces seized positions on Kiska and Attu Islands. These two islands, like Midway Island, played an important role in the Japanese strategy by providing patrol bases for the protection of the eastern expansion of the Japanese Empire. After the failure to occupy Midway Island in the Pacific, Attu's and Kiska's value decreased because, as extended bases, they were difficult to supply. The 2,500 Japanese troops occupying Attu and 5,183 on Kiska fought the elements to slowly build an airstrip out of the rugged terrain. They constructed gun positions to cover vital beaches and passes: buildings were erected, even though the majority of troops lived in tents.

In preparation to remove this threat and to prevent the Japanese from any further eastward movement, the United States began to occupy islands in first the eastern and then the central Aleutians. Actually, Aleutian airbases were begun just prior to the Japanese attack at Pearl Harbor on

December 7, 1941. Construction at Cold Bay was initiated in August 1941 and at Fort Glenn (Umnak) shortly afterwards. The Dutch Harbor post was quickly enlarged and served as the main supply depot and staging base. The Pearl Harbor attack gave great impetus to the completion of these bases.

Seeking an air base site within fighter-plane distance of Japanese-held Kiska, the United States considered building an airfield on Tanaga Island. But the Navy favored Adak because of its natural, secluded harbors. The Army argued that the Tanaga airfield could be built more quickly, and the Joint Chiefs of Staff decided against Adak. However, subsequently a Navy survey board noted that the Tanaga airfield would present serious navigational hazards, causing the Chief of Naval Operations to withdraw his support for Tanaga. The Army, faced with either Adak or Tanaga standing still, finally agreed to Adak. However, the airfield on Tanaga's western tip was still completed although it was never intensively used.

On August 26 and 27, 1942, a reconnaissance party of Alaska Scouts landed on Adak from an offshore submarine. The island was found free of Japanese forces, so they sent out the all-clear signal. The next day, a flotilla of scows, yachts, fish schooners, barges, tugs, and purse-seiners adapted for military use hove to in Kuluk Bay, Adak.

At 0700 on August 30, the first landing craft hit the Adak beach. This amphibious operation deposited 4,500 men on the island. This was accomplished despite 100 mph winds that stopped operations in the morning, piling up boats on the beaches. Fox holes were dug for protection against the weather but by nightfall, all had made it ashore.

The engineers found that near the landing areas was located a flooded tidal basin with a narrow outlet on Kuluk Bay. Using an ingenious drainage system the Army engineers built an airfield in 10 days--more than 10 weeks earlier than expected. By September 12, planes were able to take off. On September 14, twenty-eight P-38's and twelve B-24's based on Adak gave Kiska its first good bombing. Canadian planes joined ours based at Adak for raids against Kiska. Navy seabees and Army Engineers worked around the clock to provide quarters for 15,000 men, hangars, piers, warehouses, two airfields, and ship facilities. Finger Bay, to the south, became a submarine base, a harbor for patrol craft, and a ship-repair facility. Combine Kuluk Bay was the fleet anchorage. The island was an assembly point for Kiska invasion troops. Great Sitkin, twenty miles east of Adak, was established as a depot for supplies.

Amchitka was occupied by American forces in January 1943. No opposing enemy forces were encountered; although, Japanese reconnaissance parties were known to frequent the Island. Like Adak, construction of the facilities were rapid, but unlike Adak, the construction of the airfields were at higher and drier sites. Facilities were built on the southeastern third of the island, with a small radar site at the northwestern end. Three airstrips were constructed near Constantine Harbor and many miles of roads were built, including one extending the length of the island. Several hundred quonset huts and other buildings were erected, several of which are still standing. Peak troop strength varied greatly from 3,000 to 25,000.

B-24 and B-25 raids were carried on from Amchitka to Attu and nearby Kiska and its heavily fortified submarine pens. Together Adak and Amchitka contained about 34,000 Allied troops for the upcoming invasion of Attu and Kiska. Other islands were directly affected during this period. An airfield and hospital was constructed at Atka. An emergency airfield was built on Ogliuga in the Delarof Group. Small radar sites were installed on Umnak; Aleut Point on Amchitka, and on Semisopochnoi.

The United States reacted to this threat to our continent's northern steeping stones by planning an invasion of Attu. In December of 1942, the U.S. Chief of Staff proposed to remove the enemy from the Aleutian Islands. The Eleventh Air Force began sending planes over Kiska whenever the weather permitted, increasing in vigor and intensity during March of 1943. On March 26, 1943, an American Naval task force intercepted a Japanese relief force twice as large headed for Attu and Kiska. Although no decisive victory for either side was in evidence, the Japanese force failed to reach the islands. On March 2, 1943, the U.S. Joint Chiefs of Staff indicated Attu was the first target of the American invasion force. Seldom has an operation been planned with so little knowledge of the physical conditions to be encountered. The only available map was a Coast and Geodetic Survey chart showing terrain 1,000 yards beyond the shoreline. It was known, however, that the Japanese occupied only the eastern quarter of the island, where the only harbors on the island were located.

By the time the U.S. forces sailed from San Francisco on April 24, 1943, five different plans of operation existed. It was not until this force reached Cold Bay on April 30th that a final plan was adopted. D-Day, originally set for May 8, 1943, was postponed to May 11 due to rain, fog, rough seas, and the threat of Japanese attack. During the 10-day period prior to the landings, the Army Air Force dropped 95 tons of bombs on Attu. Then, under the Command of Albert E. Brown, the assault began on May 11. In the pre-dawn darkness, the 7th Scout Company paddled ashore from submarines to a small beach near the northwest corner of Holtz Bay (Beach Scarlet). Simultaneously, a reconnaissance party landed on Beach Red (northwest of West Arm of Holtz Bay) to report beach conditions. By 1230 hours troops began landing on Beach Red, with units headed toward Beaches Blue and Yellow in Massacre Bay. The majority of troops landed by 1615 hours.

No enemy opposition was encountered at any of the beaches. The fog which hampered the landings also concealed them from the enemy. By 2130, five hours after the main landings commenced, a total of 3,500 were ashore. Contact with the enemy had been made three and one-half hours earlier when a U.S. patrol encountered four unsuspecting Japanese about a mile southwest of Foltsov Point. Two of the Japanese were killed and the other two escaped. The Japanese finally responded to the landing with artillery, machine gun, and mortar fire from well-concealed positions overlooking the landing beaches. So well did the Japanese control the field that for three days after the landings on Massacre Bay, the U.S. troops had moved only a few hundred yards. Naval gunfire support was removed when Japanese submarines attempted to torpedo the battleship U.S. Pennsylvania and a troop transport. On the island the stalemate continued, with the U.S. troops attacking up exposed valleys through the thick mucky tundra, as the

Japanese fought back with accurate and intense fire.

A controversial command decision relieved General Brown of his responsibility of the ground operations, with General Landrum being appointed in his place. General Brown's relief coincided with the rapid advance of the American Northern Force which broke the deadlock. Intense naval gunfire and air support drove the enemy back to the West Arm areas of Holtz Bay, allowing the Northern and Southern forces to meet at Jarmin Pass. The Japanese withdrawal and the meeting of the landing forces marked the turning point of the campaign. Although two weeks of hard costly fighting remained, the uncertainty and frustration of the first few days never reoccurred. The end came on the frenetic night of May 29th, when most of the surviving Japanese, 700 to 1,000 strong, in a suicidal attempt charged through the American lines. Most were killed, and on May 30, the Japanese announced the loss of Attu.

Grim statistics indicated the invasion was expensive. Over 15,000 men were committed to the attack, and the resulting casualties from enemy action and exposure to the weather were approximately 20 percent of that number. Until Iwo Jima, Attu was the most costly Pacific battle in casualty ratio, but it also was the first major offensive the United States launched in World War II to reclaim their former territory.

Immediately after the defeat of the Japanese Army engineers began construction of a field-type air base using steel runway matting. Ten days after the engineers started, six P-40's landed. This achievement was due to the use of a packaged kit, which contained all the supplies necessary to construct and operate the airfield for a 60-to-90 day period. The Navy's Seabees began construction of a larger, hard-surfaced field about 1,000 yards southwest of Massacre Bay, this is the only field presently in use.

On July 10, 1943, eight bombers (B-25's) landed on Attu to refuel. The following day they headed west to bomb Paramashiru on the northern islands of Japan. It was the second attack of World War II on the Japanese homeland. Despite a complete surprise, the damage was minimal. Another attack was launched and was even less successful. A third attack in September resulted in a 50 percent loss of aircraft; no further raids were scheduled.

After Attu fell, the invasion of Kiska was to begin. Many of the lessons learned at Attu were included in the plan for the Kiska invasion. Admiral Nimitz set D-day for August 15, 1943, but unlike Attu, Kiska was subjected to heavy pre-invasion bombardment. Over 1,000 tons of bombs were dropped from AAF planes, and 430 tons of explosives were hurled from a Naval task group onto Kiska. All through the D-day and that first night the U.S. forces moved inland, but occasional gunfire revealed little. During the first four days casualties were light with 21 dead and 121 sick or wounded. The Navy lost 70 dead and 47 wounded when the destroyer U.S.S. Abner Read hit a mine on August 18. Unfortunately the only guns fired were those of friend against friend, for the Japanese had abandoned the island on July 28, almost three weeks before the invasion.

During the last days of the Attu Campaign, Brigadier General John E. Copeland, Commanding General of the 7th U.S. Infantry Division, selected certain of his troops of his 4th Regiment to comprise a landing party for Shemya. On May 28, 1943, under a thick fog cover, landing barges approached the shores of Shemya. High waves whipped by lashing winds tossed the landing barges on jagged reefs, ripping hulls open, and dashing the troop-laden craft against rugged rocks. Troops, waist deep in the chilled waters, waded ashore with supplies and equipment carried on their backs or in their arms. The Army had arrived on Shemya and the only resistance encountered was from the angry elements.

A construction program was begun immediately using troop labor, working 10 to 12 hours a day, to whittle an airfield out of the tundra. On September 11, 1943, the first American bomber (a B-24) landed on Shemya following a mission over the Kurile Islands of Japan. Along with civilization, came the bombers of the famed U.S. 11th Air Force which made continuous sorties from Shemya directly into the enemy homeland, dumping their lethal cargo on the military and industrial installations of Northern Japan. On August 13, 1945, the last bombing mission from Shemya was made by men and aircraft of the 404th Bomb Squadron against the Japanese staging area on Northern Paramushiro. The following day, the Japanese officially and unconditionally surrendered. Sirens on Shemya blasted for 10 minutes, extra beer rations were issued, and the next two days were declared holidays. Peace had come to Shemya and the world. The countless fighter and bomber missions flown from "The Black Pearl of the Aleutians" had played a significant part in the destruction of the Japanese war-making potential.

The physical marks of this chapter in Aleutian history are, like all the others, there for all to see. Unlike the others, however, these marks need not be carefully sought out in kitchen middens or communal dwelling sites 150 or more years old. Aircraft runways, piers, roads, telephone and power distribution systems, temporary buildings, and damaged ships of both Japanese and U.S. origin are to be seen throughout the length of the Chain. On Attu and Kiska the marks of combat are implanted for at least the duration of this geological age. Abandoned military buildings are still much in evidence over 20 islands.

By the end of 1943, U.S. Forces in Alaska were being reduced, the northern threat was over. Now the islands became supply bases and navigational aids for ships and planes. Military activity greatly decreased after World War II, but never ceased. Garrisons at Cold Bay, Dutch Harbor, Adak, Amchitka, Shemya and Attu were decreased and converted to various functions, principally to resupply and navigation aid purposes. The small, remote sites were abandoned at the war's end. Cold Bay was finally abandoned and has developed as an aircraft service and refueling stop for various airlines flying to the Aleutian Islands and Asian continent. Dutch Harbor was abandoned by the military in late 1947. It has since recovered from the postwar depression caused by the military's departure. Today it once again serves as a resupply and refueling port for ships bound for Bristol Bay and the Bering Sea. King Crab and Salmon processing plants provide employment for cannery workers and fishermen. Chernofski and Fort Glenn (Umnak) were both abandoned shortly after the war and now have livestock operations (see Grazing). Atka saw the return of its villagers in 1945 and, shortly afterward, the military departed. The airfield became obsolete in the late 1950's, and now the village is visited monthly by a Navy tug from Adak, bringing supplies and mail. No development has occurred at Atka other than building and maintaining the existing state-operated school and residences of the villagers. Employment is gained by work in the Pribilof fur-seal program and the fishing industry of the eastern Aleutians.

In 1946, an Army-Navy team visited Adak to establish a permanent Naval Base on the island. However, the Army controlled the island until 1948, when the Air Force took over. In July 1950, Adak became a Naval Station. The U.S. Naval Communications Station at Clam Lagoon was commissioned on September 15, 1951. On November 30, 1962, the U.S. Naval Facility was commissioned as a tenant command of the Naval Station. During late 1971, Fleet Air Alaska command was transferred from Kodiak to Adak. The Adak Naval Station is presently under military command of the Commander, Fleet Air Alaska and under the management control of the Chief of Naval Materiel, Air Systems Command. The mission is to maintain and operate existing facilities and provide services and material to support operations of aviation activities and units, as designated by the Chief of Naval Operations. The station has cross-service support agreements with the Coast Guard (Adak and Attu LORAN transmitting stations and buoytender), U.S. Fish and Wildlife Service, U.S. Coast and Geodetic Survey, and the U.S. Air Force (radio signal propagation station). In 1972, the Bureau of Sport Fisheries and Wildlife established the headquarters for the Aleutian Islands National Wildlife Refuge at Adak.

The military occupation of Amchitka ended in 1950, at which time a White Alice Communications station was constructed and operated by Western Electric Company for the Department of Defense. This station was abandoned in 1959. During 1951-57, the Fish and Wildlife Service carried out a fox and rat eradication program on Amchitka Island, using strychnine and "1080". Foxes were eradicated and the rat population reduced somewhat. Also eradicated were feral dogs and cats abandoned on the island at the end of the military occupation. In October 1965, Project Longshot was carried out on Amchitka Island. This was a Department of Defense underground nuclear test of about 80 kiloton yield, and was carried out with AED assistance. In 1967, construction activities and environmental studies in preparation for underground nuclear testing were initiated by the AEC and its contractors on Amchitka Island. During all Atomic Energy Commission activities, biological or bio-environmental effects were investigated, but it should be emphasized that these have been studies only on a short-term effect. In October 1969, the Atomic Energy Commission detonated a nuclear device of approximately 1 megaton yield approximately 4,000 feet below the surface of Amchitka Island. This was defined as a "calibration test" and was called Project Milrow. The analysis of the effects of this detonation led to a determination that a test of a higher yield could be safely carried out on the island. During the fall of 1971, Project Cannikin was carried out. The purpose of this Project was to test a military nuclear device. At present, the AEC is removing buildings, equipment, and other facilities that have been placed on the island since 1961. They expect that this rollup will be completed by the latter part of 1973. It is not known what plans they might have for future testing on the island. One can assume that such will depend upon our national security.

Shemya was partially demobilized after World War II and was retained on a standby basis. It was used during the Korean War by military transports flying the Great Circle Route to and from Japan. Following the Korean conflict, Shemya was abandoned as a military base. During the mid-and-late-50's, private airlines used the island as a refueling stop for their Great Circle flights. In 1958, with the mounting tensions of the "Cold War" dictating increased U.S. military preparedness, Shemya was again reactivated and our armed forces returned. Shemya now is officially is Shemya Air Force Station and is a military community composed of Army, Air Force, and civilian contingents, each with its own mission in support of the total national defense effort. Most activities are classified and security clearance is required before entering on the base.

The U.S. Navy maintained a mobile navigational aid antenna at Gillon Point, on Agattu Island during 1962 and 1965. Eight to ten naval personnel were stationed on Agattu from August 1, 1962, to October 10, 1962, and from May 1, 1965, to October 13, 1965. During 1966, the United States Air Force considered Agattu Island for a "classified mission." What this mission involved was never disclosed. Speculation varied from additional nuclear testing to a missile target area. Much protest to another "invasion" of the Aleutian Islands National Wildlife Refuge was made by conservationists. Subsequently, the Air Force dropped Agattu from consideration.

The Navy used Attu for radar picket aircraft until 1958 and also maintained a communications station until the late 1950's. The Coast Guard built a LORAN A station near Murder Point at the south end of Casco Cove during the late 1950's; it was decommissioned in 1960. The old Navy communications stru ture was renovated by the Coast Guard and in 1960 was commissioned. It presently houses the LORAN A and C station. This station is the only human habitation on Attu. It houses thirty-two Coast Guard personnel and seven Air Force personnel. The Air Force mission is classified. The Coast Guard mission is to provide navigational aid for planes and ships operating in the Pacific Ocean and Bering Sea. In 1967 members of the National Park Service visited Attu for the purpose of determining whether or not the World War II battleground deserves status as a Registered National Historic Landmark. Recommendations have been made, but as of January 1, 1971, there has been no action for formal designation.

The Aleuts in the Chain were greatly affected by the second World War. At the outbreak there was an Aleut village on Attu as well as on Atka and other islands farther east. The Attuans were captured by the Japanese forces in 1942 and interned in Japan for the duration of the war. After the war ended the Attuans were returned and resettled with the Atkans in the village of Atka. The Natives in the remainder of the Aleutians were evacuated, at the outbreak of fighting, to southeast Alaska by the American government. Here they remained for the duration of the War. Upon their return in 1945 they found their houses and belongings either destroyed or stolen. Rats were rampart throughout the villages. Rebuilding and restoration of buildings and services required many years. The post-war depression left the Aleuts nearly destitute, and it was not until the crab boom in the 1960's that they were really able to recover economically.

Names and Exploration

The origin of names found in the Aleutian Islands area are from 4 sources: Aleut, Russian, British and American (Orth, 1971). Of the Aleut names, a very high percentage was first obtained and recorded by the Russians. Russian names were applied through a period of approximately 125 years, 1741 to 1866. Many Russian names were translated after the American purchase; however, several hundred are still applied to the various features of the islands. British names began with the 1776 expedition of Captain Cook. Various English traders and naval officers after Cook for a period of about 20 years contributed to the naming of Alaskan geography, and most of the names of major coastal features can be attributed to them. American names were initiated with the American whalers in 1848. One of the largest contributions made was by the U.S. Navy's North Pacific Exploring Expedition of 1855, which was concentrated in the Aleutian Islands and Bering Sea. Since then, after the purchase of Alaska in 1867, most of the work of exploring, surveying, mapping and naming Alaskan features has fallen to the U.S. Coast and Geodetic Survey.

The origin for the naming of the Aleutian Islands is that the name Aleutian was used to designate the Natives living on these islands, and this was first applied by Admiral von Krusenstern of the Imperial Russian Navy to the entire Chain. Other names have been Aleotskia Isles, Aleotiennes, The Aleutian Isles, the Billy Mitchell Islands, The Fox Islands, Catherina Archipelago, the Catherine Archipelago, and the Katerina Archipelago. The last three names were in honor of Catherine the Great.

Some meanings of the more commonly used names in the Aleutians are:

Adak - may be from the Aleut word "adaq" which has been translated to mean "father".

Agattu - possibly from the Aleut name "agataku". Early Russians called the island "Ostrof Kruglyy", meaning "round island."

Andreanofs - named after a Russian merchant named Andreian.

The name of Buldir for Buldir Island may have three origins. Many scholars correlate the island of Bering with the present-day Buldir Island, and, if so, it may have been named for the sailor that died on its discovery day. The name "Ostrov Buldir" was published on a map by Lt. Sarichev. Baker of the USGS gives the meaning of "buldir" as "hut" or "hovel" implying a descriptive name. Von Landsdorff appears to translate the name as "round".

Delarof comes from the name for the Greek-born Eustrate Ivanovich Delarof, director of the Russian-American Company from about 1784-91.

Kiska is an Aleut name used by the early Russians. Dall gives the meaning as "gut" but Geoghegan gives the word "angig" as the meaning.

Krenitzin was named for Captain Lt. Peter Krenitzin, Imperial Russian Navy, who, along with Lt. Levashev of the Imperial Russian Navy, explored and mapped over 30 islands in the Aleutians during the period 1768-69.

Near Group - the name "Near" was given by early Russian explorers because they are the nearest of the Aleutian Islands to Asia.

Rat in the Rat Group came from the introduction of the common rat to the island after the wreck of a Russian sailing vessel about 1750.

The name Semichi for the Semichi Islands in the Near Group was applied by the early Russians, the name being derived from "semik" which is "the feast on the 7th Thursday after Easter", on which day they were discovered.

Semisopochnoi is derived from the Russian word "sem" meaning "seven" and "sopochka", meaning "extinct volcano" or "seven volcanoes" or "seven peaks".

The descriptive name of Dutch Harbor came from the Russians, because it was believed that a Dutch vessel was the first to enter the harbor. Veniaminof reported earlier that navigators called it "Holland Harbor".

The most colorful and rather forbidding name associated with Attu Island is Massacre Bay, located on the southeast coast. This name was given by G.I. Davidov in 1802, presumably referring to the killing of fifteen Aleuts by the promyshlenniki in 1745. The Russians called it Gavan Ubiyennykh and Gavan Ibiyennaya, meaning "massacre harbor".

Explorations and explorers who have contributed significantly to the discovery, the mapping, naming and subsequent reporting of the Aleutian Islands or parts thereof follow. The earliest recorded explorers are Ivan Ivanovich Bering, George Wilhelm Steller, Captain Lieutenant Alexei Ilich Chirikov. During the period of 1724 to 1741 in their initial explorations of Alaska, extending as far east as Sitka, Alaska, several features in and adjacent to the Aleutian Islands were named for all three explorers.

Ivan Chernoye from 1832 to 1838 was a pilot for the Russian American Company who made various surveys in the Aleutian Islands during the early 1870's.

Captain James Cook in 1778, visited the eastern Aleutian Islands. William Coxe, 1780, published in 1780 a research treatise under the title Account of the Russian Discoveries between Asia and America, which was frequently used in the preparation of naming parts of the Aleutian Islands, Alaska Peninsula and Kodiak Island.

William Healey Dall made reconnaissance surveys during 1865 to 1899 throughout the Aleutians westward to Attu and other parts of Alaska.

Gavril Ivanovich Davidof and Lt. Nicholai Alexandrovich Khvostof, both Russian Naval officers, in 1803 traveled along the Aleutian Islands, Kodiak Island, and in the Cook Inlet area for the purpose of scientific research. The islands of Davidof and Khvostof in the Rat Group are named after these two individuals.

George Davidson explored the eastern Aleutians during the period of 1867 to 1869.

Richard Henry Geoghegan, from 1902 to 1943 became interested in Alaskan Native languages and is known primarily for his translations from Russian of Father Ioann Veniaminov's Aleut vocabulary.

John Jacob Gilbert surveyed the Fox Island Group in 1901 and the passes in the eastern Aleutian Islands principally between Unalaska and Unimak Island.

Stephen Glotov, was a Russian fur trader in the Aleutians from the period 1863 to 1866 and contributed much by his writings. .

Constantin Grewingk in 1850 published contributions to the knowledge of the orography, geography of the northwest coast of America and neighboring islands, from which many names have been derived.

The Harriman Alaska expedition in 1899 visited Alaska cruising over 9,000 miles, with the resultant names by the expedition for several geological features.

Calvin Leighton Hooper, in the period 1880 to 1899 spent a number of years in Alaska and in later years was commander of the Bering Sea Fleet. His annual reports to the U.S. Treasury Department contributed many geological facts.

Ingenstrem, in 1829 to 1832 was a Russian-American pilot, made various surveys on Atka and Amlia Islands. The Ingenstrem Rocks in the Western Aleutians east of Shemya were named for this man.

Peter Kuzmich Krenitzin cruised through the eastern Aleutian Islands in 1768 to 1769. The Krenitzin Islands in the eastern Aleutians were named for him.

Admiral Johann von Krusenstern was appointed by Alexander the First of Russia to lead an expedition to explore the Russian Pacific shore and to develope diplomatic and trade relations with Japan and China. This gentleman was the first to name the Aleutian Islands as such. Many surveys were carried out. This man was later responsible for many publications on the North Pacific, including an atlas of the Pacific Ocean published in 1827. He personally never set foot on the northwest coast of America.

Kuritzien, a Russian navigator, made a survey of Umnak Island in 1849.

George Heinrich von Langsdorff traveled in 1805 to the Aleutian Islands, Pribilofs, Kodiak, and Southeast Alaska.

Feodor Petrovich Lutka commanded the corvette Seniavine sent by the Russian government on an exploration around the world. His Aleutian explorations were contained in an account "Voyage Around the World..." published in 1836. Cape Lutke on the south coast of Unimak Island is named for this navigator and explorer.

Captain John Meares of the Royal Navy in 1786 explored eastward through the Aleutians to Unalaska, Shumagin, and Kodiak Islands, Cook Inlet and Prince William Sound.

Father B.R. Hubbard visited the Aleutian Islands in 1934 under the auspices of the National Geographic Society.

In 1854-55, the U.S. Naval North Pacific Exploring Expedition made surveys in the North Pacific, Aleutian Islands, Bering Sea, and Siberian coast area.

Ivan Petroff was employed during much of the period of 1866 to 1892 collecting, examining, and translating Russian sources for H.H. Bancroft's History of Alaska, published in 1866. Petroff traveled throughout the eastern Aleutian Islands and the Alaska Peninsula areas, as well as Kodiak and the Pribilofs. The Russian Hydrographic Department, between 1844 and 1851, issued several charts of the northwest Pacific Ocean, Bering Sea, including the Aleutian Islands.

Rufus Harvey Sargent, working for the USGS, explored throughout the southern half of Alaska, including the Aleutian Islands.

Gavrila Andreevich Sarichev, sailed under the command of the Imperial Royal Navy from 1790 to 1792, explored the Aleutian Islands. The most notable survey was in the vicinity of and at Unalaska Island. Cape Sarichef on the northwestern end of Unimak Island is named for this individual.

Martin Sauer, accompanied members of the Imperial Russian Navy in 1790-92, as official secretary and translator. He recorded many names of the features in the eastern Aleutians.

Glieb Semenovich Shishmarev, with the Imperial Russian Navy, sailed through the Aleutians during the period 1816-1821.

Zera Luther Tanner, in the period of 1888 to 1893 commanded the U.S. Bureau of Fisheries steamer Albatross, cruising the Alaskan waters making investigations of the fisheries. The U.S. Navy Survey Expedition, 1933-36, conducted by the U.S. Navy, involved hydrographic and coastal surveys in the Aleutians. This expedition contributed a great many names to the area.

The U.S. Revenue-Cutter Service contributed many names during the cruises of their various revenue cutters into Alaskan waters. This agency was the predecessor of the U.S. Coast Guard.

Ioann Veniaminof, in the period from 1824-1842 as a missionary to Unalaska, wrote a grammar and dictionary of the Aleut language. He transferred to Sitka in 1834, and published his most valued Notes of the Islands of the Unalaska District. Mount Veniaminof on the Alaska Peninsula was named for this individual.

Ferdinand Westdahl, U.S. Coast and Geodetic Survey, surveyed the eastern Aleutian Islands in the vicinity of Unimak Island and the Sanak Island group eastward. Westdahl Peak on Unimak is named for him.

Ilia G. Wosnesensky in 1842-43 explored, collected, and made various observations in the Aleutian Islands and western Alaska.

CHAPTER V

LAND STATUS

The Aleutian Islands National Wildlife Refuge was established by Executive Order 1733, dated March 3, 1913, signed by President William H. Taft. Subsequent Executive Orders and Public Land Orders have altered the Refuge boundary. The existing Refuge boundary encompasses all of the Aleutian Islands west of a line drawn through False Pass (east of Unimak Island) and includes Cape Krenitzin, Amak Island, Sea Lion Rocks, and the Sanak Island Group. However, within this broad boundary delineation the islands of Akun, Akutan, Sanak, Tigalda, Umnak, Unalaska, Sedanka, and all but 195 acres of the southern end of Amaknak Island in Unalaska Bay have been removed from refuge jurisdiction. Lands within the Refuge on which there are overlapping jurisdictions created by land orders and where the primary withdrawal takes precedence over the Refuge withdrawal are: about 100 acres for lighthouse purposes at Cape Pankof on Unimak Island; the Scotch Cap and Cape Sarichef lighthouse withdrawals on Unimak; the eastern section of about 1,900 acres on Ugamak Island for lighthouse purposes; about 61,000 acres on Adak Island for military purposes; and about 1,800 acres on Attu Island for an aid-to-navigation facility.

Active Interagency Agreements provide for the use of: about 127 acres at Cape Sarichef on Unimak Island by the U.S. Air Force for runway and Distant Early Warning (DEW) site purposes; Shemya Island by the U.S. Air Force for air navigational installations and related facilities; about 486 acres and a six mile access road right-of-way on Attu Island by the U.S. Coast Guard for watershed and classified military purposes.

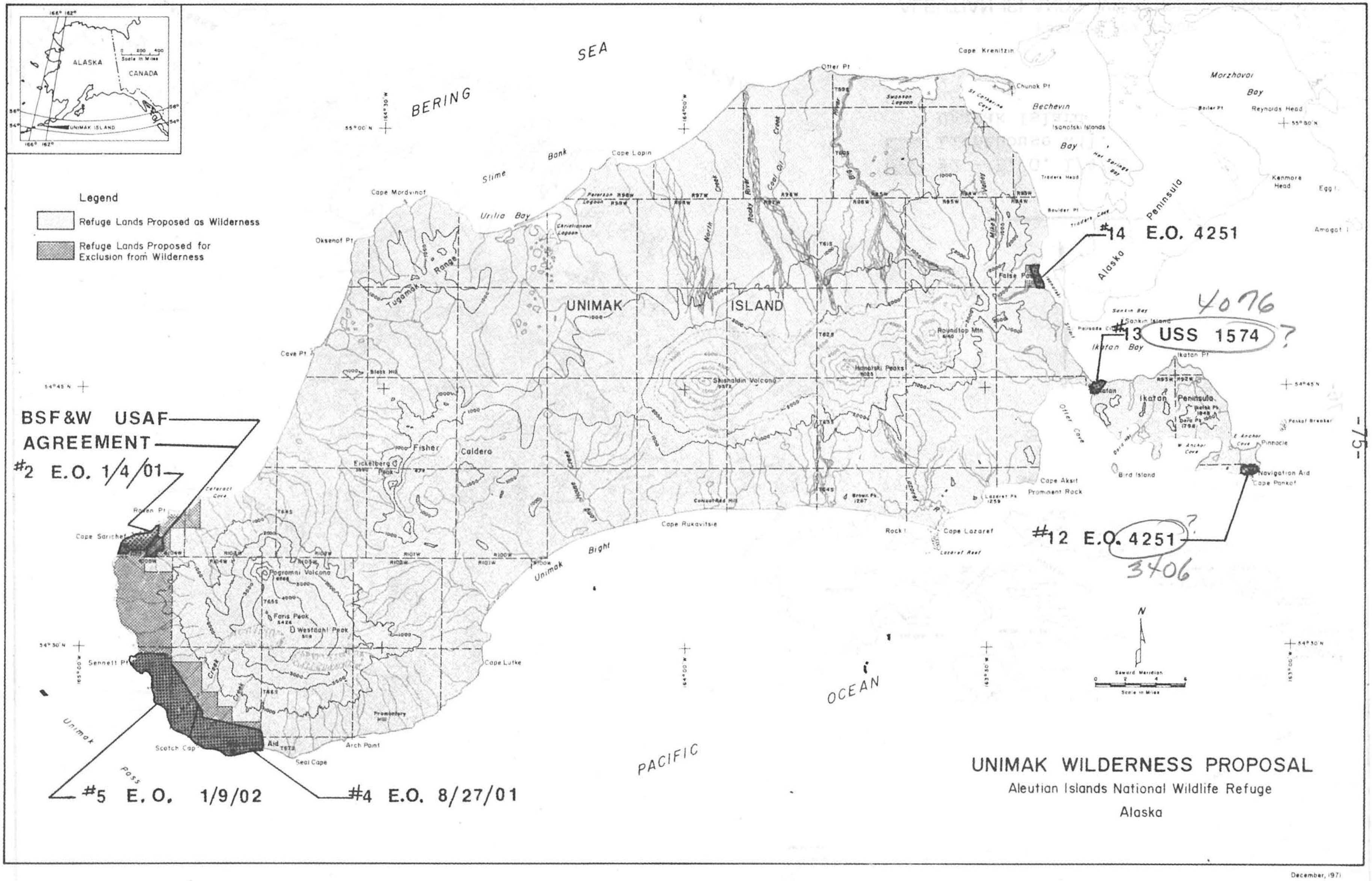


Figure 5. Land Withdrawals and Land-Use Agreement- Unimak Island

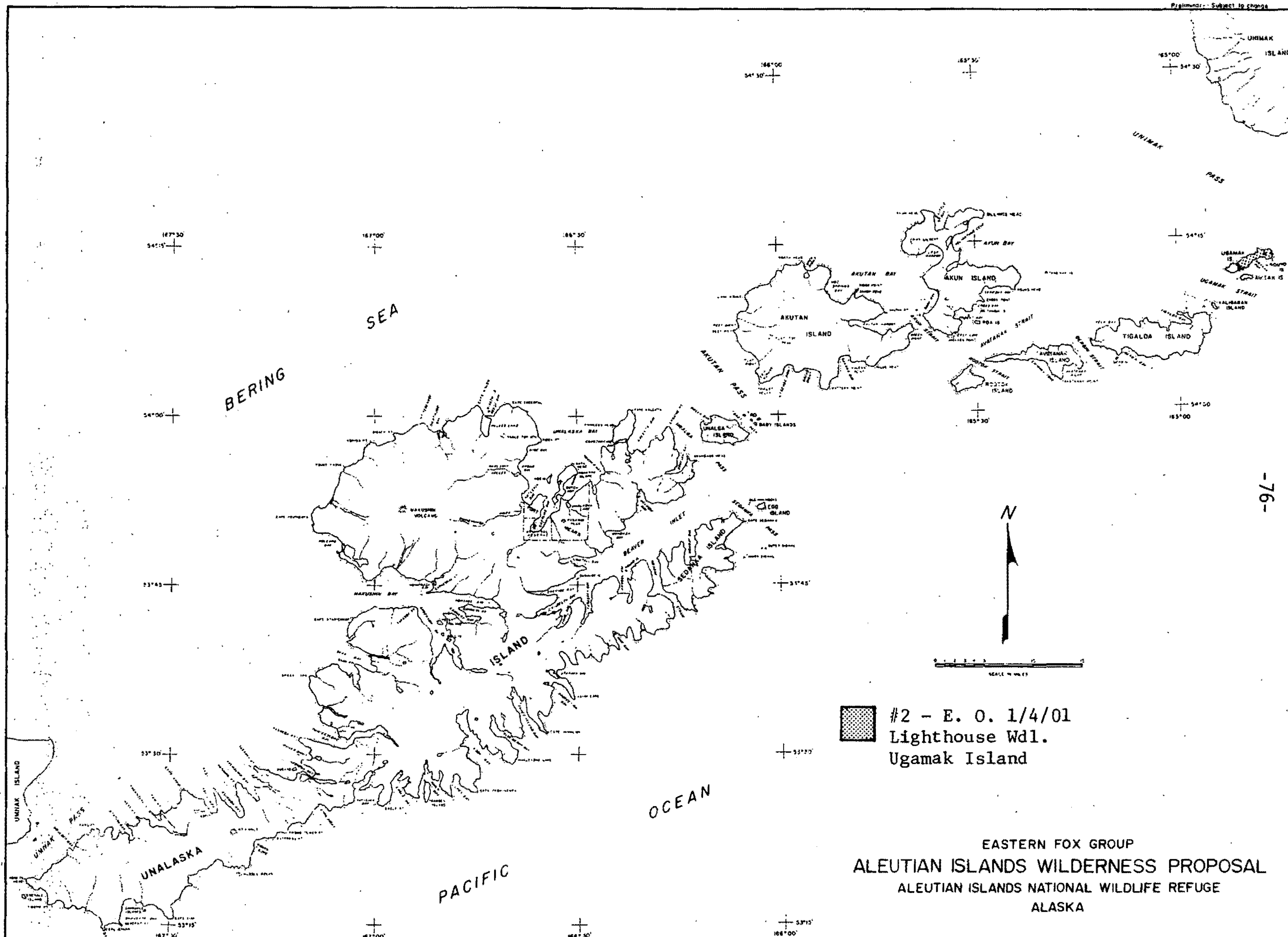


Figure 6. Lighthouse Withdrawal- Ugamak Island

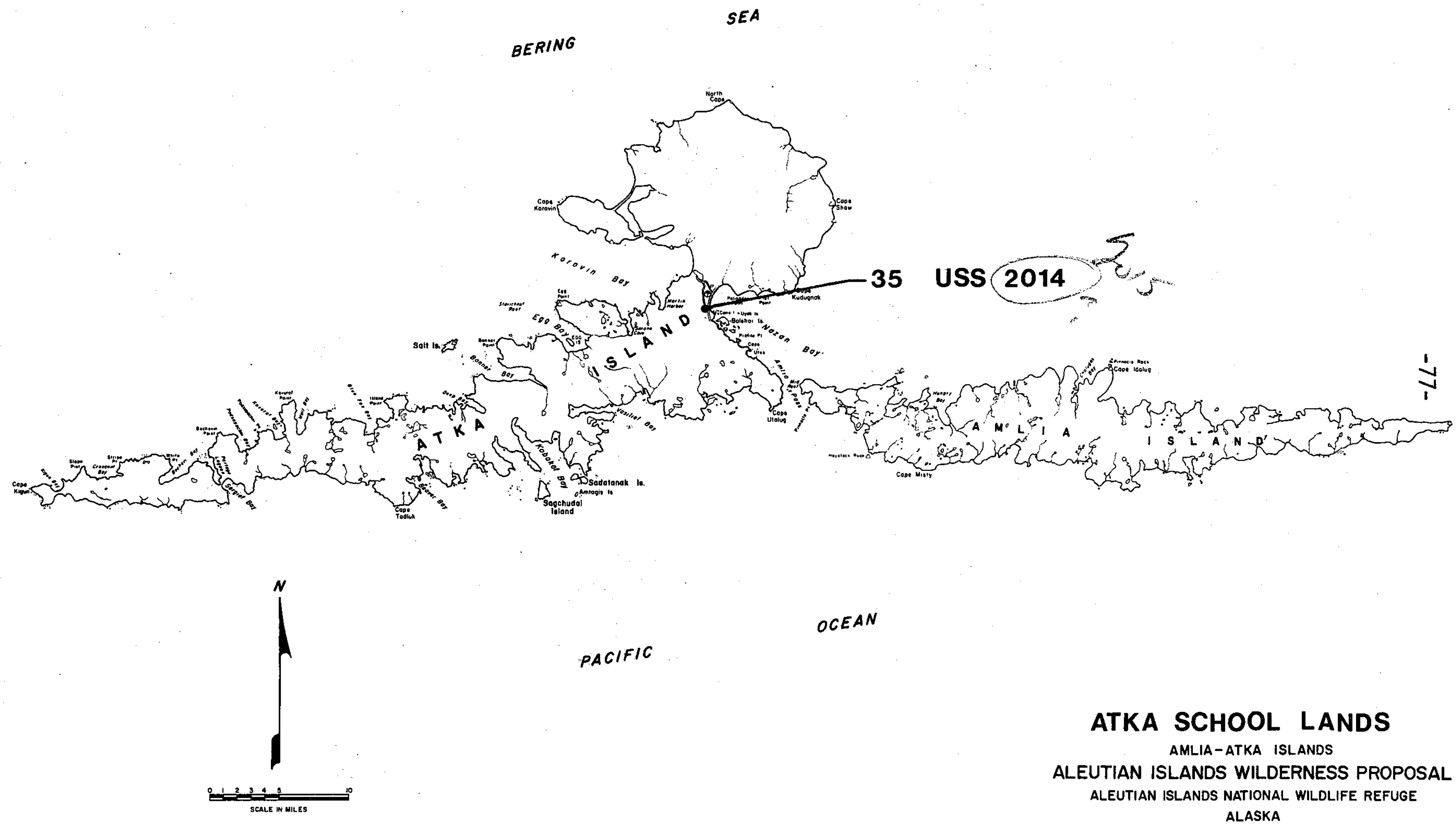


Figure 7. Land Withdrawal- Atka Island

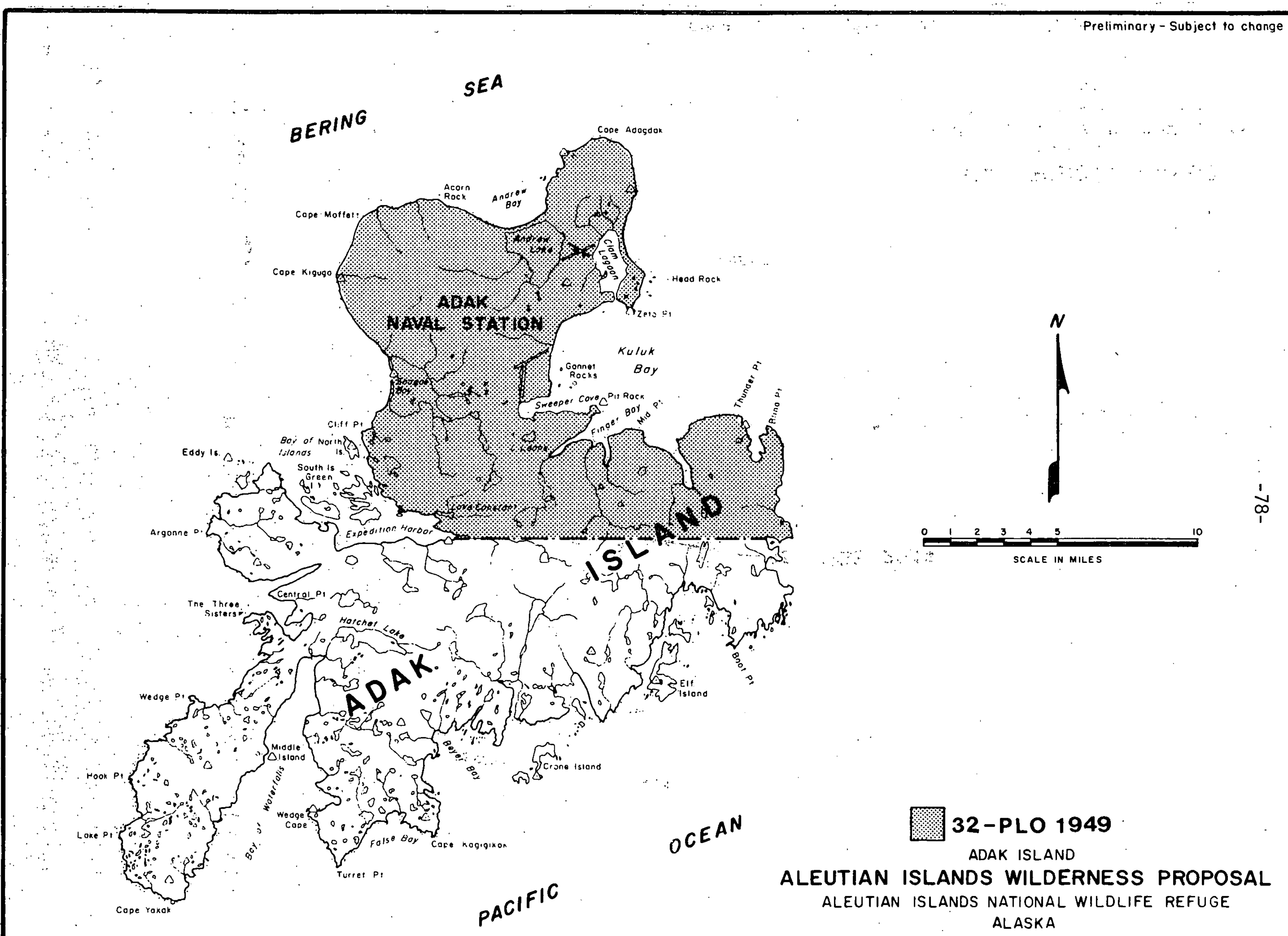
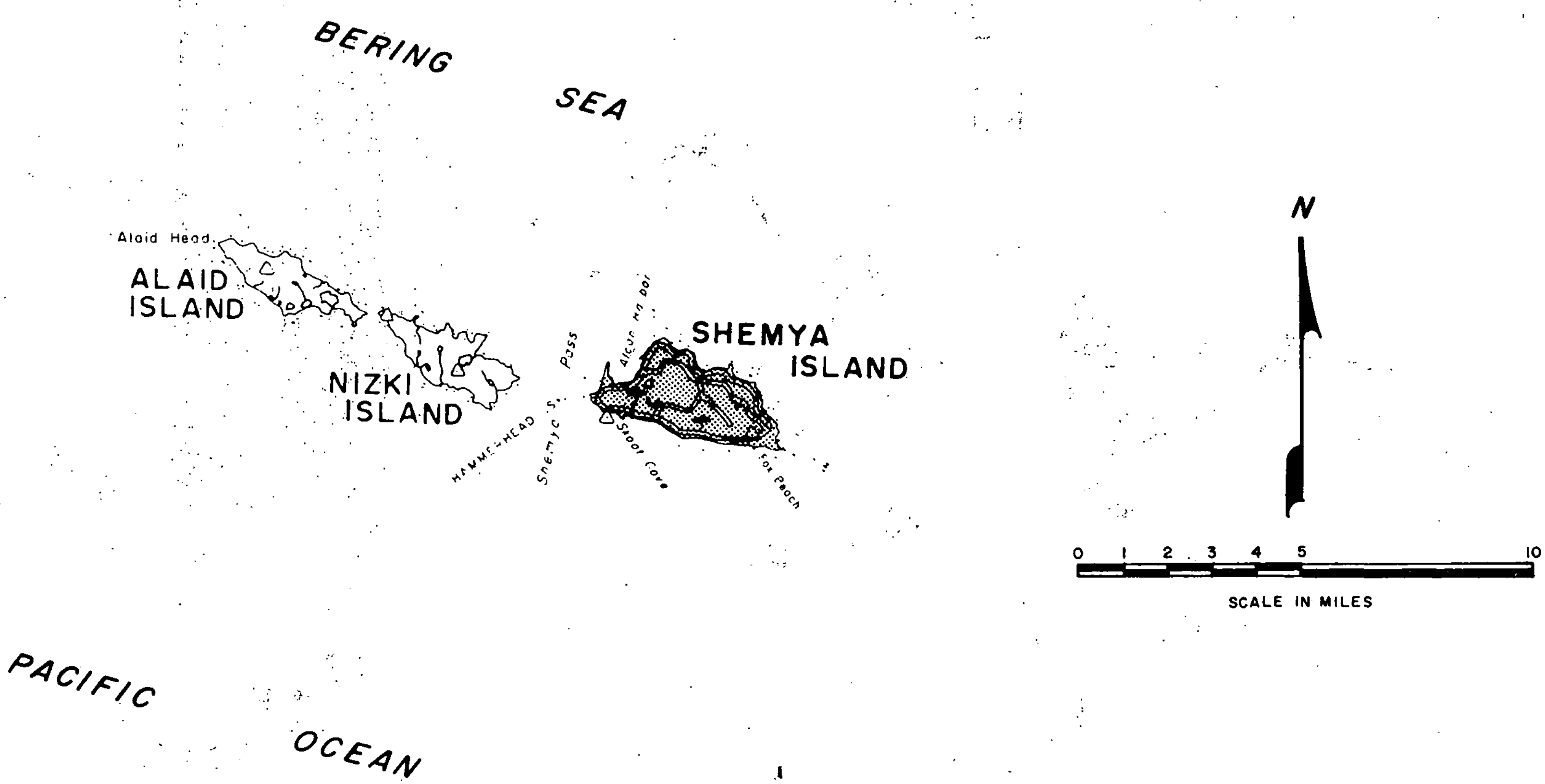


Figure 8. Land Withdrawal- Adak Island

Preliminary – Subject to change



34 BSF&W–USAF AGREEMENT

SHEMYA ISLAND

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 9. Land Use Agreement- Shemya Island

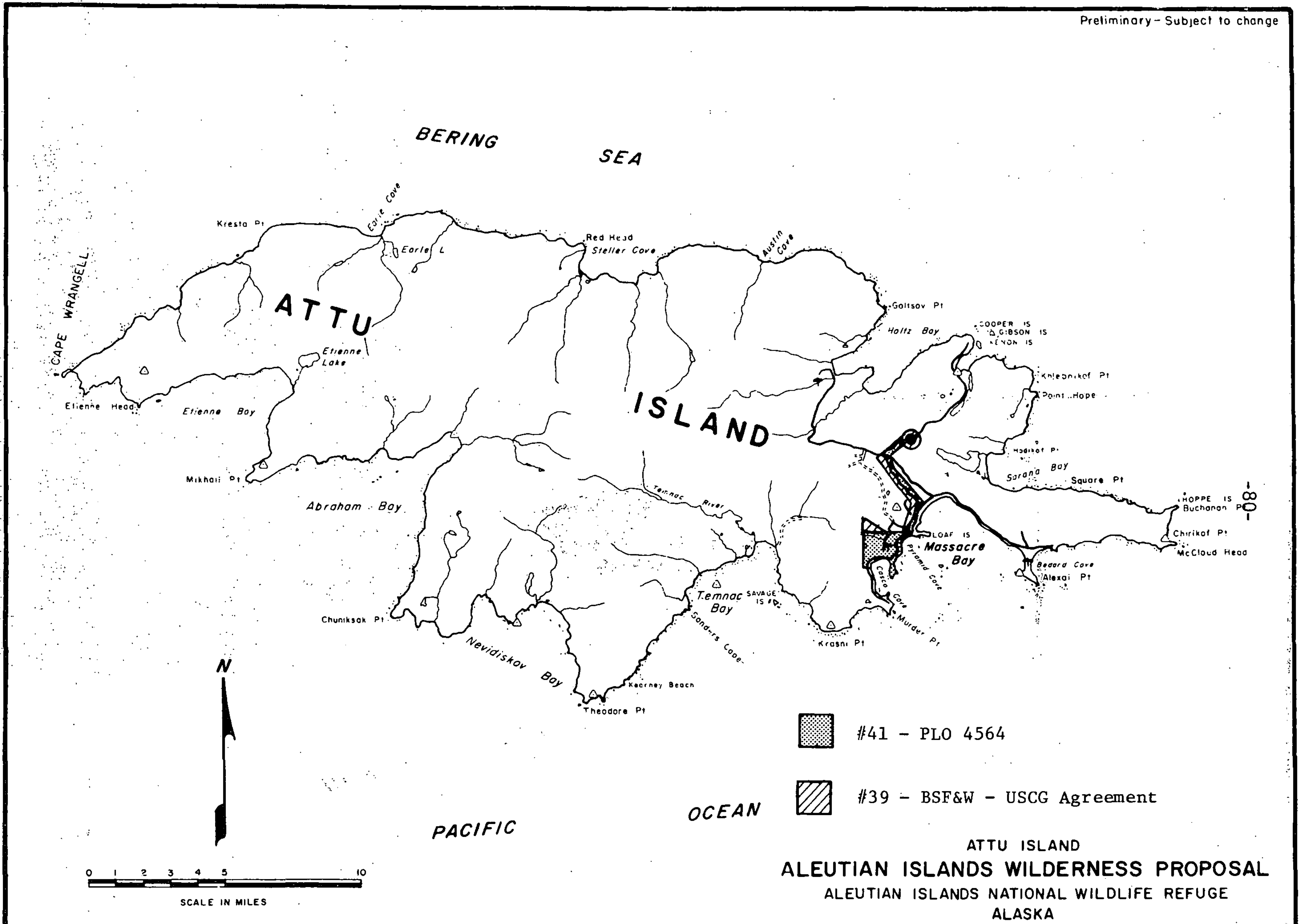


Figure 10. Land Withdrawal and Land Use Agreement- Attu Island

Private land inholdings within the Refuge boundary are located at Ikatan and False Pass on Unimak Island and at Atka on Atka Island. At Ikatan about 10 acres containing an abandoned cannery are owned by Pacific American Fisheries. About 32 acres in four individual tracts at False Pass are owned by Peter Pan Fisheries, Inc., along with a gravel airstrip built and owned by the State of Alaska. About 2.62 acres of school lands at Atka village are owned by the State of Alaska. All but the land at Ikatan are within the townships automatically selected by the Aleut Village Corporations under the Alaska Native Claims Settlement Act. However, Ikatan is within that area eligible for Native Selection.

Jurisdiction

Boundary - Alaska Regional Solicitor Hugh J. Wade issued the opinion on February 22, 1971 to the Alaska Area Director that "...the boundary line of the Aleutian Islands National Wildlife Refuge is the mean high tide of the water line on each of the islands of the Aleutian Chain. We are further of the opinion that the law is very clear that reefs that extend out from the islands that are covered by the ebb and flow of the tide are submerged lands and therefore State owned and not within the boundaries of the Aleutian Islands National Wildlife Refuge". In addition, Assistant Regional Solicitor James R. Mothershead in a memorandum dated February 22, 1971, to the Regional Solicitor, Anchorage concludes in his opinion"...(1) any naturally-formed area of ground, soil, earth, rock, or reef which is surrounded by water and above the level of mean high tide is deemed an "island"; (2) any island, as so defined, within the area set aside by Executive Order 1733 and not later excepted by Executive Orders 5000 and

5243 is a part of the Aleutian Islands National Wildlife Refuge to the extent of the upland enclosed by mean high tide line of the island; and (3) all water and submerged land seaward from such mean high tide line to the three-mile limit is outside the Refuge and under the jurisdiction of the State of Alaska, incidental to which is the right of the State to manage, administer, regulate, and develop the natural resources in such area, including the fisheries and other marine life."

Primary - Assistant Fish and Wildlife Solicitor Charles H. Vaughn issued the opinion on June 26, 1972 to Director, Bureau of Sport Fisheries and Wildlife that primary jurisdiction of the Aleutian Islands National Wildlife Refuge lies within the Bureau of Sport Fisheries and Wildlife. He viewed the Executive Order 1733 clause "...shall not interfere with the use of the islands for lighthouse, military, or naval purposes, or the extension of the work of the Bureau of Education on Unalaska and Atka Islands", as not operating as a limitation of jurisdiction but as an assurance of permission for specified use if needed.

Refuge Use Permits- Associate Solicitor C. Brewster Chapman, Jr., Territories, Wildlife and Claims, in a memorandum dated October 6, 1969 to Director, Bureau of Sport Fisheries and Wildlife given an opinion as to whether any Federal agency engaged in military activities in the Refuge would require a formal permit from the Bureau of Sport Fisheries and Wildlife. He determined that "...Executive Order 1733 also says: "The establishment of this reservation shall not interfere with <u>the use</u> of the islands for lighthouse, <u>military</u>, or naval purposes, or with the extension of the work of the Bureau of Education on Unalaska and Atka Islands". (Emphasis added) It therefore becomes obvious that the "use permit" was created in broad fashion by the Executive Order itself and it is our opinion that for these purposes no formal use permit from the Bureau is required". Chapman further thinks that 50 CFR 26.1 and 50 CFR 25.4 prescribes consultation and agreement with any Federal agency and the Bureau before the permitted use is begun.

Military, Naval, and Lighthouse - This section is included only for the record. To further clarify and define Executive Order 1733 provision "...shall not interfere with the use of the islands for lighthouse, military, or naval purposes...", "Proposed Memorandum of Understanding, Aleutian Islands National Wildlife Refuge, Excluding Unimak" and a "Proposed Memorandum of Understanding, Unimak Island, Aleutian Islands National Wildlife Refuge" were prepared by the staffs of interested local parties, i.e., CINCPAC, Director Alaskan Region Federal Aviation Administration, Commander, Coast Guard District Seventeen, and Alaska Area Director, BSF&W. Although headquartered in Hawaii, CINCPAC has defense responsibility for the area of the Aleutian Islands National Wildlife Refuge.

Although the solicitor had issued the opinion that primary jurisdiction within the Aleutian Islands National Wildlife Refuge lies with the BSF&W, the establishing Executive Order 1733 does provide for lighthouse, military or naval purposes.

We further thought that this would adequately identify the intent of all concerned Federal agencies regarding land use.

As previously stated under Refuge Use Permits, Associate Solicitor Chapman thought that 50 CFR 26.1 and 50 CFR 25.4 prescribes consultation and agreement with any Federal agency and the Bureau before the permitted use is begun. We thought that the proposed memoranda of understanding recognized the Executive Order provision and identified the intent of all concerned Federal Agencies to recognize each others responsibilities and to establish consultation and agreement prior to any land-use in the Refuge. We felt this necessary so that Congress could make its decision as to the suitability of the area for wilderness purposes.

Concurrence among the interested local parties on the need for such an agreement and upon the wording of the proposed memoranda of understanding was achieved after a lengthy process of detailed negotiations. Inevitable differences which arose were settled through a process of mutual accommendation to produce documents which each party felt would be viable. These memoranda were planned to be forwarded by each agency to their respective Secretary, for their concurrence and subsequent agreement between the Secretaries of Interior, Defense, and Transportation. At that time the agreement was planned to be an addendum to this report and included in the wilderness packages for the Unimak Wilderness Proposal and the Aleutian Islands Wilderness Proposal. However, these memoranda of understanding were rejected by our Department. They thought that they were not required for the purpose of making a wilderness proposal.

Refuge Water Rights - Enactment of the "Alaska Water Use Act" occurred in 1966, but since no water development has taken place or diversions been made within the Aleutian Islands Refuge, water has not been appropriated under the definition of the Water Use Act. Appropriation is defined in the Act as "...diverting, impounding or the withdrawing of a quantity of water from a source of water for beneficial use." No claim for surface or ground water rights has been made to date for the refuge.

Land Status Within the Refuge Boundary

Refuge Permits- There are eight active refuge use permits, six of which terminate during 1973. Table 3 lists all of these currently in effect. Permits #32942 AL 1-66, and RO-90 lie within Native selection areas and permit AL 1-73 is located in Chichagof Harbor, which will probably be selected as an historical site by the Aleut Corporation. Permit AL 1-66 at Atka also lies within Native Allotment Claim AA-8043.

The remaining permits were issued to the U.S. Atomic Energy Commission for operations related to their activities on Amchitka. Termination of their presence on Amchitka is expected by the end of 1973. All the permits terminate in 1973 and renewal is not expected. Removal of apparatus installed under permit has not been accomplished to date. The AEC rationalizes that the cost of sending men, ships, and helicopters to the various islands to accomplish cleanup is excessive. But the terms of the permits call for removal of all material and the site to be left in as natural a condition as possible. Both the U.S. Atomic Energy Commission and the Bureau of Sport Fisheries and Wildlife will be remiss in their responsibilities if the permit conditions are not fulfilled. In considering the Islands for wilderness purposes, it is assumed that permit stipulations will be adhered to.

Military, Naval and Lighthouse - In recognition of the provision of Executive Order 1733, "...shall not interfere with the use of the islands for lighthouse, military, or naval purposes...", the Bureau of Sport

Table 3. Active Refuge Use Permits

Permit #	Permitee	Island	Purpose	Use Period
32942	Chris Gunderson	Caton	Grazing	1-1-69 to 12-3-73
AL 1-66	James H. Christianson	Atka	King crab processing plant	1-1-66 to 12-31-85
AL 1-73	Wakefield Fisheries	Attu	Moorage space - Chichagof Harbor	1-1-73 to 4-1-73
RO-90	U.S. Coast Guard	Unimak	Two Nav-Aids-St. Catherine Cove	7-17-68 to 7-17-38
RO-102	U.S. Atomic Energy Commission	Semisopochnoi & Amatignak	Seismic station & repeater station, respectively	5-1-69 to 5-1-73
RO-102, amendment #1	"	Amatignak & Little Sitkin	Delete repeater station & include seismic station, respectively	5-1-69 to 5-1-73
RO-93	"	Kiska	Wind tower	11-18-68 to 11-18-73
AL 1-70	"	Amatignak, Semisopochnoi, & Rat Islands	Install & operate facilities	8-1-70 to 6-30-73

Fisheries and Wildlife requested military land-use requirements in the Aleutian Islands Refuge from the Alaska Command. Subsequently, the Commander-in-Chief, Pacific (CINCPAC) replied, since they have the defense responsibility for the area of the Aleutian Islands Refuge. By a letter of March 27, 1972, from Captain C.S. Christensen, Jr. (for CINCPAC) to the Alaska Area Director, Bureau of Sport Fisheries and Wildlife, the military requested that the following lands be withheld from wilderness consideration because of defense requirements. Unimak was not included in this request, but was listed in a January 7, 1972, letter from Christensen.

Classified Navy and Air Force uses exist or are in planning stages for the following area:

a. Adak. The 61,000-acre parcel of land lying north of latitude 51°-47'-15"N (approximately) as described in Public Land Order 1949 of 19 August 1959.

b. Amchitka. Three parcels of land described below, plus road and communications right-of-way connecting the three areas.

(1) Parcel 1. The land east and south of the unimproved road and trail which traverses the island from the Bering Sea starting at 179°-11'-43"E, 51°-26'-53"N in a southwesterly direction to the Pacific Ocean at 179°-07'-47"E, 51°-25'-29"N.

(2) Parcel 2. The land west of a line starting at the mouth of the stream which empties into the Bering Sea at 178°-42'-32"E, 51°-38'-29"N, thence upstream in a southwesterly direction to the head of that draw, thence due south following the draw of an intermittent stream to its mouth where it empties into the Pacific Ocean at 178°-41'-26"E, 51°-36'-34"N.

(3) Parcel 3. The high point of the island, the hill at peak elevation 1,160 feet, located at 178°-48'-40"E, 51°-36'-23"N and that land lying within a radius of one-half mile from the peak of that hill.

In order to provide adequate security for these areas, CINCPAC felt that it would be highly desirable to withhold public access to any wilderness area established on the remainder of the island. These military land-use requirements are unrelated to Atomic Energy Commission requirements.

c. Shemya. Entire island, approximately 3,520 acres.

d. Attu. Coast Guard Reservation, approximately 1,700 acres; plus an area 100 yards in radius centered in a gravel pit at 173°-10'-28"E, 52°-53'-04"N near Benchmark A16EVE 1944; plus access road and communication lines connecting these parcels. The communication lines parallel the road which trends approximately two miles northeastward from the Coast Guard building, then about three miles in a generally northwesterly direction, terminating at the gravel pit.

Atomic Energy Commission - For the record, there is no documented use agreement between the Bureau of Sport Fisheries and Wildlife and the Atomic Energy Commission regarding Amchitka Island. Our information is that this was a verbal agreement on the cabinet-level, made sometime during 1966. The Memorandum of Understanding, AT26-1-320, dated May 17, 1967 and the Supplemental Agreement, of July 1968, only provides for a Bureau of Sport Fisheries and Wildlife and Atomic Energy Commission responsibilities for the needs and requirements of the area's wildlife.

We have requested information from the AEC as to their future land requirements for Amchitka and adjacent islands but have received no answer at the time of this writing (Letter of January 31,1972 from Alaska Area Director, Mr. Watson, BSF&W to Assistant Mgr. of Engineering and Logistics, William Smith, AEC, Las Vegas).

Native Use

Native Allotment Act - The Alaska Native Allotment Act of May 17, 1906 (34 Stat. 197) - amended August 2, 1956 (70 Stat. 954; 48 USC 357, 357a, 357b) enabled individual Natives to secure certificates of allotment for a maximum of 160 acres, in up to four separate tracts. No improvements to the land were necessary just proof of "substantially continuous use and occupancy" for a period of five years. This allowed for the traditional seasonal use of hunting, fishing, and trapping sites.

However, the Act in authorizing the Secretary to allot these lands, specified that they, at the time of use, shall be vacant, unappropriated and unreserved non-mineral lands. Five Native allotments within the refuge have been applied for and are listed below:

Application Number	Date of Application	Name	Island Area Applied for	Date first Occupied	Action on Application
AA-8040	6-12-72	Larry W. Dirks, Sr.	Atka-40A	May 1960	Rejected*
AA-8041	"	Clara Z. Golodoff	Atka-40A	June 1965	Rejected
AA-8043	"	Nick Nevzoroff	Atka-40A & Amlia-120A	May 1963	Rejected
AA-8044	"	Daniel N. Prokopeuff	Amlia-160A	May 1966	None
AA-8055	6-16-72	Nickolas W. Dirks	Amlia-160A	May 1960	None

* Rejection appealed

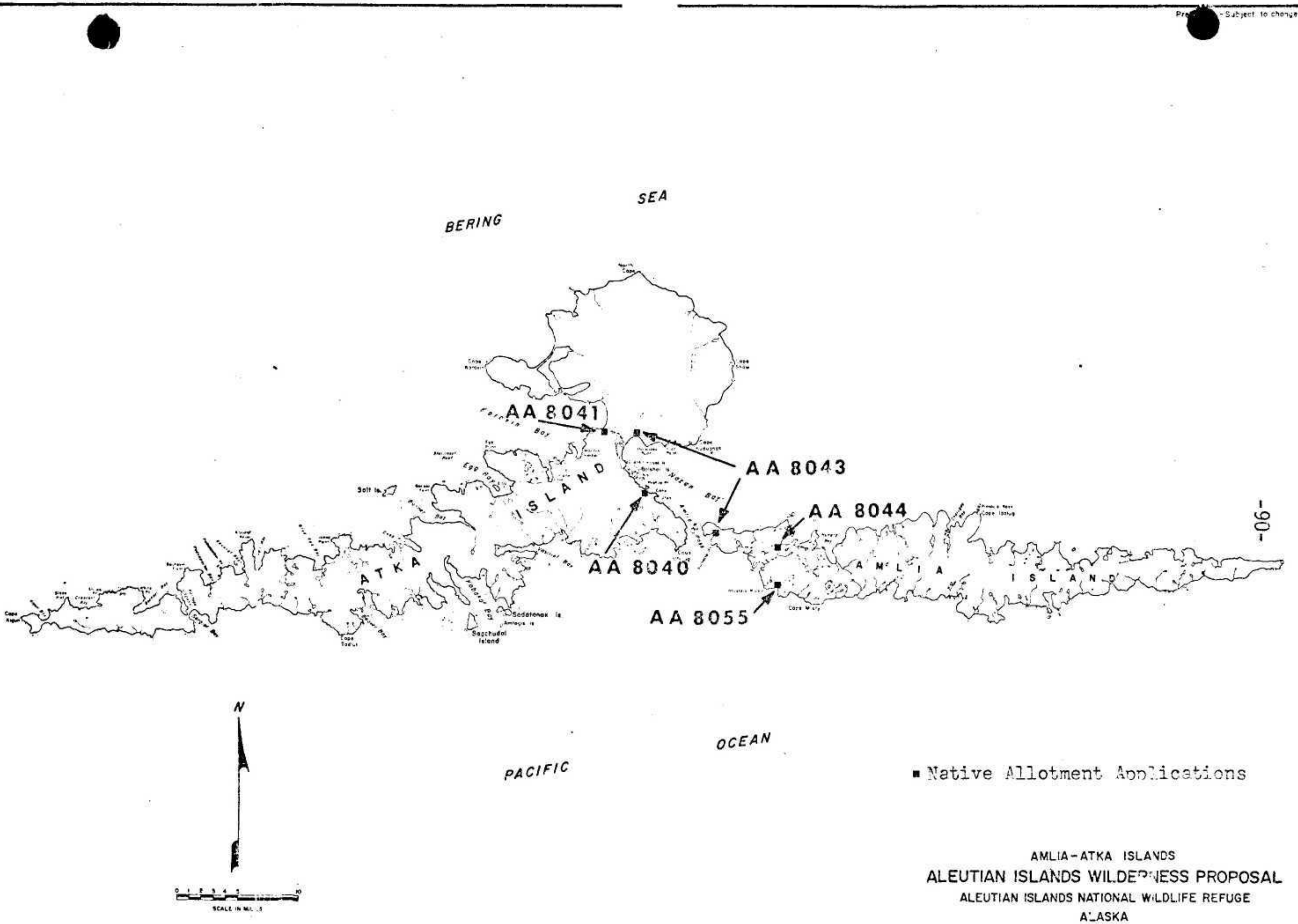


Figure 11. Native Allotment Applications

The Bureau of Land Management has rejected three of the applications because the land was reserved for refuge purposes during the period of the use by the applicants. No action has been taken on the remaining two applications. One rejection (AA-8040) has been appealed to the Board of Land Appeals, Office of Hearings and Appeals, Arlington, Virginia.

If the claims are found to be valid the impact upon the refuge would be insignificant. Applications AA-8041 and AA-8043 are within the Atka village township automatically withdrawn under ANCSA. AA-8040 and part two of AA-8043 are within the area in which the village of Atka can withdraw lands under ANCSA. AA-8044 and AA-8055 are outside the ANCSA lands but would pose no foreseeable conflict with refuge management if they are found to be valid. For the purpose of this proposal it is assumed that the applications are not valid.

Alaska Native Land Claims Settlement Act - On December 18, 1971 the U.S. Congress passed the Alaska Native Claims Settlement Act, Public Law 92-203. In extinguishing land claims for Alaska Natives, Congress compensated them with legal title to 40 million acres of land and $962.5 million. Land selection is based on village enrollment. The Act affects the refuge in the following ways; (1) selection by Atka and False Pass villages of a single township in which the villages are located; (2) selection of the equivilent of two additional townships in reasonably compact tracts of not less than 1,280 acres around Atka and False Pass, and Unalaska, Biorka, Paulof Harbor and Akutan; (3) conveyance of fee title to a maximum of 160 acres of land occupied by individual Natives as a primary place of residence; and (4) conveyance of fee title to existing cemetary sites and historical places. (1) and (2) Selection by the villages is summarized as follows:

Village	Enrollment as of 11/2/72	1970 Census	Land Entitled to select	Within Refuge Boundaries
Atka	133	88	92,160	69,120
Nikolski	96	57	69,120	1,300
Biorka	1	0	-	-
Unalaska	212	178	115,200	195
Akutan	112	101	92,160	10,755
False Pass	62	62	69,120	69,120
Paulof Hbr.	14	39	-	-
			437,760	150,490

There is variation in the interpretation of the Act in regards to what acreage can be claimed by an identified village where enrollment does not reach 25 individuals and as to the acreage that can be claimed for cemetery and historical sites. No definite acreage figures can be given till these determinations are made. Enrollment for Biorka and Paulof Harbor fall short of 25. However, even if they are granted the one township in which they are located, no selection of refuge lands would occur. This also is true if individual Natives seek their primary place of residence sites in these villages.

The largest withdrawal of refuge lands is at Atka village. Because of the relatively low wildlife value in the area of possible selection, there is expected to be no significant conflict with refuge purposes.

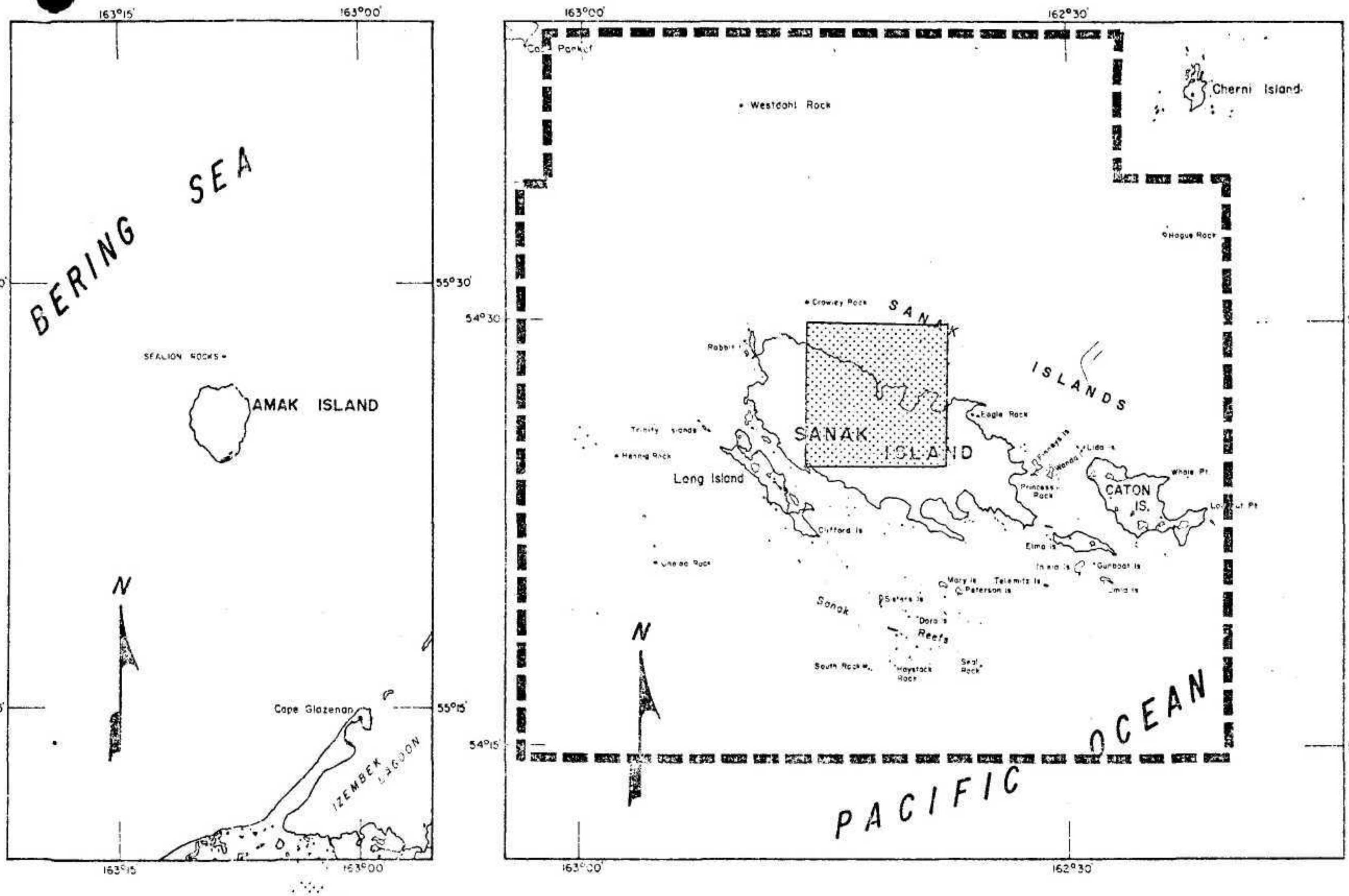
Section 22(g) of that act provides:

> If a patent is issued to any Village Corporation for land in the National Wildlife Refuge System, the patent shall reserve to the United States the right of first refusal if the land is ever sold by the Village Corporation. Notwithstanding any other provision of this Act, every patent issued by the Secretary pursuant to this Act--which covers lands lying within the boundaries of a National Wildlife Refuge on the date of enactment of this Act shall contain a provision that such lands remain subject to the laws and regulations governing use and development of such refuge.

It is possible that the Aleut Corporation may not be in agreement with this and may contest it. In this eventuality, the issue will probably be settled by the courts. Regardless of what decision is made, these areas are to be eliminated from wilderness consideration in this proposal those lands not actually selected under this Act should then be evaluated for wilderness consideration.

(3) Section 14 (h) (5) provides:

> The Secretary may convey to a Native upon application within two years from the date of enactment of this Act, the surface estate is not to exceed 160 acres of land occupied by the Native as a primary place of residence on August 31, 1971. Determination of occupancy shall be made by the Secretary, whose decision shall be final. The subsurface estate in such lands shall be conveyed to the appropriate Regional Corporations;



0 1 2 3 4 5 10 15

SCALE IN MILES

PAULOF HARBOR

AMAK ISLAND AND SANAK ISLAND GROUP

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 12. Area in Which Land Can Be Selected By The Paulof Harbor Village Corp.

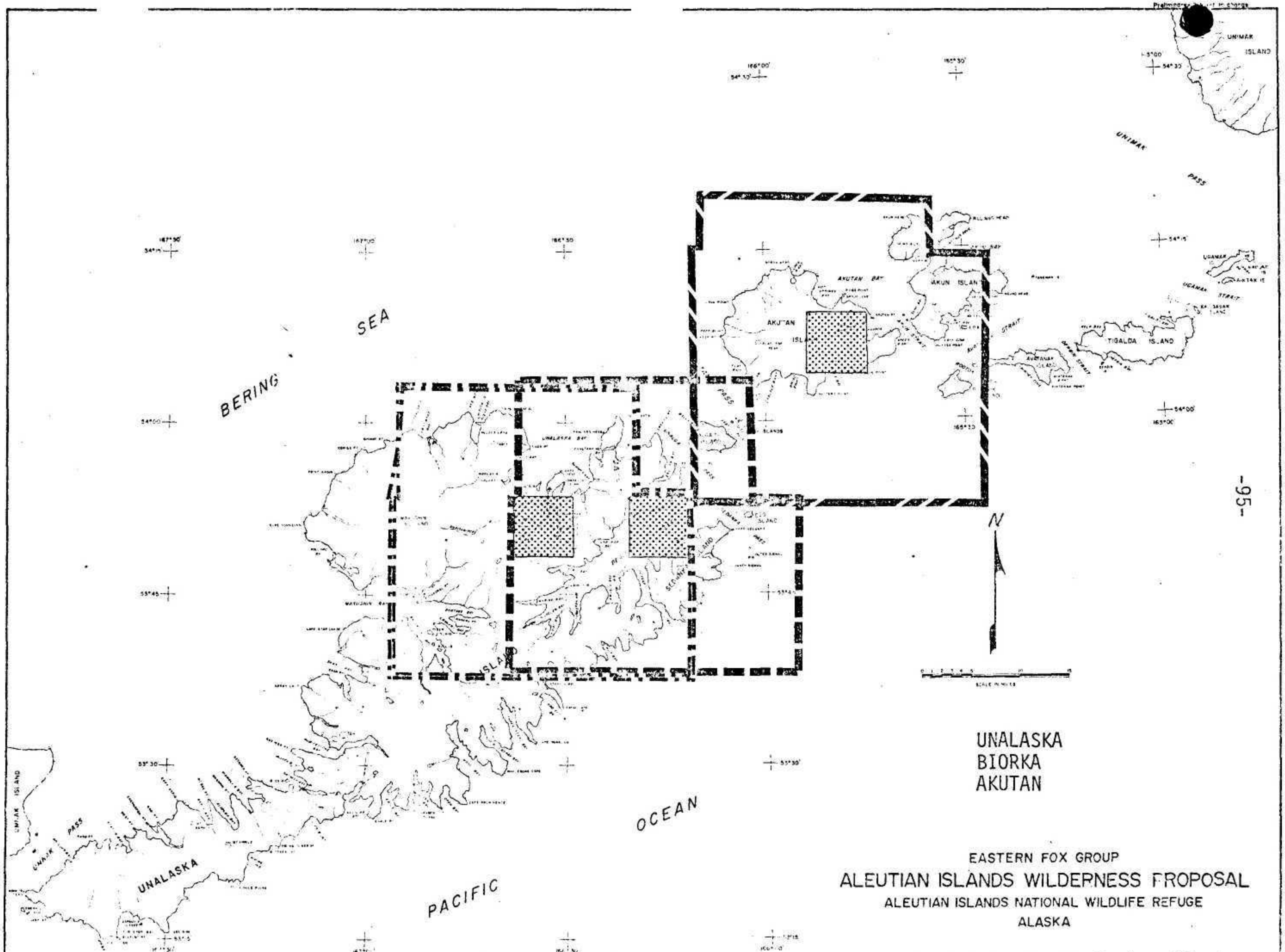


Figure 13. Area in which land can be selected by the Unalaska, Biorka, and Akutan Village Corporations

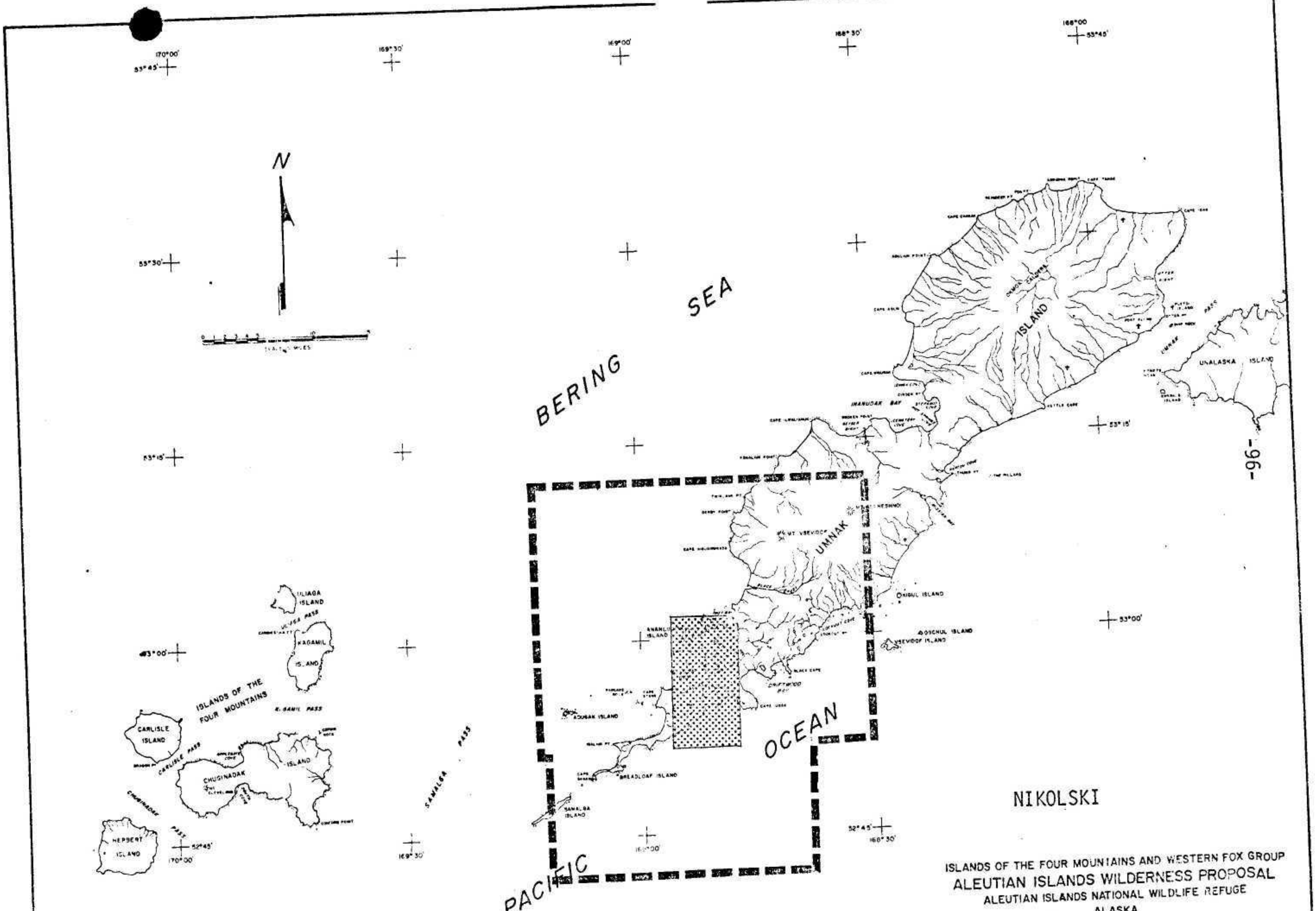


Figure 14. Area in which land can be selected by the Nikol ki Village Corporation

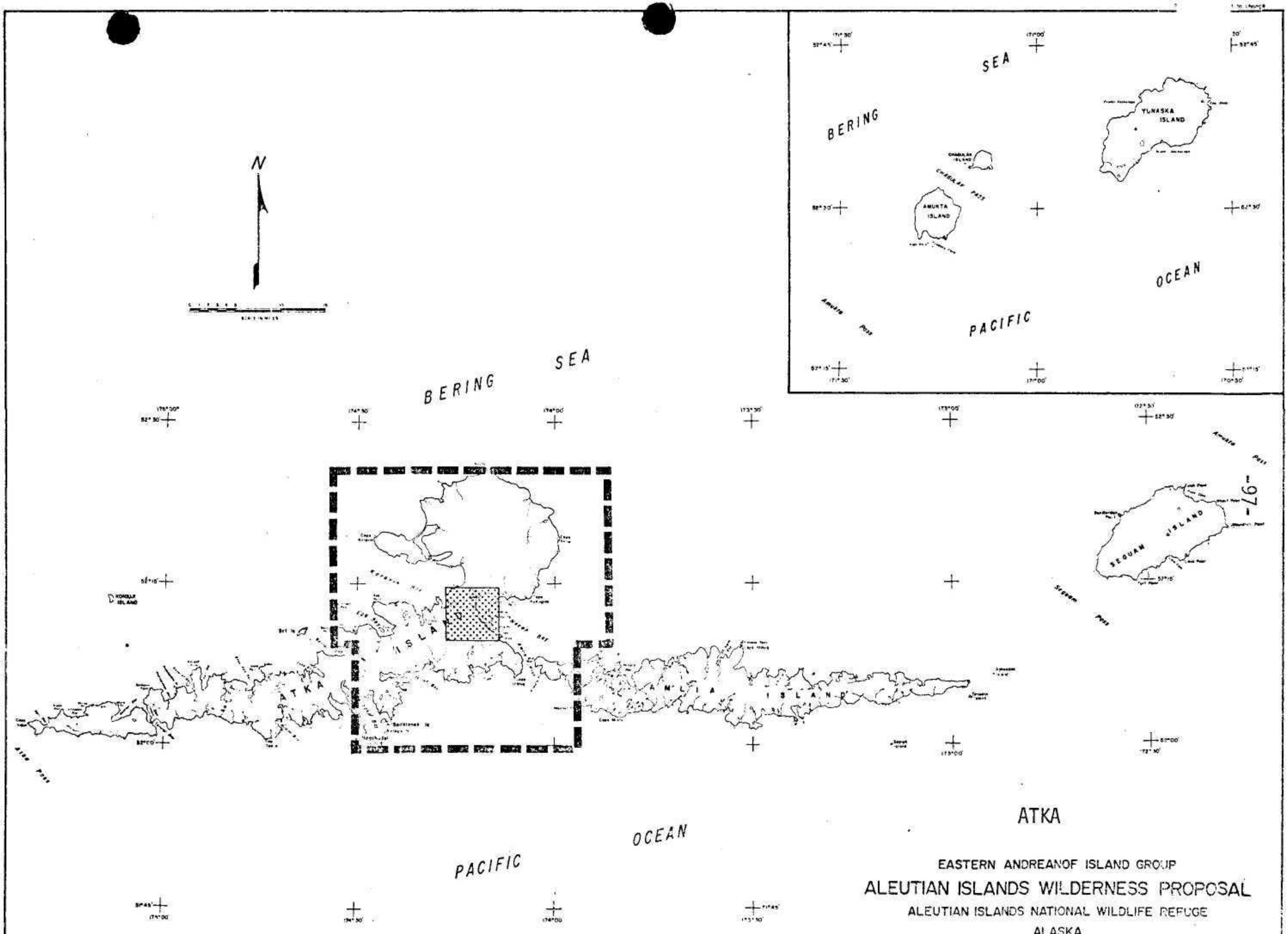


Figure 15. Area in which land can be selected by the Atka Village Corporation.

No applications for primary place of residence are expected within the refuge boundary outside those areas covered by the village withdrawals.

(4) Section 14 (h) (1) states;

> "The Secretary may withdraw and convey to the appropriate Regional Corporation fee title to existing cemetery sites and historical places."

The Aleut Corporation has not, at the time of this writing, identified cemetery and historic sites. Certainly the cemetery at Constantine Harbor, Amchitka Island, and the site of Attu village on Attu Island will be identified. Beyond this it is expected that all archeological sites will be claimed as historic sites. This may have a significant impact on the Aleutian Islands Refuge where a large number of archeological sites exist. The restriction of a maximum of 2 million acres for Section 14 (h) may limit the number of sites actually chosen. The Bureau in either event may wish to explore an agreement with the Aleut Corporation where the Bureau provides protection and development of such sites under the authority of the Antiquities Act.

The following list of known archeological sites is mostly entirely from McCartney (1972) but includes other sites located by Bureau of Sport Fisheries and Wildlife personnel during the course of the field studies.

Sites on refuge and non-refuge islands are included as they are all part of the archipelago and comprise the Aleutian cultural area. Only sites from Unimak west are treated here, including those from the Sanak Islands, and Amak Island.

No attempt has been made to summarize all that is known about particular sites beyond locations. In some cases, published papers provide measurements and other details but most of the sites included have not been published and there exist no public descriptions of the same. As the primary purpose is to indicate known site locations on the various islands rather than site descriptions, the reader is obligated to seek details through citations provided.

The roughly 350 sites included on these maps are only an approximation of the actual early historic and prehistoric sites occupied. All islands have not been surveyed with equal intensity or thoroughness. Only the archaeological and some ethnographic sources of the past century are reviewed and the early Russian sources for possible additional site locations. Only sites that have been personally seen or that have been inspected by investigators such as Dall, Jochelson, Hrdlicka, McCartney, Laughlin, Bank, Turner, and others. Additional site locations have been suggested by Native and white informants to Bergsland, Bank, Hrdlicka and Jochelson. Included in the notes are references to Jochelson's burial cave locations and Bergsland's sites because these authors are rather specific as to their Native sources. It is likely, of course, that most of the "reported" sites included in Hrdlicka's and Bank's writings will be verified in the future and will expand our list of known sites.

Included are sites known to have been damaged or destroyed during World War II by military construction. Almost all sites within military reservations were destroyed and are no longer available for scientific testing.

But because the aim here is to provide as complete a site inventory as possible, they are included in the listing. Where there is information about the present condition of such damaged sites, that information is provided.

The sites included here are either a) prehistoric, b) early historic, or c) both. Without historical documentation or archaeological testing, it is often impossible to know if a village or settlement dates from the prehistoric or historic period. We do have good evidence that the Russian contact after 1741 caused a great depopulation throughout the chain due to disease and genocide (Hrdlicka 1945: 32, 173). Also, the Russian fur companies were responsible for moving the native population around to suit their exploitative needs and large, important settlements were established where only insignificant sites existed during the prehistoric period. This site abandonment and transfer marks the tumultuous period of Russian colonization of the late 18th and early 19th centuries.

As emphasized previously, the reader should be very cautious about drawing conclusions regarding site and population densities from the accompanying maps. Not all islands have been equally inspected for sites. On the other hand, different areas on the same island have received unequal scrutiny. The fact that Amchitka has 78 reported sites and Umnak only 11 says more about the relative intensity of site surveys than about actual prehistoric population size or settlement patterns on these islands.

The following notes about sites are arranged in an east-west sequence to correspond with the map arrangement. The numbers indicating site locations are arbitrarily assigned as there has been no attempt on the part of archaeologists working in the archipelago to list sites by order of their discovery in a central file. The only exceptions are the Amchitkan sites which have been given formal designations in published reports; the site numbers here follow those already published.

Site Locations

Amak Island - Small site reported by Jones in 1970 but no specific location given.

Sanak Islands - 1) C. Gunderson of Paulof Harbor 1969, personal communication) reports one site in Sanak Harbor.

Fox Islands

Unimak- Veniaminof (Hrdlicka 1945: 40) reports 12 settlements at the end of the 18th century but specific locations are not given.

1) Sekora (1971) reports a small site here.
2) Sekora (1971) reports a small site here.
3) Sekora (1971) reports a small site here.
4) Sekora (1971) reports a small site here.
5) Sekora (1971) reports a small site here.
6) Sekora (1971) reports a small site here.
7) Sekora (1971) reports a small site here.
8) Sekora (1971) reports a small site here.
9) Sekora (1971) reports a small site here.

Ugamak- Veniaminof (Hrdlicka 1945: 39) reports "a fairly populous settlement" abandoned in 1826 but the exact location is unspecified.

Tigalda- 1) Grayson (1969) reports on P. Spaulding's 1953 collection from this site; Spaulding located one other site besides this one on the island.

Veniaminof (Hrdlicka 1945; 39) reports 5 old sites but locations are not given.

Avatanak- P. Spaulding located one village site on this island during 1953; Veniaminof (Hrdlicka 1945: 37) reports 3 villages in pre-Russian times.

Rootok- Veniaminof (Hrdlicka 1945: 36) reports a village on this island (Aaktak or Goloi) in the past but "now (1835) the island is unhabited." (sic)

Akun- 1 & 2) P. Spaulding located 4 sites during 1953 (Grayson 1969); Turner and Turner (1972) report the Chulka and Islelo sites somewhere on Akun Strait but exact locations are unspecified; Turner (1972) originally reported 7 sites on the island. Veniaminof (Hrdlicka 1945: 37) reports a total of 8 sites during the latter part of the 18th century.

Akutan- Turner (1972) reports 5 old village sites on this island; P. Spaulding (Grayson 1969) also reports 5 sites, presumably the same ones. Veniaminof (Hrdlicka 1945: 37) reports a total of 7 occupied villages during the 18th century.

Baby Islands- 1) M. McCasland of Unalaska Village (1972, personal communication) reports at least one site with house depressions on one of the small central islands of the group.

Unalga- Veniaminof (Hrdlicka 1945: 40) reports a settlement on the south shore during the 19th century.

Unalaska- (including Sedanka and Amaknak Islands)
1) Bank (1971: 22) notes this as a large site at the western end of the island.
2) Bank (1971: 22) indicates this site is prehistoric in age.
3) Bank (1971: 22) indicates this site is prehistoric in age.
4) Bank (1971: 22) indicates this site is prehistoric in age.
5) Bank (1971: 22) reports this site as does A. Hartt (1972, personal communication) who visited it on the University of Washington research vessel, Commander.
6) Bank (1971: 22) indicates this site is prehistoric in age.
7) Bank (1971: 22) indicates this site is prehistoric in age.
8) Bank (1971: 22) indicates this site is prehistoric in age.
9) M. McCasland (1972, personal communication) reports this burial cave site not far from the Chernofski sheep ranch. McCasland also reports several other small midden sites around the edge of Chernofski Harbor but the exact locations are not known.
10) Hrdlicka (1945: 263) reports a midden site on the spit protecting Chernofski Harbor.
11) Hrdlicka (1945: 263) also indicates a cave and rock shelter used for burials just north of Chernofski Harbor; McCasland confirms these sites.
12) Bank (1971: 22) indicates this to be a prehistoric site.
13) Weyer (1929) reports on the Split Rock site, a small islet off Sedanka Point; the exact location is not illustrated by Weyer; Hrdlicka (1945: 148, 270) also illustrates the islet but is equally vague about its exact location. McCartney (1971: 96, 112-13) has analyzed part of Weyer's Split Rock artifacts.

14) Bank (1971: 22) reports a prehistoric site at the historic village locality of Kashega.
15) Bank (1971: 22) indicates this to be a prehistoric site.
16) Bank (1971: 22) indicates this to be a prehistoric site.
17) Bank (1971: 22) reports a prehistoric site at the historic village of Makushin.
18) Bank (1971: 22) indicates this to be a prehistoric site.
19) A possible small site was seen by McCartney, 1972.
20) The Eider Point site was reported by A.R. Cahn as site P during World War II while stationed at Dutch Harbor (McCartney 1967: 53); later reported by Bank (1953a: 250-2); also seen by McCartney, 1972. Dall (1873: 283) reported "Pestriakoff, or Eider Village, near Cape Cheerful; his reference is presumably to the same site.
21) A site at the head of Captains Bay is reported by J. Foliart of Unalaska Village (1972, personal communication); Dall (1877: 45) reports a total of 9 sites on this bay but locations are not specified.
22) Cahn's site O was reported during World War II (McCartney 1967: 53); partially destroyed by military road building.
23) Cahn's site L was reported during World War II (McCartney 1967: 52); partially destroyed by military road building.
24) Cahn's site J was reported during World War II (McCartney 1967: 52); partially destroyed by military road building.
25) Cahn's site M was reported during World War II (McCartney 1967: 53); partially destroyed by military road building.
26) Cahn's site K was reported during World War II (McCartney 1967: 52); partially or fully destroyed by military road building and other construction on the southernmost tip of Amaknak.
27) Cahn's site C was reported during World War II (McCartney 1967: 47; 1970) partially destroyed by military construction.
28) Cahn's site E was reported during World War II (McCartney 1967: 49-50); partially or fully destroyed by military construction.
29) Cahn's site D was reported during World War II (McCartney 1967: 47-9); reported earlier by Jochelson (1925: 37); also described by Bank (1953a: 252, 1953b: 43-6); greatly damaged by military road construction and building/pillbox excavations; visited by McCartney, 1972.
30) Cahn's site F was reported during World War II (McCartney 1967: 50); believed to be fully destroyed by military road construction.
31) Cahn's site G was reported during World War II (McCartney 1967: 50-2); partially or fully destroyed by military road construction. This is the closest site to the burial cave containing mummies reported by Dall (1875, 1877; 58) and Jochelson (1925: 48-9); the cave was completely destroyed by blasting for a beach road during World War II.

32) Cahn's sites H and N were reported during World War II (McCartney 1967: 52-3); one or both partially destroyed by military road construction; visited by McCartney, 1972.
33) Cahn's site B was reported during World War II (McCartney 1967: 44-7); this site was noted by Jochelson (1925: 37) and excavated by Hrdlicka (1945: 247-50); partially destroyed by military road building; visited by McCartney, 1972.
34) This site was reported by Cahn during World War II (McCartney 1967: 55); completely destroyed by military road building.
35) Cahn's site A was reported during World War II (McCartney 1967: 42-4); reported earlier by Dall (1877) and Jochelson (1925: 37); partially destroyed by military road, pipeline and building and pillbox construction.
(NOTE: Besides the analysis of Amaknak artifacts by McCartney (1967,1969,1971), Quimby also published on Cahn's collections in the Field Museum of Natural History (Quimby 1945,1946, 1948).
36) J. Foliart (1972, personal communication) reports this site on Summer Bay, probably partially destroyed by military road construction.
37) Bank (1971: 22) reports this prehistoric site.
38) Bank (1971: 22) reports this prehistoric site.
39) The Hog Island site was reported by Jochelson (1925: 37); completely destroyed by military construction during World War II; referred to as site T by Cahn (McCartney 1967: 55).
40) A prehistoric midden site is reported by Dall (1877: 72) at the present locality of Unalaska Village (Iliuliuk); probably greatly damaged due to dense settlement at the historic village around it.
41) Cahn's site R was reported during World War II (McCartney 1967: 55); state of preservation unknown.
42) Cahn's site S was reported here during World War II (McCartney 1967: 55); probably damaged from beach road construction.
43) Cahn's site Q was reported during World War II (McCartney 1967: 55); state of preservation unknown.
44) Dall (1873: 283) reports an old site on Kalekta Bay but does not give a specific location.
45) Bank (1971: 22) indicates a site here; Dall (1873: 283) reports an old site on Nakeetin Bay but does not give a specific location; perhaps Bank and Dall refer to the same site.
46) Bank (1971; 22) reports a site here on a narrow spit.
47) Bank (1963: 37) reports a village site here.
48) Bank (1963: 37) reports a village site here.
49) Bank (1963: 37) reports a site here.
50) Bank (1963: 37) reports a site here.
Veniaminof (Hrdlicka 1945: 37) reports that 3 villages were occupied on Amaknak Island during the 18th century;

he also reports that 24 villages were scattered around Unalaska proper at Russian contact (Hrdlicka 1945: 40); presumably the 24 did not include the 3 Amaknak sites. No site locations are included for either island. Dall (1873: 285) reports 7 old villages on Amaknak of which only Cahn's site A is identified by location.

Ship Rock- 1) Mummy caves are reported by Hrdlicka; (1945: 325) on this small island between Unalaska and Umnak.

Umnak- (including Ananiuliak Island)
1) This site is reported by Jochelson (1925: 30) at the southwestern end of the island.
2) A possible site seen by McCartney, 1972.
3) This site is reported by Jochelson (1925: 30).
4) This site is reported by Jochelson (1925: 30); visited by McCartney, 1962.
5) The Chaluka midden site was reported and excavated by Hrdlicka (1945: 364-7); site descriptions are found in Laughlin and Marsh (1951) and Bank (1953a: 255-8); artifactual materials are described by Laughlin (1958, 1963), Laughlin and Marsh (1956), Denniston (1966) and Aigner (1966); Lippold (1966) describes faunal materials from the site; excavated at by Turner and McCartney, 1962; more recent excavations by Laughlin and Aigner.
6) The Sheep Creek site on upper Nikolski Bay was tested during 1963 by McCartney, M. Yoshizaki and R. Nelson.
7) The Anangula core and blade site (dated to 8,000 BC) is situated at the southwestern end of Ananiuliak Island; reported by Laughlin (1951, 1963, 1967), Laughlin and Marsh (1954), Black and Laughlin (1964), McCartney and Turner (1966a,b), and Laughlin and Aigner (1966); excavated by McCartney, M. Yoshizaki and R. Nelson, 1963; more recent excavations by Aigner.
8) A recent village or midden site on the Seaweed Pass side of Ananiuliak is described by Laughlin and Marsh (1954: 28-9); visited by McCartney, 1962, 1963.
9) This site at Okee Bay is reported by Jochelson (1925: 30).
10) The midden site at Ashishik Point was reported and excavated by G. and C. Denniston during 1963 (Campbell 1964: 536).
11) This site is reported by Jochelson (1925: 30); the location is only approximate, estimated from Jochelson's map. Veniaminof (Hrdlicka 1945: 39) reports 20 settlements on Umnak during the pre-Russian, late prehistoric period but locations are not specified except for Nikolski Village and Tulik Village, the latter opposite Ship Rock at the eastern end of the island.

Samalga- Jochelson (1925: 123) reports a burial cave on this island; Veniaminof (Hrdlicka 1945: 38) claims that at least 400 natives occupied the island before 1764.

ISLANDS OF THE FOUR MOUNTAINS

Chuginadak- 1972 Survey: This entire island was circumnavigated.
1) This is a possible site on a lower bench above the beach, seen by McCartney, 1972.
2) This is a possible site seen by McCartney, 1972.
3) This is a possible site on a lower bench above the beach, seen by McCartney, 1972.
4) This is a possible site seen by McCartney, 1972.
Veniaminof (Hrdlicka 1945: 37) reports about 100 natives living on this island prior to 1764.

Herbert- 1972 Survey: This entire island was circumnavigated.
1) This is a possible site adjacent to a standing cabin, seen by McCartney, 1972.
Veniaminof (Hrdlicka 1945: 38) reports 2 old settlements on this island but their locations are not specified.

Carlisle- 1972 Survey: This entire island was circumnavigated.
1) This is a possible site seen by McCartney, 1972.
2) This is a possible site adjacent to a standing cabin, seen by McCartney, 1972.
3) There are 2 small sites situated on this narrow peninsula; seen by McCartney, 1972.
Veniaminof (Hrdlicka 1945: 38) reports a "moderate sized settlement" on the southeastern side of the island.

Kagamil- 1972 Survey: This entire island was circumnavigated.
1) This is a possible site location, seen by McCartney, 1972.
2) This is a site area--possibly 2 separate areas close together---seen by McCartney, 1972.
3) This is a possible small site, seen by McCartney, 1972.
4 & 5) These localities are those of burial caves at the southern end of Kagamil; Dall (Hrdlicka 1945: 189) describes mummies from these caves as does Hrdlicka (1945: 237-46); Jochelson (1925: 123) cited the burial caves on "Kagam-Ilan" and Bank (1953b: 42-44) described artifacts from the burial caves.
6) This is a site seen by McCartney, 1972.
Veniaminof (Hrdlicka 1945: 37) reports a "fairly large settlement" on the southeastern side of the island but the exact location is not given.

Uliaga- 1972 Survey: This entire island was circumnavigated.
1) Bank (n.d. map) indicates this site location.
2) McCartney, 1972, saw this site of about 24 depressions and 4 V-shaped drainage ditches situated in a low ravine above the beach.

Jochelson (1925: 123) reports a burial cave on "Ulagan," presumably referring to this island; no location is given.

Yunaska- 1972 Survey: This entire island was circumnavigated. Veniaminof (Hrdlicka 1945: 38) reports 2 old settlements on Yunaska but does not specify locations. No sites were seen during the 1972 Survey.

Amukta- Veniaminof (Hrdlicka 1945: 38) claims that old sites existed on the island but gives no details.

ANDREANOF ISLANDS

Seguam- 1) This is a possible site seen by McCartney, 1972.

Amlia- 1) Bank (n.d., map; 1953a: 249) reports a large village site here.
2) Bergsland (1959: 24,46) reports a village site at this location.
3) A small site is found at the head of Sviechnikof Harbor; McCartney visited the site and collected a few surface artifacts, 1972.
4) Bergsland (1959: 21,45) reports an old site here.
5) Bergsland (1959: 21,45) reports a village site here.
6) A possible site was seen here by McCartney, 1972.
7) A possible site was seen here by McCartney, 1972.
8) Bergsland (1959: 21,44) reports an old site here.
9) Bergsland (1959: 21,44) reports an old site here.
Jochelson (1925: 122) reports a burial cave on the eastern end of Amlia but the specific location is not given.

Atka- 1) This site situated on the narrow isthmus at Kigun Bay was seen by McCartney, 1972.
2) Bank (n.d., map; 1953a: 249) and Bergsland (1959: 34,49) report a site at the narrow isthmus at Sergief Bay; presumably they refer to the same site.
3) Bank (n.d., map) and Bergsland (1959: 34,49) report a site here; presumably they refer to the same site.
4) This site is reported by Bank (n.d., map).
5) This site is reported by Bank (n.d., map).
6) Bank (n.d., map) and Bergsland (1959: 31,48) report a site here; presumably they refer to the same site.
7) This site is reported by Bank (n.d., map).
8) This site is reported by Bank (n.d., map).
9) Bank (n.d., map) and Bergsland (1959: 24,46) report a site here; they presumably refer to the same site.
10) This site is reported by Bank (n.d., map).
11) Jochelson (1925: 27) reports a site here.

12) Jochelson (1925: 27), Hrdlicka (1945: 219,274) and Bank (1953a: 250-1) refer to a site at this location; Dall (1877) illustrates artifacts from an unspecified site on Nazan Bay which may have come from this site.
13) Bank (n.d., map) reports a small site here.
14) Bank (n.d., map) reports a small site here.
15) Bank (n.d., map) reports a small site here.
16) Bank (n.d., map) and Bergsland (1959: 29,47) report the old historic and perhaps prehistoric site of Korovinski.
17) Bank (n.d., map) reports a small site here.
18) Bank (n.d., map) reports a small site here.
19) Bank (1953a: 249) illustrates a site on Bluefox Bay but the exact location is not given.
20) Bergsland (1959: 27,46) reports a site at this location; presumably this site and 14 above are not confused and 2 sites exist close to one another.
21) Bergsland (1959: 31,48) reports a site here.
22) Bergsland (1959: 33,48) reports a permanent settlement on Salt Island; the exact location is not specfied.

Oglodak- 1) Bergsland (1959: 35,50) reports a settlement somewhere on the island.

Tagalak- 1) Bergsland (1959: 35,50) reports a site at the eastern tip of the island.

Chugul- 1) Bergsland (1959: 36,50) reports a site in this north shore embayment; McCartney noted 3 small possible site areas close together at the same locality, 1972.

Great Sitkin- 1) Bergsland (1959: 36) reports several families living on the island in the late 18th century; no settlement area is indicated.

Little Tanaga- 1) Bergsland (1959: 37,51) reports a site here.
2) Bergsland (1959: 37,51) reports a site adjacent to the narrow isthmus on Chisak Bay.

Kagalaska- 1) Bank (1971: 28) reports a site here.
2) Bank (1971: 28) reports several village sites in this locality.

Adak- 1) This is a possible small site seen by McCartney, 1972.
2) This small site is situated directly opposite the Navy Station docks in Sweeper Cove; inspected closely by McCartney, 1972.
3) Bank (1971: 28) reports a small site here but it apparently has been completely destroyed by military construction during World War II and after.

4) Bank (1971: 28) reports a small site here; restricted area which could not be inspected closely during 1972.
5 & 6) Bank (1971: 28) reports these 2 small sites in an area now greatly altered due to military road construction and dumping; completely destroyed during World War II or more recently.
7) Bank (1971: 28) reports a site located at the east end of the spit forming Andrew Lake; not located during 1972 and believed to have been destroyed by military construction along this shore.
8) This large midden site on the north spit of Shagak Bay was closely inspected by McCartney, 1972.
9) A small site was seen here by McCartney, 1972.
10) Bank (1971: 28) reports a large site here; Dall (1877: 44) reports several sites near the Bay of Islands but the locations are unspecified.
11) Hrdlicka (1945: 318) and Bergsland (1959: 38,53) report a large site at this location.
12) A large midden site was noted here by McCartney, 1972.
13) A possible site was seen here by McCartney, 1972.
14) Bank (1971: 28) reports a site from this area.
15) Bergsland (1959: 38,53) reports a site here; presumably the same site was seen by McCartney, 1972.
16) Bank (1971: 28) reports a site here.
17) Bank (1971: 28) reports a site here.
18) Bank (1971: 28) and Bergsland (1959: 38,53) report a site here; presumably they refer to the same site.
19) Hrdlicka (1945: 318) reports a site here; Bergsland (1959: 38,53) refers to a site at the "bottom" of the bay, presumably the same site.
20) Bank (1971: 28) refers to a site here.
21) Bank (1971: 28) refers to a site here.
22) A small site was seen here by McCartney, 1972.
23) A site is reported by A. Hartt (1972, personal communication) to be located at the head of Chapel Cove.
24,25, & 26) Three small midden areas were noted here by McCartney, 1972.
27) Bank (1971: 28) and Bergsland (1959: 38,53) report a site here; presumably they refer to the same site.
28) A possible small site was noted here by McCartney, 1972.
29) A large site was noted on a ravine hillside, adjacent to a stream by McCartney, 1972.
30) A large site was noted here by P. Sekora, 1972.
31) Bank (1971: 28) notes a site here.
32) Bank (1971; 28) notes a site here.
33) A small possible site was seen here by McCartney, 1972.
34) Bank (1971: 28) reports a site here.
35) Bank (1971: 28) reports a site here.
36) Bank (1971: 28; 1953a; 250) reports a site here.
37) Bergsland (1959: 38,53) reports a site here.
38) Bergsland (1959: 38,53) reports a site here.

Kanaga-

1) Bank (1971: 28) reports a large village site here.
2) Bank (1971: 28) reports a large village site here.
3) Bank (1971: 28) reports a site here; also reported by Nelson and Barnett (1955: 387-8)
4) Bank (1971: 28) and Bergsland (1959: 39,54) report a site here.
5) Bank (1971: 28) reports a site here.
6) Bank (1971: 28) reports a site here.
7) Bank (1971: 28) reports a site here.
8) Bank (1971: 28) reports a site here.
9) Bank (1971: 28) reports a site here.
10) Bank (1971: 28) reports a site here.
11) Bank (1971: 28) reports a site here.
12) A site is reported from this location by P. Sekora (1972, personal communication).
13) Hrdlicka (1945: 342-46) reports a large site at Swallow Point.
14) Hrdlicka (1945: 342-46) reports 2 sites close together at this locality.
15) Bank (1971: 28) reports a site here.
16) Bank (1971: 28) reports a site here.
17) Bank (1971: 28) and Bergsland (1959: 39,54) report a small site here; presumably they refer to the same site.
18) Bank (1971: 28) reports a small site here.
19) A small site was noted here by McCartney, 1972.
20) Bank (1971: 28) reports a site here.
21) Bergsland (1959: 39, 54) reports a site here.
22) Bergsland (1959: 39, 54) reports a site here.
23) Bergsland (1959: 39, 54) reports a site here, presumably a different site from 2 above.
24) Bergsland (1959: 39,54) reports a site here.
25) Nelson and Barnett (1955: 387-8) report a large midden on this point.
26) Nelson and Barnett (1955: 387-8) report a burial cave here which they inspected.
27) Nelson and Barnett (1955: 387-8) report a midden site here. Jochelson (1925: 122) reports traces of large village sites with burial caves on Tanaga and Kanaga; exact locations are not specified.

Tanaga-

1) Hrdlicka (1945: 313-14) reports a site on Cable Bay but was not sighted during 1972.
2) A possible small site was seen here approximately 10 m. above the present beach by McCartney, 1972.
3) A possible site was seen here about 10-15 m. above the present beach by McCartney, 1972.
4) Several surface depressions were noted close to Barabara Island, the name reflecting possible historic or prehistoric dwellings; seen by McCartney, 1972.

5 & 6) These 2 sites on the inside of Hot Springs Bay show extensive evidence of historic and prehistoric occupation; over 40 house depressions are seen plus a large prehistoric (?) midden area with additional depressions heavily grown over with vegetation; seen by McCartney, 1972; also reported by Bergsland (1959: 39,54).
7) A site is reported by Bergsland (1959: 39,54) at the narrow end of the island, near Cape Sudak.
8) Bergsland (1959: 40,54) reports a site here.
9) Bergsland (1959: 40,54) reports a site here.
10) Bergsland (1959: 40,54) reports a site here.

DELAROF ISLANDS

Ilak- 1) Jochelson (1925: 123) and Hrdlicka (1945: 314) report burial caves on this small island; exact location not specified.
2) Bergsland (1959: 40,55) reports a village site on the island as well.

Tag Islands- 1) One possible site was seen at the northern tip of the largest island by McCartney, 1972.

Skagul- 1) A possible site was noted at the southern tip of the island by McCartney, 1972.

Ogliuga- 1) Two small possible site areas were noted close together by McCartney, 1972.
2) A possible site was noted here on a storm beach 5-6 m. above the present beach by McCartney, 1972.

Kavalga- 1) A large site on this narrow isthmus contains many house depressions; seen by McCartney, 1972.
2) Bank (n.d., map) reports a site here.
3) Bank (n.d., map) reports a small site here.
4) Bergsland (1959: 40,55) reports a site here.

Unalga- 1) A large site is located on a 4-5 m. storm beach above the present beach, near a recent cabin site; seen by McCartney, 1972.

Ulak- 1) This site is situated on a 25 m. knoll overlooking Pratt Cove; approximately 5-7 depressions indicate the locations of houses. This site is either prehistoric or early historic or both; seen by McCartney, 1972.
2) This is a possible site on a hill crest, seen by McCartney, 1972.
3) This is a possible site located above the storm beach, seen by McCartney, 1972.

Amatignak- 1) This is a possible site locality on the storm beach, seen by McCartney, 1972.
2) This is a possible site located on a knoll top, seen by McCartney, 1972.

RAT ISLANDS

Amchitka- The 78 sites indicated are taken from Desautels, et al. (1971) using the same number designations. Dall (1877: 44) refers to a Constantine Harbor site, possibly 2 or 8. Hrdlicka (1945: 349-51) located and tested 3 sites at locations 2 and 3; McCartney visited these in 1972 and found the "lower" site (3) partially destroyed by military construction, the "hill" site mostly destroyed by a beach road built by the military during World War II (2) and the "high" site completely destroyed by this beach road (2). Guggenheim (1945) was responsible for the first major survey for sites on the island; Turner (1970) reports further on some of these sites.
Site 32 was excavated by Cook, Dixon and Holmes (1972); Bergsland (1959: 41,55) also makes reference to 66 on Cyril Cove.

Rat Island- 1) Bank (n.d., map) reports a large site at the northwestern tip of the island.
2) Bank (n.d., map) reports a large site at this location.
3) Bank (n.d., map) reports a large site on Gunners Cove.
4) Bank (n.d., map) reports a small site here.

Little Sitkin- 1) A possible small site was noted on the tip of an off-shore islet here, seen by McCartney, 1972.
2) A possible small site was seen here by McCartney, 1972.
3) A possible small site was seen here on a low knoll crest by McCartney, 1972.

Khvostof- 1) A possible small site was seen here by McCartney, 1972.

Segula- 1) A possible small site was noted at Iron Point by McCartney, 1972.

Kiska- 1) Hrdlicka (1945: 221) reports a site here.
2) Bank (n.d., map) reports a large midden site here.
3) Bank (n.d., map) reports a small site here.
4) Bank (n.d., map) reports a large site here.
5) Bank (n.d., map) reports a site here.
6) Hrdlicka (1945: 221-3) reports a large midden site at the western tip of Little Kiska Island, possibly damaged by World War II military construction.
7) Hrdlicka (1945: 221-3) reports a site here; Dall (1877: 44) refers to a shell heap on the southern shore of Kiska Harbor and it may be this same site.

8) Hrdlicka (1945: 221-3) reports a site on the beach front here; completely destroyed by Japanese and American military construction during World War II.

Buldir- 1) A small site with eroding shell is reported by R. Jones (1963: 84) to have been located on the beach of the only flat meadow on the island. This site, seen by Jones in 1962, was not relocated in 1972 and is considered to have been possibly destroyed during the intervening period. Approximately two-thirds of the steep shores of this island were walked over in 1972; no other sites were found.

NEAR ISLANDS

Shemya- 1) Bank (n.d., map) reports a site here.
2) Bank (n.d., map) reports a small site here.
3) Bank (n.d., map) reports a small site here.
4) Bank (n.d., map) reports a large site here.
Because of the intensive military occupation from World War II to the present on this small island, probably all sites have been fully destroyed. Hurt (1950) describes a small collection of artifacts assembled during World War II and McCartney (1971) describes artifact collections from this island and Attu Island made during the war years.

Nizki Island- 1) Bank (n.d., map) reports a large village site here.
2) Bank (n.d., map) reports a small site here.
3) Bank (n.d., map) reports a large site here.
4) Bank (n.d., map) reports a small site here.

Alaid Island- 1) Bank (n.d., map) reports a small site here.
Jochelson (1925: 122) reports "traces of village sites and a burial cave where remains of painted wooden masks are preserved" on "Simichi Island," presumably one of the current Semichi group.

Agattu- 1) A. Spaulding (1962) reports on excavations made during 1949 at Krugloi Point.
2) Hrdlicka (1945: 288-94) reports at least 2 sites at McDonald Cove; excavations were made in both.
3) Bank (n.d., map) reports a village site here.
4) Bank (n.d., map) reports a small site at the extreme western tip of Agattu.
5) Bank (n.d., map) reports a site here.
6) Bank (n.d., map) reports a site here.
7) Bank (n.d., map) reports a site here.
8) Bank (n.d., map) reports a site here.
Jochelson (1925: 122) reports a "grotto-like cave on the walls of which are many figures representing woman's sexual parts"; the location is not specified.

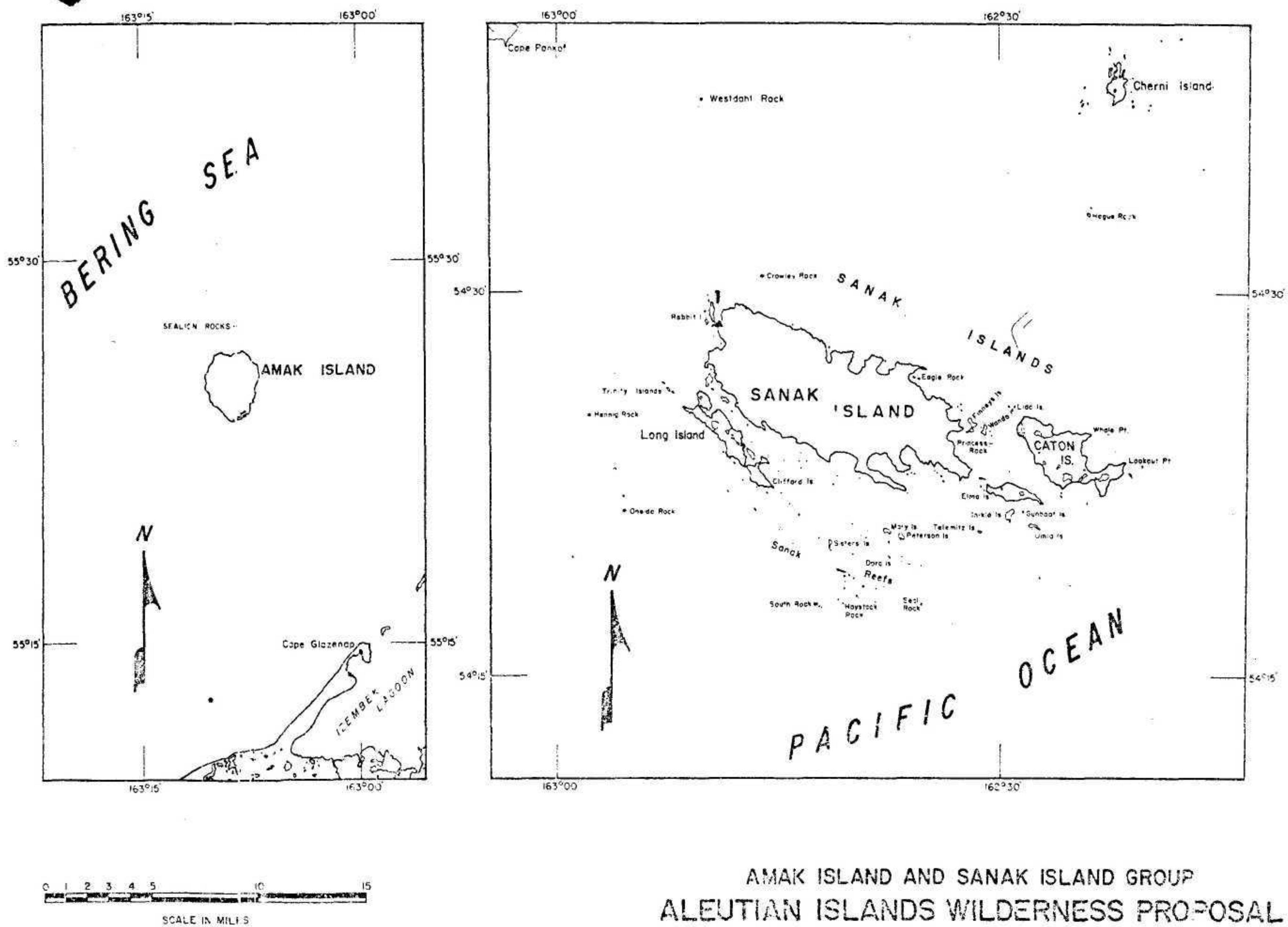
Attu- 1) Dall (1877: 43) reports a site located here.
2) Dall (1877: 43) and Jochelson (1925: 24) report a site at the mouth of Chicagof Harbor.
3) Jochelson (1925: 24) reports a site here; probably damaged to some degree by the military construction in this area since World War II.
4) P. Sekora (1972, personal communication) reports a small site near the beach, at the end of a present air strip.
5) Bank (n.d., map) reports a small site here.
6) Bank (n.d., map) reports a large site here.
7) Bank (n.d., map) reports a small site here.
8) Bank (n.d., map) reports a large village site here.
9) Bank (n.d., map) reports a large village site here.
10) Bank (n.d., map) reports a small site at the westernmost tip of Attu.
11) Bank (n.d., map) reports a small site here.
12) Hrdlicka (1945: 312) reports a site at the historic village here.
13) Dall (1877: 44) reports a site on the "western shores" of Sarana Bay but the exact location is unspecified. Bergsland (1959: 41) also notes "a settlement in Sarana Bay" with no specific location.

Land Status Documents

Following is a chronological listing of Executive Orders, Public Land Orders, Cooperative Agreements, Legal determinations, and correspondence pertaining to Refuge land status. Copies are included in the appendix.

1. Executive Order of January 13, 1899, signed by William McKinley, reserved and set apart for lighthouse purposes a portion of Amaknak Island that fronts on Dutch Harbor.

2. Executive Order of January 4, 1901, signed by William McKinley, reserved and set apart for lighthouse purposes the Scotch Cap and Cape Sarichef areas on Unimak Island. The Scotch Cap portion was revoked by the Executive Order of August 27, 1901.



▲ Archaeological sites

AMAK ISLAND AND SANAK ISLAND GROUP

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 16. Archeological Sites- Sanak Group and Amak Island

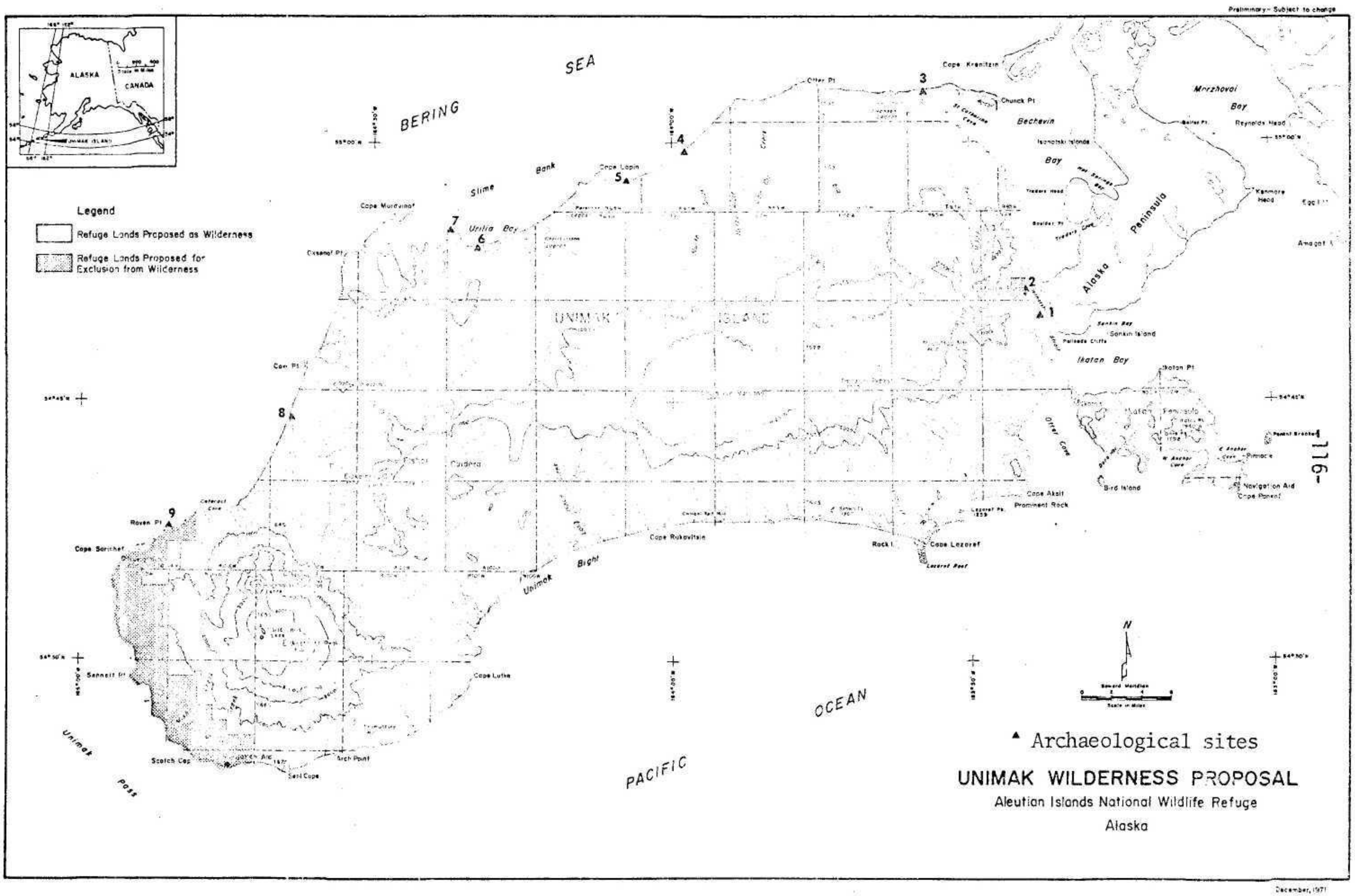


Figure 17. Archeological Sites- Unimak Island

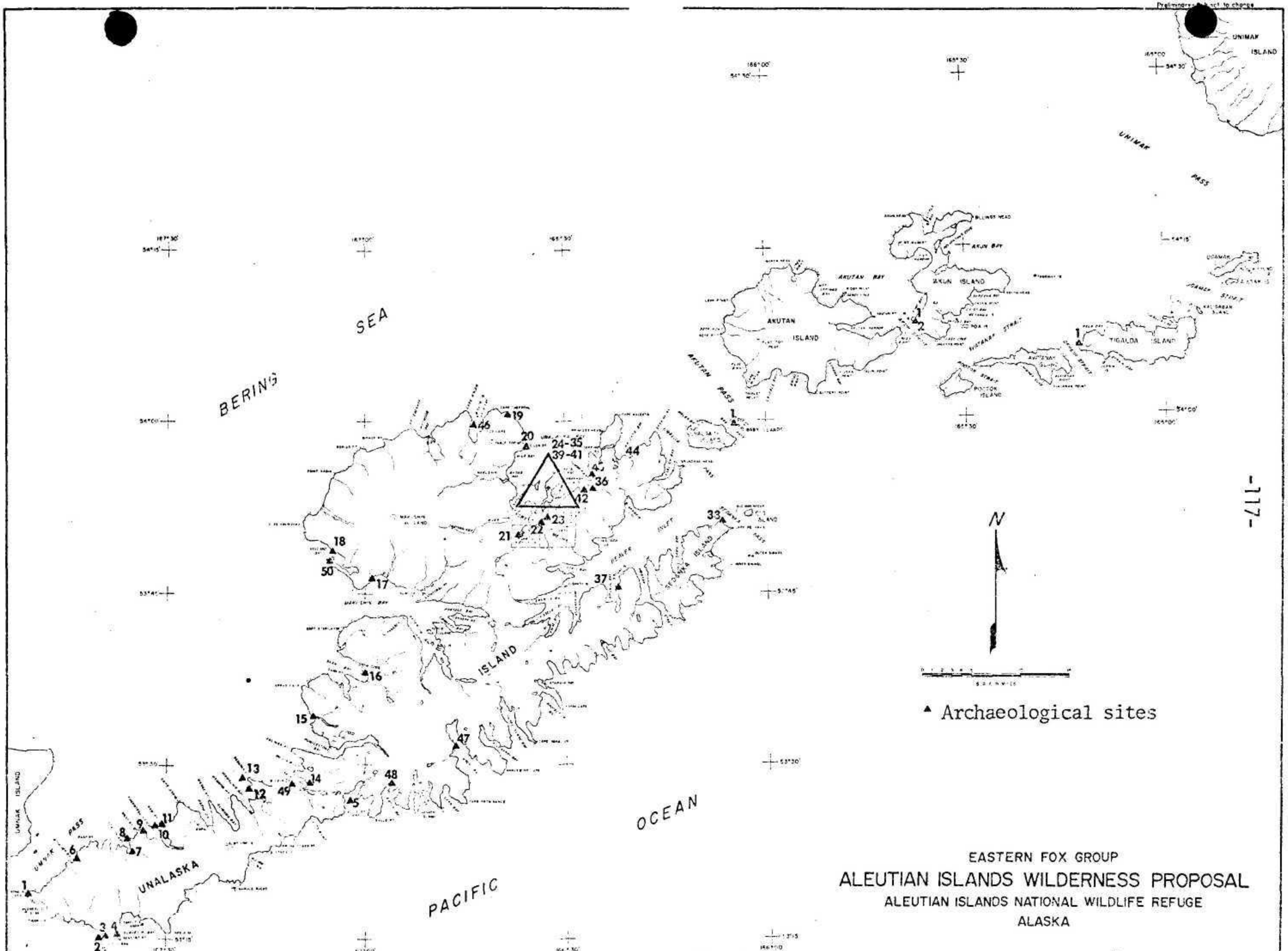


Figure 18. Archeological Sites- Eastern Fox Group

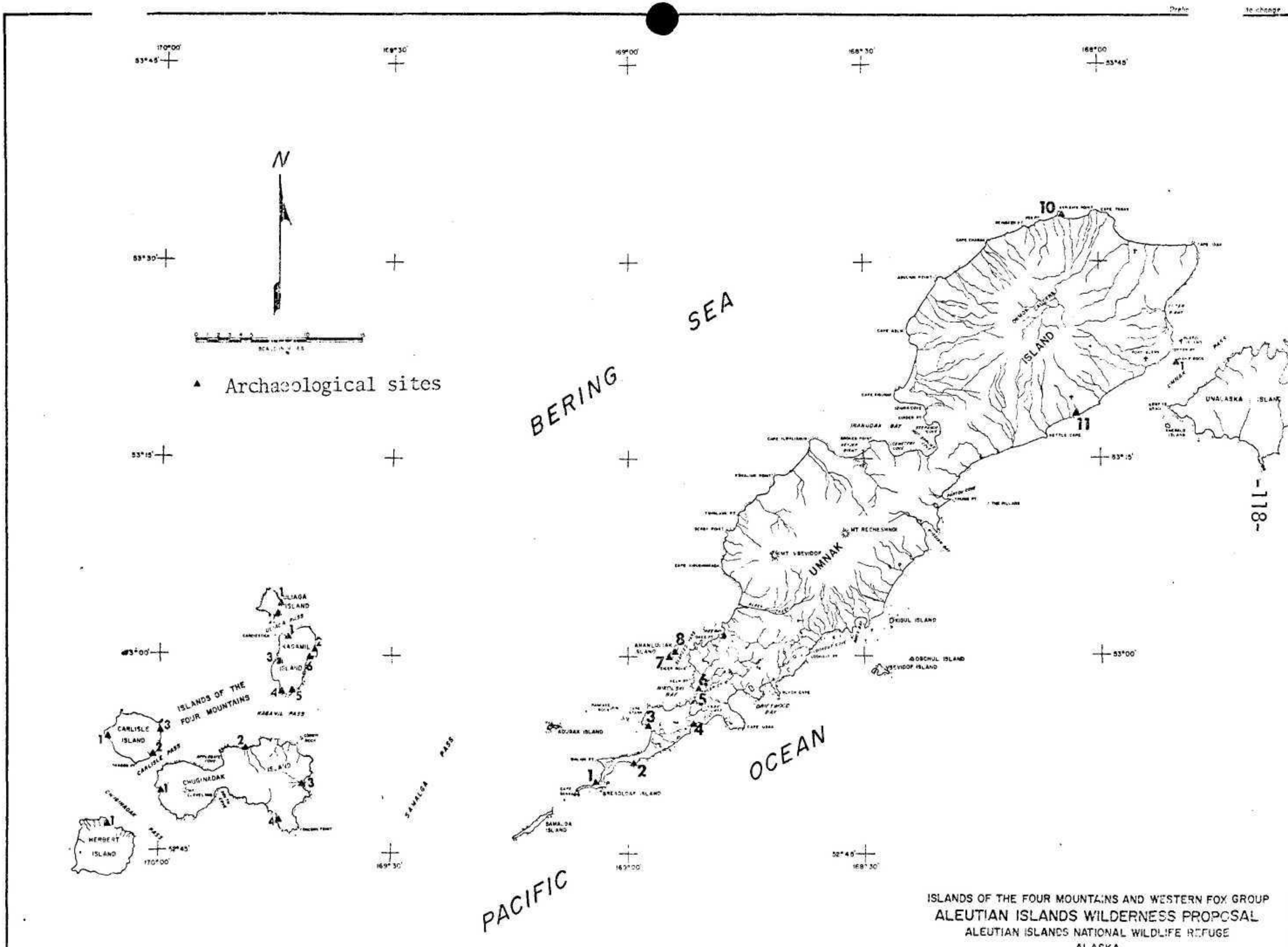


Figure 19. Archeological Sites- Is. of Four Mtns. and Western Fox Group

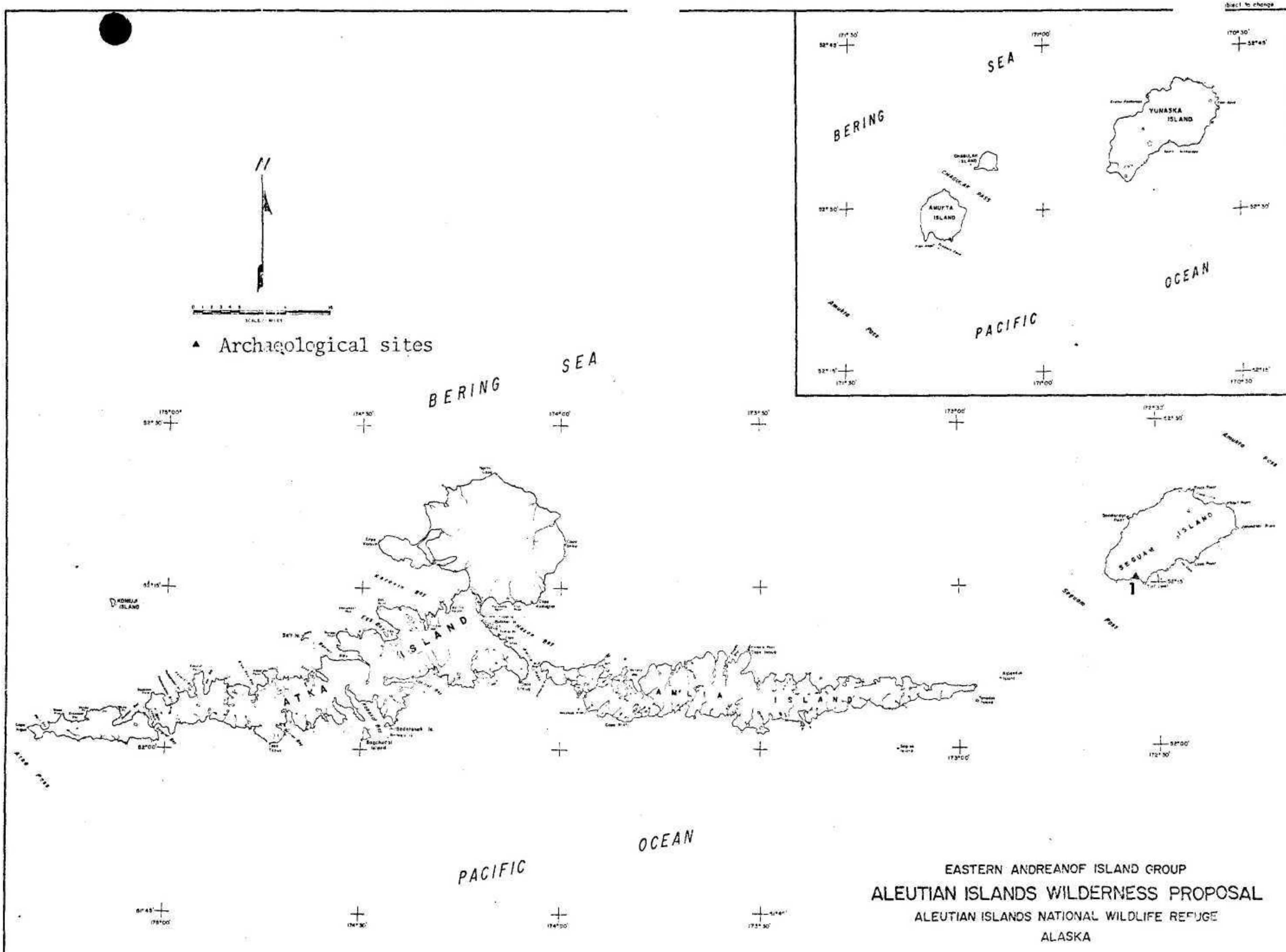
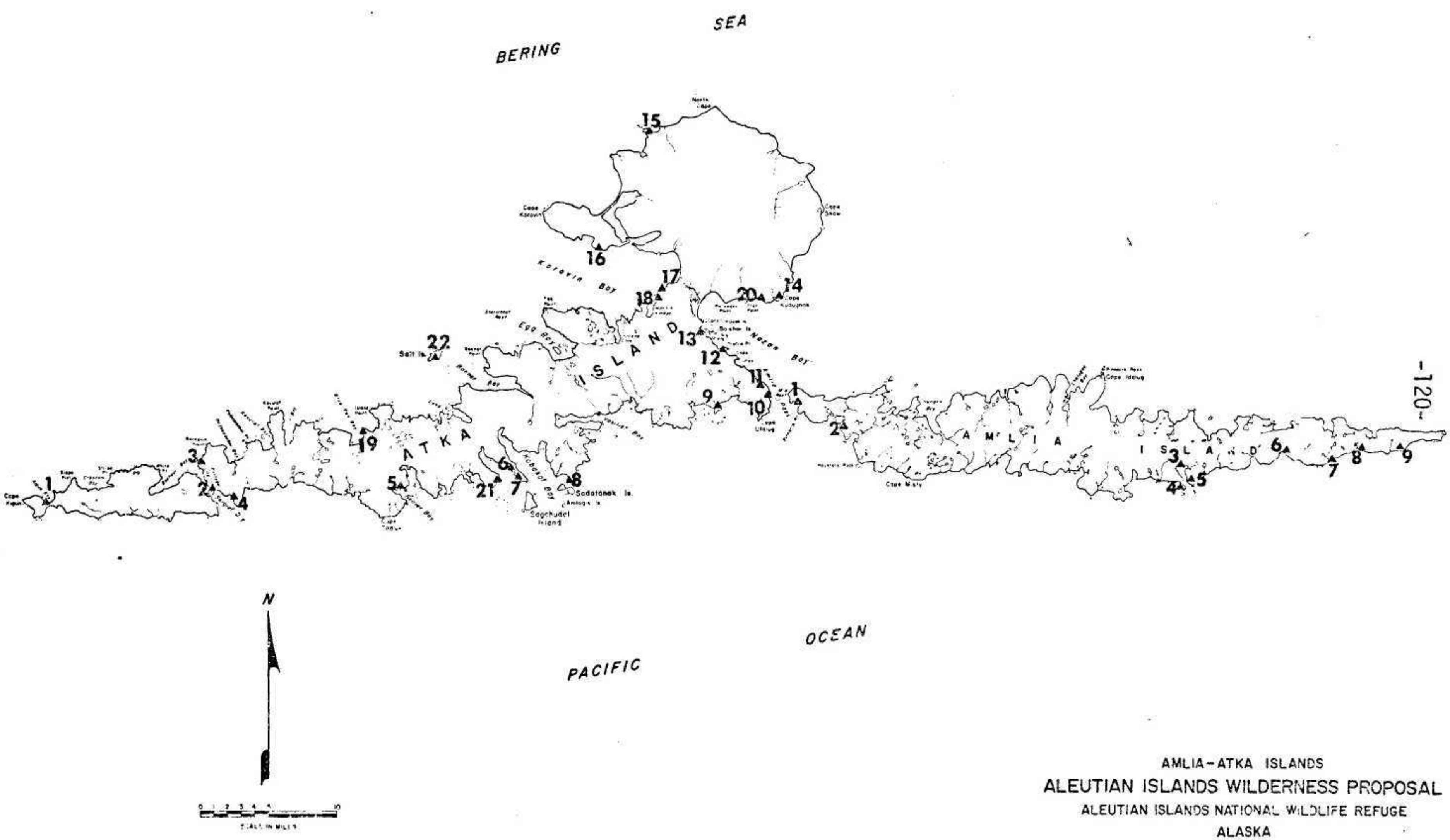
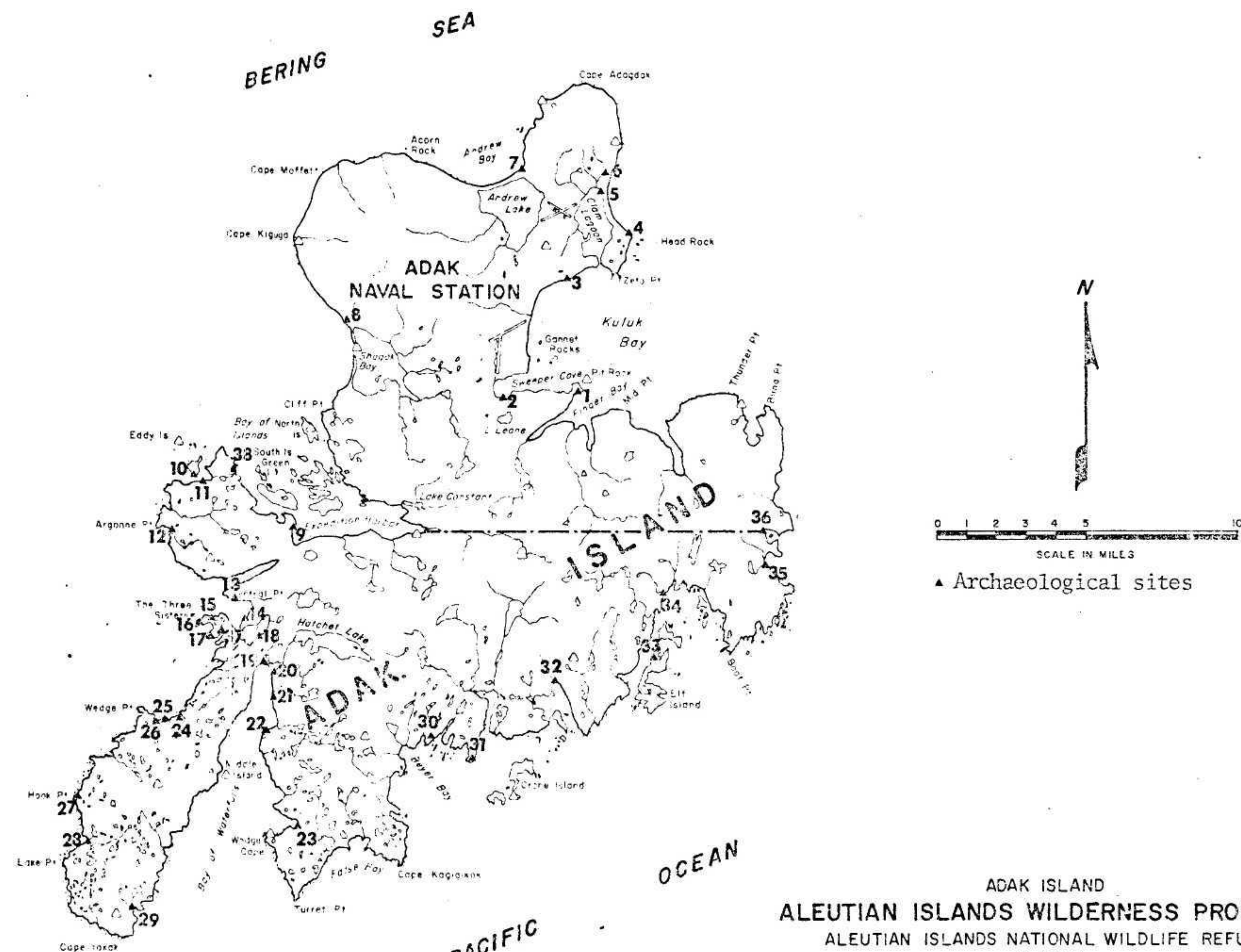


Figure 20. Archeological Sites-Eastern Andreanof Group



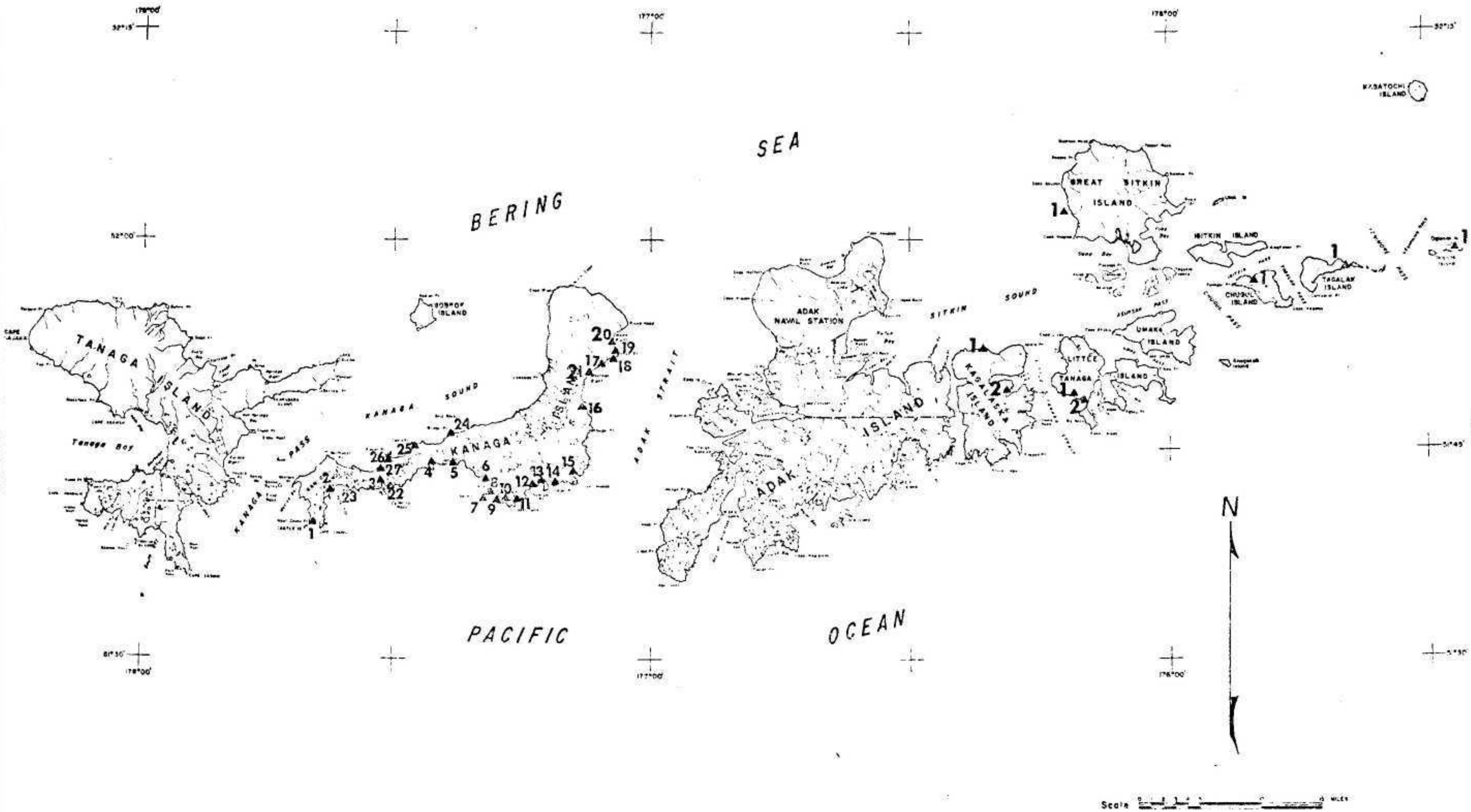
▲ Archaeological sites

Figure 21. Archeological Sites-
Amlia and Atka Islands



ADAK ISLAND
ALEUTIAN ISLANDS WILDERNESS PROPOSAL
ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA

Figure 22. Archeological Sites- Adak Island



▲ Archaeological sites

WESTERN ANDREANOF ISLAND GROUP
ALEUTIAN ISLANDS WILDERNESS PROPOSAL
ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA

Figure 23. Archeological Sites-
Western Andreanof Group

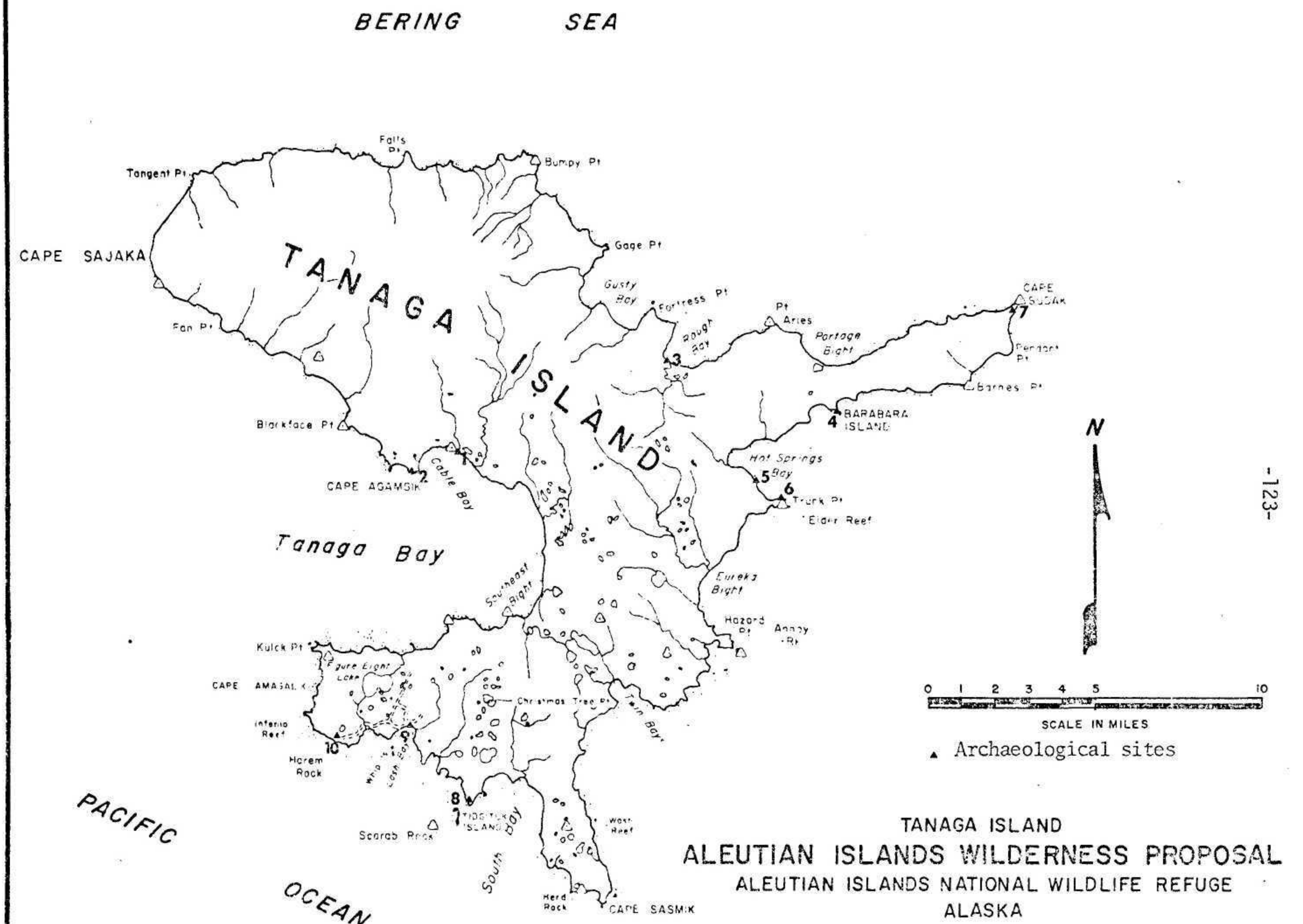


Figure 24. Archeological Sites- Tanaga Island

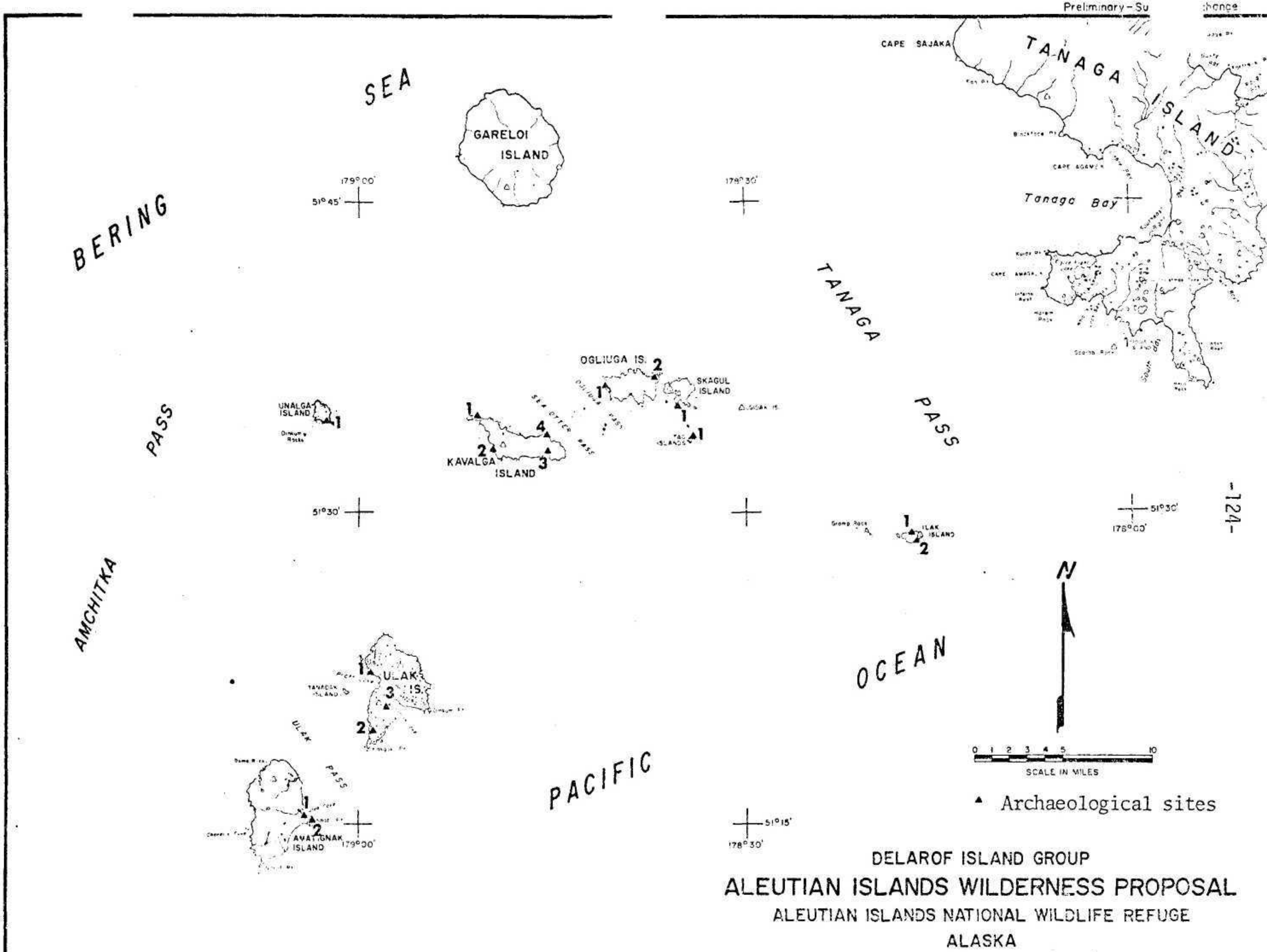
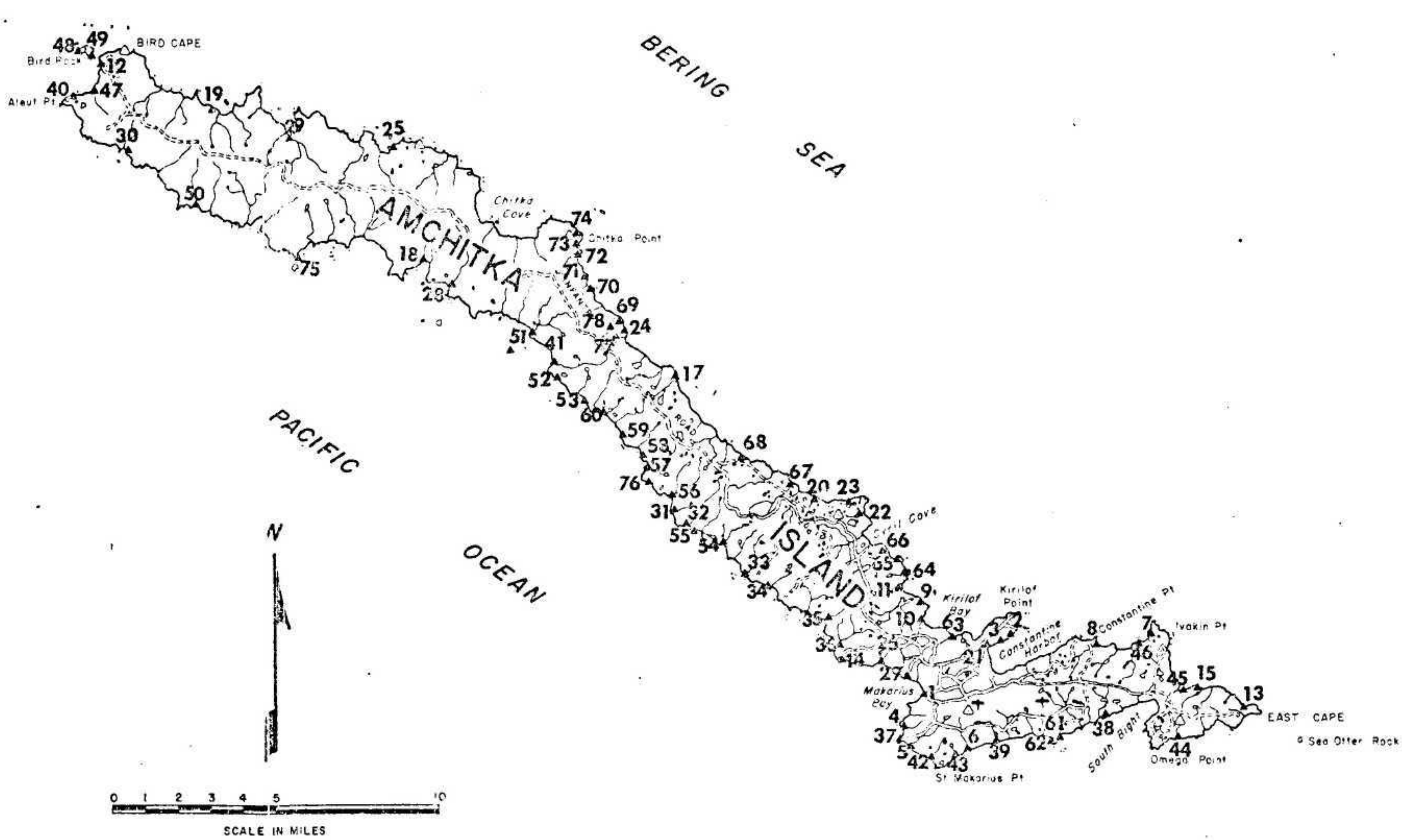


Figure 25. Archeological Sites- Delarof Group



▲ Archaeological sites

AMCHITKA ISLAND

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 26. Archeological Sites- Amchitka Island

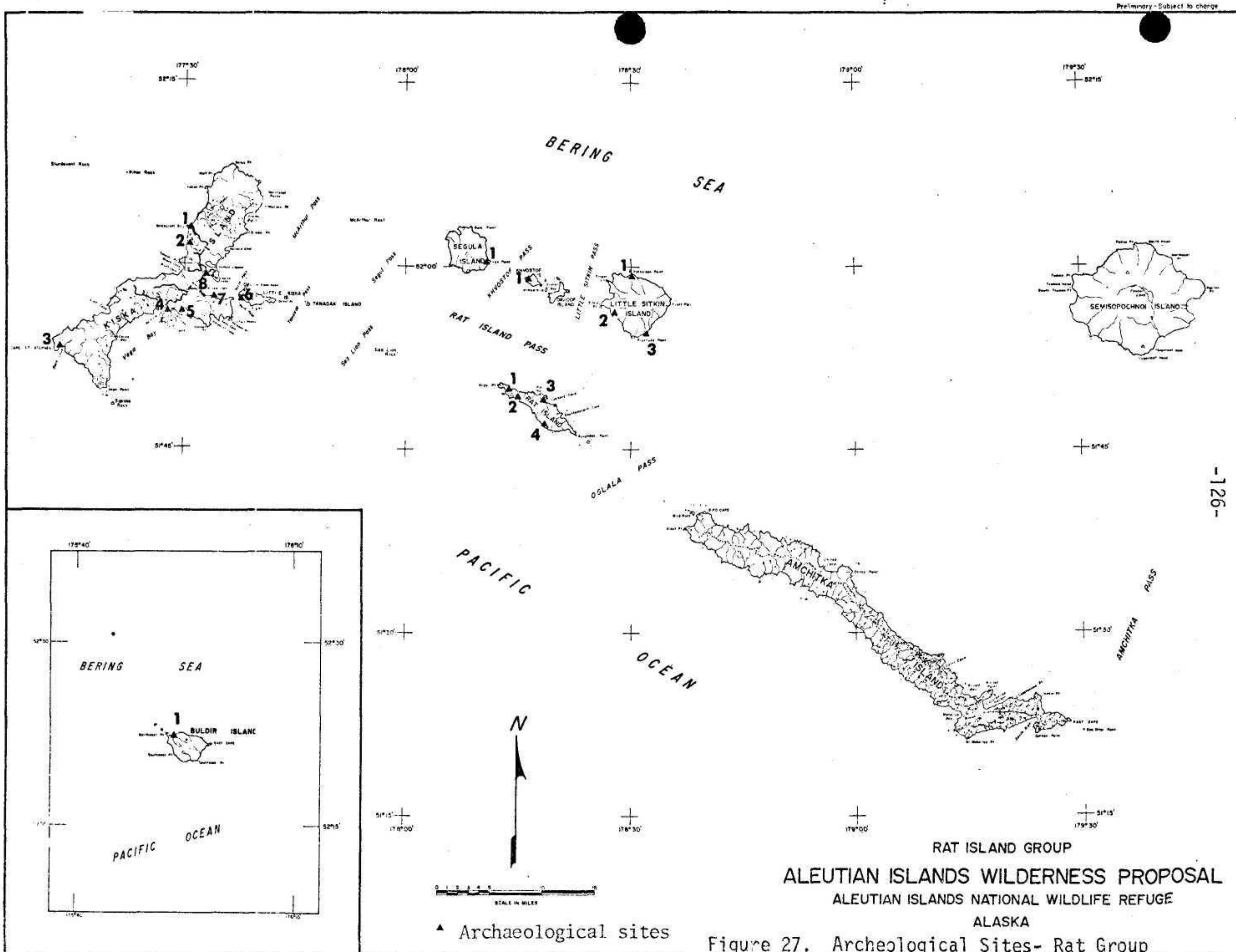


Figure 27. Archeological Sites- Rat Group

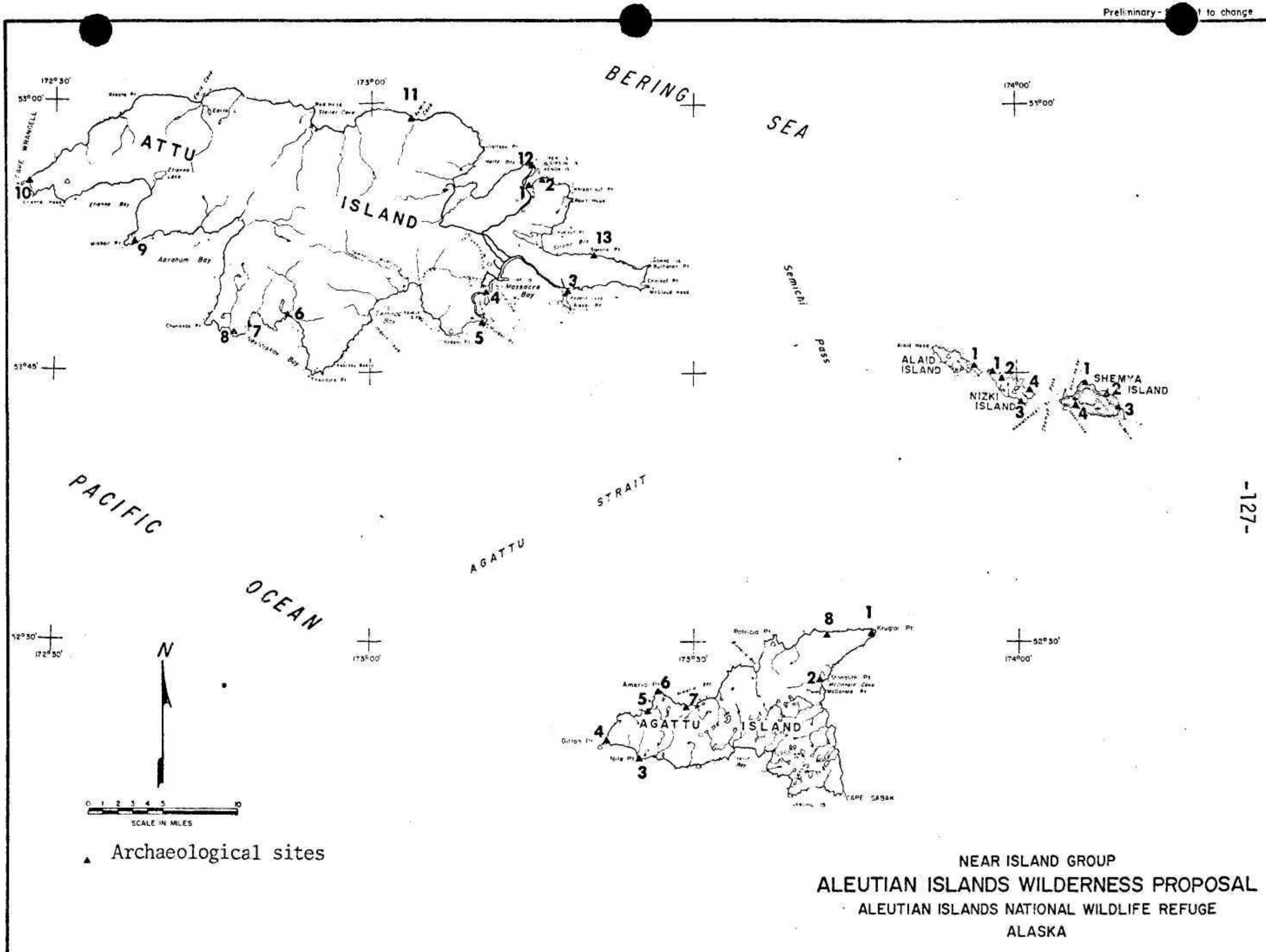


Figure 28. Archeological Sites- Near Group

Also withdrawn for lighthouse purposes were Ugamak, Rootok, Egg and Unalga Islands (along with the adjacent Sea Gull Rocks). Public Land Order 2476 of September 5, 1961, revoked the Executive Order of January 4, 1901, so far as it reserved the following for lighthouse purposes; Ugamak (all lands lying west of longitude 164° 50' W), Rootok, and Egg Islands, and Pinnacle, entrance to Sumner Bay, Unalaska Island. The Bureau of Land Management determined that these lands did return to Refuge Status (See memo of April 20, 1972,from Clark R. Noble, Bureau of Land Management to Alaska Area Director, Bureau of Sport Fisheries and Wildlife). Those lands lying east of 164° 50' W on Ugamak are still reserved for lighthouse purposes. The portion of Executive Order of January 4, 1901, referring to Unalga Island and the adjacent Sea Gull Rocks was revoked by Public Land Order 1224 of September 14, 1955. The Island and Rocks were returned to Refuge Status.

3. Executive Order of April 2, 1901, signed by William McKinley, ordered that all of Amaknak Island, except for the lighthouse withdrawal (Executive Order of January 13, 1899) and North American Commerical Company tract of land, be reserved for public purposes. Revoked by Executive Order 5457 of October 1, 1930.

4. Executive Order of August 27, 1901, signed by William McKinley, revokes the Executive Order of January 4, 1901,pertaining to the Scotch Cap reserve in lieu reserves and sets apart another Scotch Cap area for lighthouse purposes.

5. Executive Order of January 9, 1902, signed by Theodore Roosevelt, reserves and sets apart for lighthouse purposes Scotch Cap, West. This withdrawal

is located immediately northwest of Scotch Cap established by the Executive Order of August 27, 1901. Priest Rock, and all rocks adjacent thereto at Cape Kalekta, Unalaska Island, are also reserved and set apart for lighthouse purposes.

6. Executive Order of June 10, 1902, signed by Theodore Roosevelt, partially revoked Executive Order of January 13, 1899, as it relates to a strip of land in the lighthouse reservation on Amaknak. This strip of land was reserved and set apart for a Naval coal depot. Revoked by Executive Order 5457 of October 1, 1930.

7. Executive Order of June 13, 1902, signed by Theodore Roosevelt, reserved and set apart for Naval purposes:

A. Approximately 580 acres on the eastern shore of Bay of Waterfalls, Adak Island. Revoked by Public Land Order 4143 of January 3, 1967.

B. Approximately 900 acres on the western shore of Kiska Harbor, Kiska Island. This was superseded by Executive Order of December 9, 1903.

8. Executive Order of December 9, 1903, signed by Theodore Roosevelt, reserved and set apart for Naval purposes, Kiska and Little Kiska Islands and all adjacent islets and rocks. This superseded paragraph two in Executive Order of June 13, 1902. Executive Order of December 9, 1903, was revoked by Public Land Order 1224 of September 14, 1955.

9. Executive Order 1456 of January 6, 1912, signed by William H. Taft, reserved and set aside for use as a wireless telegraph station approximately 76.46 acres of Amaknak Island. Superseded by Executive Order 8786, June 14, 1941.

10. Executive Order 1733 of March 3, 1913, signed by William H. Taft reserved and set apart as a preserve and breeding ground for native birds, for the propagation of reindeer and fur bearing animals, and for the encouragement and development of the fisheries, all islands of the Aleutian Chain, Alaska, including Unimak and Sanak Islands on the east, and extending to the end including Attu on the west.

11. Executive Order 2442 of August 11, 1916, signed by Woodrow Wilson, modified Executive Order 1733 authorizing the Secretary of the Interior to issue patents for approximately 38.13 acres of land on Akutan Island.

12. Executive Order 3406, of February 13, 1921, signed by Calvin Coolidge, reserved and set apart for lighthouse purposes:

A. Approximately 100 acres on Cape Pankof, Unimak Island.

B. Approximately 4 acres in Akutan Harbor, Akutan Island.

C. Approximately 3 acres at Spithead, Amaknak Island.

13. Executive Order 4076 of September 20, 1924, signed by Calvin Coolidge, partially revoked Executive Order 1733 as to approximately 10.24 acres at Ikatan on Unimak Island for fish cannery purposes.

14. Executive Order 4251 of June 10, 1925, signed by Calvin Coolidge, partially revoked Executive Order 1733 as to approximately 27.5 acres at False Pass on Unimak Island for fish cannery purposes.

15. Executive Order 5000 of November 23, 1928, signed by Calvin Coolidge revoked Executive Order 1733 in so far as it affects Akun, Akutan, Sanak, Tigalda, Umnak, Unalaska, and Sedanka Islands. The public lands in the

aforementioned islands, subject to valid rights and the provisions of existing withdrawals, were returned to public domain status. There have been no subsequent land orders returning any of the aforementioned lands to the jurisdiction of the Aleutian Islands National Wildlife Refuge.

16. Executive Order 5234 of December 19, 1929, signed by Herbert Hoover, revoked Executive Order 1733 insofar as it affected all of Amaknak Island except for the very southern portion of the island. This area of 195 acres is presently administered as part of the Aleutian Islands National Wildlife Refuge (See Bureau of Sport Fisheries and Wildlife memo of June 25, 1965 from Acting Assistant Director William White to Regional Director, Portland, Oregon).

17. Executive Order 5289 of March 4, 1930,signed by Herbert Hoover reserved school lands, not to exceed 40 acres at Akutan, Atka, and Umnak Islands. The school land on Atka is listed as U.S. Survey No. 2014, dated June 10, 1963 and consists of 2.62 acres. This is within the Village withdrawal provided for by the Native Claims Settlement Act.

18. Executive Order 5318 of April 7, 1930, signed by Herbert Hoover, added to and made part of the Aleutian Islands Reservation, Amak Island, Sea Lion Rocks, and a small unnamed island lying southeast of Amak Island.

19. Executive Order 5457 of October 1, 1930, signed by Herbert Hoover, amends Executive Order 5243 so as to revoke Executive Order of April 2, 1901, and to exclude from restoration the lands on Amaknak Island set apart for lighthouse purposes affected by Executive Order of January 13, 1899, Executive

Order of June 10, 1902, and the lands reserved by Executive Order 1456 of January 6, 1912. This does not affect the southern portion of 195 acres that remain within the Aleutian Islands Reservation per Executive Order 1733.

20. Executive Order 6044 of February 23, 1933, signed by Herbert Hoover, withdrew a portion of Amaknak Island, adjacent to the Aleutian Islands Reservation, for the preservation of the fishing rights of the Alaska Natives.

21. Secretarial Order dated January 24, 1938,reserved a 40-acre tract for school lands on Attu Island. Attu Withdrawal was revoked by a notice in the Federal Register (54-2833) dated April 15, 1954.

22. Executive Order 7816 of February 15, 1938, signed by Franklin D. Roosevelt ordered that those portions of Amaknak affected by Executive Order 1733, Executive Order 5243, and Executive Order 6044 be transferred to the control and jurisdiction of the Secretary of the Navy for Naval uses subject to use by the Department of Agriculture and Alaska Natives, for the purposes for which the lands were originally withdrawn and set aside, when such use will not interfere with Naval activities. Superseded by Executive Order 8786 of June 14, 1941.

23. Executive Order 7847 of March 21, 1938, signed by Franklin D. Roosevelt, reserved for Navy Department use, two tracts of land of approximately 11 acres on Amaknak Island. These two tracts are outside the boundary of the Aleutian Islands National Wildlife Refuge. Superseded by Executive Order 8786 of June 14, 1941.

24. Proclamation 2416 dated July 15, 1940, changed the name of the Aleutian Islands Reservation to the Aleutian Islands National Wildlife Refuge.

25. Executive Order 8680 of February 14, 1941, signed by Franklin D. Roosevelt, established and reserved the territorial waters between the extreme high-water marks in the three-mile marine boundaries surrounding the Kiska and Unalaska Islands as Naval defensive sea areas for purposes of national defense. These two areas are known as "Kiska Island Naval Defensive Sea Area" and "Unalaska Island Naval Defensive Area", and the airspace over said territorial waters and islands were set apart and reserved as the "Kiska Island Naval Airspace Reservation" and the "Unalaska Island Naval Airspace Reservation". A subsequent amendment published in the Federal Register of December 18, 1963, suspended the restrictions imposed on the Naval Airspace Reservation. However, they are subject to reinstatement without notice at any time when the purposes of national defense may require. The Order prohibits all but public vessels of the United States within the three-mile limit except as authorized. The Order cites no restriction to land use.

26. Executive Order 8729 of April 2, 1941, signed by Franklin D. Roosevelt, clarified Executive Order 8680 as to definition of territorial waters ("the territorial waters between the extreme high-water marks and the three-mile marine boundaries").

27. Executive Order 8786 of June 14, 1941, signed by Franklin D. Roosevelt, reserved Amaknak Island for Naval aviation purposes, but subject to Executive

Order 1733, Executive Order 5243, and Executive Order 6044 when such uses will not interfere with Naval activities. The southern end of Amaknak remained within the Aleutian Islands Reservation.

28. Federal Register Document 54-2833, dated April 15, 1954, revoked that section of Departmental Order of January 24, 1938, withdrawing 40 acres of Attu Island for school sites.

29. Public Land Order 1224 of September 14, 1955, signed by Secretary of the Interior Douglas McKay, revokes the Executive Order of December 9, 1903, reserving Kiska and Little Kiska Islands for Naval purposes, and Executive Order of January 4, 1901 insofar as it refers to Unalga Island and the adjacent Sea Gull Rocks. Public Land Order 1224 states that Kiska, Little Kiska, and Unalga Islands are within the Aleutian Islands National Wildlife Refuge.

30. Memorandum of Understanding dated July 19, 1957, between the Department of the Navy and the Department of Interior provided for use of 9,310 acres of Great Sitkin Island for temporary petroleum storage facilities. This Memorandum of Understanding terminated in five years and no record of renewal has been found. Under the terms of agreement, the lands returned at termination to their original status.

Regional Director, Paul T. Quick informed the Department of the Navy by a memorandum of September 13, 1965, that the Bureau of Sport Fisheries and Wildlife does not accept responsibility for the property installed on Great Sitkin. The Department of the Navy was again contacted by Bureau of

Sport Fisheries and Wildlife regarding this subject and by memorandum of April 1972 from Leon Conner of the Navy's Real Estate Division to Bureau of Sport Fisheries and Wildlife,Portland,Oregon stated that the property used by the Navy did not belong to the Navy but was only used under the aforementioned agreement. They feel that with this in mind and since removal of subject property would cause more damage than presently exists, they should be relieved from further responsibility and the files on this matter closed.

No further action from the Bureau of Sport Fisheries and Wildlife has been taken or is pending as of November 1, 1972.

It can thus be assumed that the Bureau of Sport Fisheries and Wildlife has responsibility for the land and the Department of the Navy for the property.

31. Cooperative Agreement and Amendment dated April 25, 1959 and October 21, 1959, respectively, between the Bureau of Sport Fisheries and Wildlife and the U.S. Air Force for use of approximately 127 acres at Cape Sarichef on Unimak Island for runway and DEW site purposes. Effective dates are January 1, 1959 to December 30, 1978.

32. Public Land Order 1949 of August 19, 1959, signed by Assistant Secretary of the Interior Roger Ernst, withdrew and reserved for use by the Department of Navy for military purposes:

> Approximately 11,670 acres in the Massacre Bay area of Attu Island; and approximately 61,000 acres of the northern part of Adak Island.

This Public Land Order also stated that "The reservation made by this order shall be the dominant reservation except for purposes of wildlife conservation and management, as to which Executive Order 1733 of March 3, 1913 shall be the dominant one". The portion of Public Land Order 1949 referring to Attu Island was revoked by Public Land Order 4564 of January 16, 1969.

33. Public Land Order 2476 of September 5, 1961, signed by Assistant Secretary of the Interior John A. Carver, Jr., revoked the Executive Order of January 4, 1901 so far as it reserved Ugamak (west end), Rootok, Egg Islands, and the Pinnacle (entrance to Sumner Bay) for lighthouse purposes. (See letter dated April 20, 1972 to Alaska Area Director from Land Office Manager Clark R. Noble, Bureau of Land Management).

34. Memorandum of Understanding dated October 10, 1961 between the Bureau of Sport Fisheries and Wildlife and the U.S. Air Force provided for the use of Shemya Island by the Air Force for operation and maintenance of the air navigation installation and related facilities. Effective dates are October 10, 1961 to June 30, 1986.

This agreement superseded the agreement dated October 29, 1956 between the Bureau of Sport Fisheries and Wildlife and Civil Aeronautics Administration (now the Federal Aviation Administration). This provided for use of the Island by the CAA for operation and maintenance of the existing air navigation facilities and supplementary features.

35. U.S. Survey Number 2014 of June 10, 1963 of 2.62 acres at Atka Village withdrawn for school purposes. Owned by the State of Alaska.

36. Federal Register Document 63-13108, dated December 18, 1963, amended Executive Order 8680 of February 14, 1941 suspending the restrictions

imposed on the Kiska Island and Unalaska Island Naval Airspace Reservations. However, they are subject to reinstatement without notice at any time when purposes of national defense may require. The Order or amendment cites no restrictions to land use (No copy in appendix).

37. Memorandum of June 25, 1965 from Acting Assistant Director, William White to Regional Director, Portland states that the 195 acre Amaknak Island Wildlife Administrative Site was dropped from the records as such and added to the lands of the Aleutian Islands National Wildlife Refuge. This is the latest action taken on this tract of land.

38. Public Land Order 4143 of January 3, 1967, signed by Assistant Secretary of the Interior Harry R. Anderson, revoked the Executive Order of June 13, 1902 insofar as it reserved approximately 580 acres in the Bay of Waterfalls on Adak Island for Naval purposes.

39. Letter of Agreement dated April 12, 1967 between the Bureau of Sport Fisheries and Wildlife and the U.S. Coast Guard provides agreement to the Coast Guard's request for a 486-acre watershed and a six-mile access road right-of-way on Attu Island.

40. Memorandum of Agreement (Number AT (26-1) -320) and its Supplemental Agreement effective May 17, 1967, and July 1, 1968, respectively between the Atomic Energy Commission and the Department of Interior provides for Bureau of Sport Fisheries and Wildlife and Atomic Energy Commission responsibilities for the need and requirements of the Island's wildlife.

41. Public Land Order 4564 of January 16, 1969, signed by Assistant Secretary of the Interior Harry R. Anderson, reserved as an aid-to-navigation facility of the U.S. Coast Guard approximately 1,800 acres of Attu Island just north of Casco Cove. This Public Land Order also revoked Public Land Order 1949 of August 19, 1959 insofar as it affects the Attu Island withdrawal of approximately 11,670 acres. As stated in Public Land Order 4564 "The lands described in paragraphs 1. (1,800 acres Coast Guard withdrawal) and 2. (11,670 acres of Navy withdrawals) are a part of the Aleutian Islands National Wildlife Refuge as established by Executive Order 1733 of March 3, 1913. 3. The withdrawal made by paragraph 1 of this order shall take precedence over but not otherwise affect the existing withdrawal for wildlife purposes".

42. AA-5709 of August 4, 1969 identifying the Vanner Tract at False Pass as owned by Peter Pan Seafoods, Inc.

43. Associate Solicitor C. Brewster Chapman, Jr., Territories, Wildlife and Claims, in a memorandum dated October 6, 1969, to Director, Bureau of Sport Fisheries and Wildlife gives an opinion as to whether any Federal agency engaged in military activities in the Refuge would require a formal permit from the Bureau of Sport Fisheries and Wildlife.

44. Alaska Regional Solicitor Hugh J. Wade issued the opinion on February 22, 1971, to the Alaska Area Director that"...the boundary line of the Aleutian Islands National Wildlife Refuge is the mean high tide of the water line on each of the islands of the Aleutian Chain.

45. Alaska Native Claims Settlement Act (P.L. 92-203) of December 18, 1971, enabled Aleuts to select certain lands in the Aleutian Islands Refuge (see

Native Claims Section).

46. Letter of January 7, 1972, from Captain C.S. Christensen, CINCPAC, to Alaska Area Director, BSF&W regarding Unimak Wilderness Proposal. Concurs to the exclusion from wilderness the Scotch Cap and Cape Sarichef area.

47. Letter of March 27, 1972 from Captain C.S. Christensen, CINCPAC, to Alaska Area Director, BSF&W, outlining military land use requirements in the Aleutian Islands Refuge.

48. Letter of April 20, 1972 from Clark R. Noble, Bureau of Land Management to Alaska Area Director, Bureau of Sport Fisheries and Wildlife clarified the status of Ugamak, Rootok, and Egg Islands. They concluded that all are a part of the Aleutian Islands National Wildlife Refuge.

49. Assistant Fish and Wildlife Solicitor Charles H. Vaughn issued the opinion on June 26, 1972 to Director, Bureau of Sport Fisheries and Wildlife that primary jurisdiction of the Aleutian Islands National Wildlife Refuge lies within the Bureau of Sport Fisheries and Wildlife.

50. Proposed memoranda of understanding with the Departments of Defense and Transportation defining their use of the Refuge area so that Congress can make its decision as to the suitability of the area for wilderness purposes.

NATIVE ALLOTMENTS

51. AA-8040 by Larry W. Dirks, Sr. for 40 acres on Atka

52. AA-8041 by Clara Z. Golodoff for 40 acres on Atka

53. AA-8043 by Nick Nevzoroff for 40 acres on Atka and 120 acres on Amlia.

54, AA-8044 by Daniel N. Prokopeuff for 160 acres on Amlia.

55. AA-8055 by Nicholas W. Dirks for 160 acres on Amlia.

NATIVE LAND CLAIMS - VILLAGE WITHDRAWALS

56. AA-6647 Akutan

57. AA-6649 Atka

58. AA-6651 Biorka

59. AA-6665 False Pass

60. AA-6684 Nikolski

61. AA-6689 Pauloff Harbor

62. AA-6709 Unalaska

Atomic Energy Commission - For the record, there is no documented use agreement between the Bureau of Sport Fisheries and Wildlife and the Atomic Energy Commission regarding Amchitka Island. Our information is that this was a verbal agreement on the cabinet-level, made sometime during 1966. The Memorandum of Understanding, AT26-1-320, dated May 17, 1967 and the Supplemental Agreement, of July 1968, only provides for a Bureau of Sport Fisheries and Wildlife representative on Amchitka to coordinate Bureau of Sport Fisheries and Wildlife and Atomic Energy Commission responsibilities for the needs and requirements of the area's wildlife. We have requested information from the AEC as to their future land requirements for Amchitka and adjacent islands but have received no answer at the time of this writing (Letter of January 31, 1972 from Alaska Area Director Watson, BSF&W to Assistant Mgr. of Engineering and Logistics William Smith, AEC, Las Vegas).

CHAPTER VI

RESOURCES

A. Birds

A total of 183 species of birds has been recorded in the Aleutian Islands and adjacent waters (Table 5). Of these, 54 species nest on the refuge, 75 are common migrants, and 55 are casual or accidental. The Alaska Department of Fish and Game (1973) has broadly identified the marine and terrestrial bird habitat in the Aleutians as follows:

(1) Marine littoral waters. These are shallow coastal waters that extend from shore outward approximately 2 miles to merge with pelagic water. Pelagic birds, sea ducks, brant and emperor geese are common in such waters and use them for feeding and resting.

(2) Pelagic waters. These are waters of the open sea beyond 2 miles from shore, they provide feeding and resting areas for pelagic bird species.

(3) Lacustrine waters. Freshwater bodies of standing water and emergent plant and aquatic animal life are found within upland basins. They provide resting, feeding and breeding habitat for such species as loons, grebes, dabbling ducks, diving ducks and some sea ducks.

(4) Riparian meadows. This includes vegetation bordering streams which serves as nesting cover and feeding areas for dabbling ducks, diving ducks, and some sea ducks.

(5) Beach ridges. These are vegetated shorelines predominantly covered with beach rye, grass, sandwort and groundsel and which are used as nesting and feeding cover.

(6) Coastal reefs. These contain exposed lichen-spattered rocky reefs and headlands largely devoid of vegetation and typically covered with marine algae.

(7) Sea beaches. These sparsely vegetated rugged beaches usually lie at the base of sea cliffs, and are often littered with driftwood, kelp and the remains of marine invertebrates.

(8) Sea cliffs. These are steep rocky cliffs and pinnacles facing seaward and used by pelagic birds and raptors such as bald eagles and peregrine falcons. They may be richly vegetated due to the constant fertilization by nesting birds.

Aleutian Island bird populations have experienced many drastic changes in distribution, numbers, and species composition since man first visited the islands. Many such changes have resulted from natural events such as volcanic activity, storms and tidal waves. In other areas, man has wrought much havoc by the introduction of carnivorous mammals. Blue foxes were placed on many islands where they nearly eliminated some breeding birds. Rats, dogs, and cats were introduced on several of the Rat and Near Islands by the military during World War II. Predator eradication programs were initiated in 1951 and succeeded in eliminating dogs and cats but only temporarily reduced fox and rats. From 1953 to 1959 an intensive predator poisoning campaign carried out on Amchitka Island succeeded in eliminating most foxes. Rats are still abundant on many of the islands, however. The overall effects of rat predation on island-nesting species of birds is not known, but at least two species of small songbirds have been nearly exterminated from Amchitka Island.

The most remarkable wildlife resource in the Aleutian Islands is the enormous number of pelagic birds found throughout the Chain. The islands serve as major breeding grounds for such species as the black-legged kittiwake, crested, least, whiskered, and parakeet auklets, Pacific fulmar, and pelagic and red-faced cormorants. Many of these birds once played an important part in the life of Aleuts who ate their eggs and flesh, and used their skins for clothing.

Because of the Chain's close proximity to both the American and Eurasian continents, casual or accidental visitations by North American and Asiatic species deviating from their normal migration routes are common. Asiatic species are frequently observed in the western Aleutians and North American species in the eastern Aleutians.

.1. Pelagic Birds

Surveys conducted from 1970 to 1972 by the Bureau of Sport Fisheries and Wildlife indicate that an estimated 2.8 million pelagic birds nest in the Aleutian Islands National Wildlife Refuge (excluding Unimak Island and Cape Krenitzin). Because this survey covered only the major colonies it is estimated that a minimum of 4 million breeding pelagic birds exist on the refuge. Table 4 summarizes the most numerous species, and Figure 29 through 35 illustrate their distribution. It is important to note that the enumerations are minimum figures and that the actual numbers are in all probability much greater.

Table 4. 1970-1972 Pelagic Bird Nesting Surveys, Major Species

Island Group	Fulmar	Cormorant	Gull	Kittiwake	Murre	Auklet	Puffin	Total
Near	-----	112,300	4,200	28,800	43,000	----	26,100	214,400
Rat	250	2,400	6,500	75,000	16,000	613,000	28,000	741,150
Delarof	3,200	4,800	1,200	1,500	700	280,000	24,100	315,500
Andreanof	450,000	19,500	7,900	39,500	121,000	107,000	189,500	934,400
Is. of Four Mts.	0	100	120	0	285,000	2,100	13,400	300,720
Fox	----	---	---	--	----	----	151,100	151,100
TOTALS	453,450	139,100	19,920	144,800	465,700	1,002,100	432,200	2,657,270

a. Auklets. The least auklet was the most abundant bird observed (about 65% of the auklets and 27% of the total birds), followed by the crested (26% of the auklets), parakeet, whiskered, Cassin's, and Rhinoceros auklets. The central Aleutians support the majority of these birds, with major colonies on Buldir, Kiska, Segula, Semisopochnoi, Gareloi, Oglodak, Kasatochi, Koniuji, Yunaska, Chagulak, and Ulak Islands. These birds can be likened to large clouds of smoke when seen in feeding flights to and from their coastal rookeries. Most auklets feed on small marine crustaceans such as amphipods, schizopods, and copepods.

b. Murres. Murres constituted about 17% of the total birds seen, with the common murre far more numerous than the thick-billed. Murre colonies are located from Cape Wrangell on Attu to Amak Island, with major colonies on Attu, Agattu, Buldir, Chagulak, Kagamil, Koniuji, and Amak Islands. Murie (1959) also recorded Bogoslof, Amukta, and Kasatochi as having major murre colonies. Marine fish, crustaceans and mollusks make up the bulk of their diet.

c. Pacific Fulmar. Over 450,000 Pacific fulmars nesting on Chagulak Island constitute the largest single known Pacific fulmar colony in North America. Much smaller colonies were found on Buldir, Gareloi, and Seguam Islands. Fulmars feed on marine fish, cephalopods, crustaceans, and carrion.

d. Puffins. Tufted and horned puffins constituted about 15% of the total birds enumerated. They were observed on nearly every island and are common throughout the Chain. Major nesting areas are on Attu, Agattu, Buldir, Khvostof, Davidof, Ulak in the Delarofs; Gareloi, Yunaska, Chagulak, Adak, Bobrof, Tanaga, Ulak in the central Andreanofs; and Uliaga, Avatanak, and Rootok Islands in the Fox Group. The tufted puffin reportedly relies on the sand lance for food, although it also utilizes sea urchins and mollusks, whereas the horned puffin feeds on marine fish, crustaceans, and mollusks.

e. Kittiwakes. The black-legged kittiwake nests throughout the Chain, but the much less abundant red-legged kittiwake nests only on Buldir Island. Major black-legged kittiwake colonies are on Attu, Agattu, Buldir, Koniuji, Chagulak and Amak Islands.

f. Cormorants. Both pelagic and red-faced cormorants are abundant, with the double-crested infrequently observed. These species are probably more abundant than the figures indicate because of the relative difficulty in counting them. Most often, their distribution is in scattered numbers around an island's periphery, making census difficult at best. Major nesting areas are on Attu, Agattu, Nizki, Alaid, Gareloi, Tanaga, Great Sitkin, and Amak Islands. Marine fish constitute most of the diet.

g. Gulls. The glaucous-winged gull is the most abundant gull, with the glaucous gull second. With a few exceptions gulls nest on nearly all of the Aleutian Islands. Although common it does not nest in any large concentrations.

h. Others. Such other pelagic birds as the fork-tailed petrel, Leach's petrel, pigeon guillemot, marbled, Kittlitz', and ancient murrelets, black oystercatcher, and northern phalarope nest in small numbers on the Aleutian Islands.

The Aleutians are host to many other pelagic birds including albatrosses and shearwaters. Black-footed and Laysan albatrosses, and slender-billed and sooty shearwaters for example are regular summer migrants to the Aleutians and its adjacent marine waters. The albatrosses occur most commonly in low-temperature water areas which are rich in nutrients and high in biotic activity. These birds are experts in gliding so are seldom grounded in the wind-swept Aleutians. Shearwaters are found throughout the length of the Aleutians but are most common in passes and other areas of upwelling or strong currents. These birds feed primarily upon fish. Slender-billed shearwaters have been noted in Unimak Pass in a concentration measuring 15 miles long and 2-3 miles wide, containing an estimated 15 million birds. Shearwaters migrate to the Aleutians for the summer from breeding grounds in the southern hemisphere.

The total number of pelagic birds using the offshore waters is considered to be quite large. Sanger (1972c) estimated the total pelagic stocks and biomass of seabirds in subarctic areas of the Pacific Ocean at 8 million in winter and 51 million in summer. The greatest number of birds occurred in the North Pacific south of the central and eastern Aleutians, the Alaska Peninsula and mainland of Alaska. Shearwaters were predominant during the summer, with shearwaters, gulls and kittiwakes, and Alcids predominant in the winter period. Sanger also estimated that these birds consumed an estimated 0.6 to 1.2 million tons of food per year and voided an estimated 120 to 240 thousand tons of feces. These bird droppings are considered an important source of phosphates and nitrates which are needed to maintain the relatively low but steady phytoplankton production which occurs throughout the summer period.

Preliminary estimates by Warren King and Gerald Sanger (personnal communication 1973) indicate that nearly 4.8 million pelagic birds are killed by the western Aleutian Japanese gill net fisheries each year. This fishery involves approximately 11 mother ships with 33 catcher boats per ship operative for a 65-day season from early May to the early part of July. The estimates are based upon the experimental fishing of the National Marine Fisheries Service and upon the number of Japanese boats. Estimates are approximately 200 birds killed per catcher boat per day. Of these, the major species caught are sooty and slender-billed shearwaters, thick-billed murres, and tufted puffins. Other species caught are horned puffins, parakeet and whiskered auklets, and ancient murrelets. The Laysan albatross and forktailed petrel have also been taken in the fish nets. Another important aspect of this Japanese fishery is that each catcher boat averages one porpoise per day in their catch. This means that along with the bird kill, over 23,500 porpoises may be killed per year (Zahn, personnal communication, 1971).

The importance of the marine birds to their environment is recognized by the Alaska Department of Fish and Game (1973):

> "The relationship of seabirds, especially murres, to the overall ecology of arctic seas is an important one. Seabirds provide a vital link in the ecology of the species which are their food. The birds' excrement, rich in potash, is important to the growth and abundance of all marine organisms. In turn, these organisms provide food for small fish which are eaten by adult fish which in turn become seabird food. It is said that seabird colonies could be fertilizing factories of the northern seas."

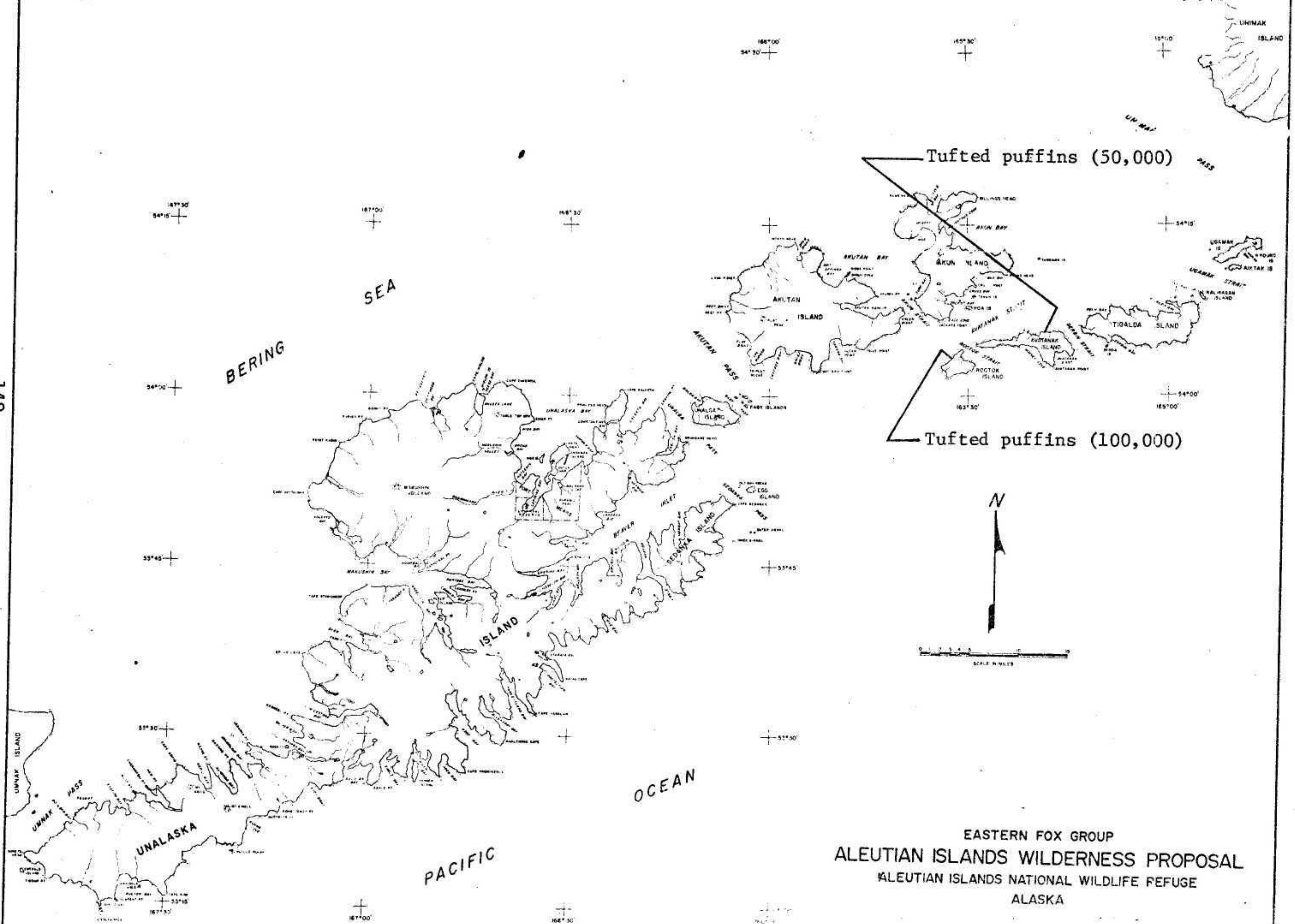


Figure 29. Pelagic Nesting Birds - 1972 Survey

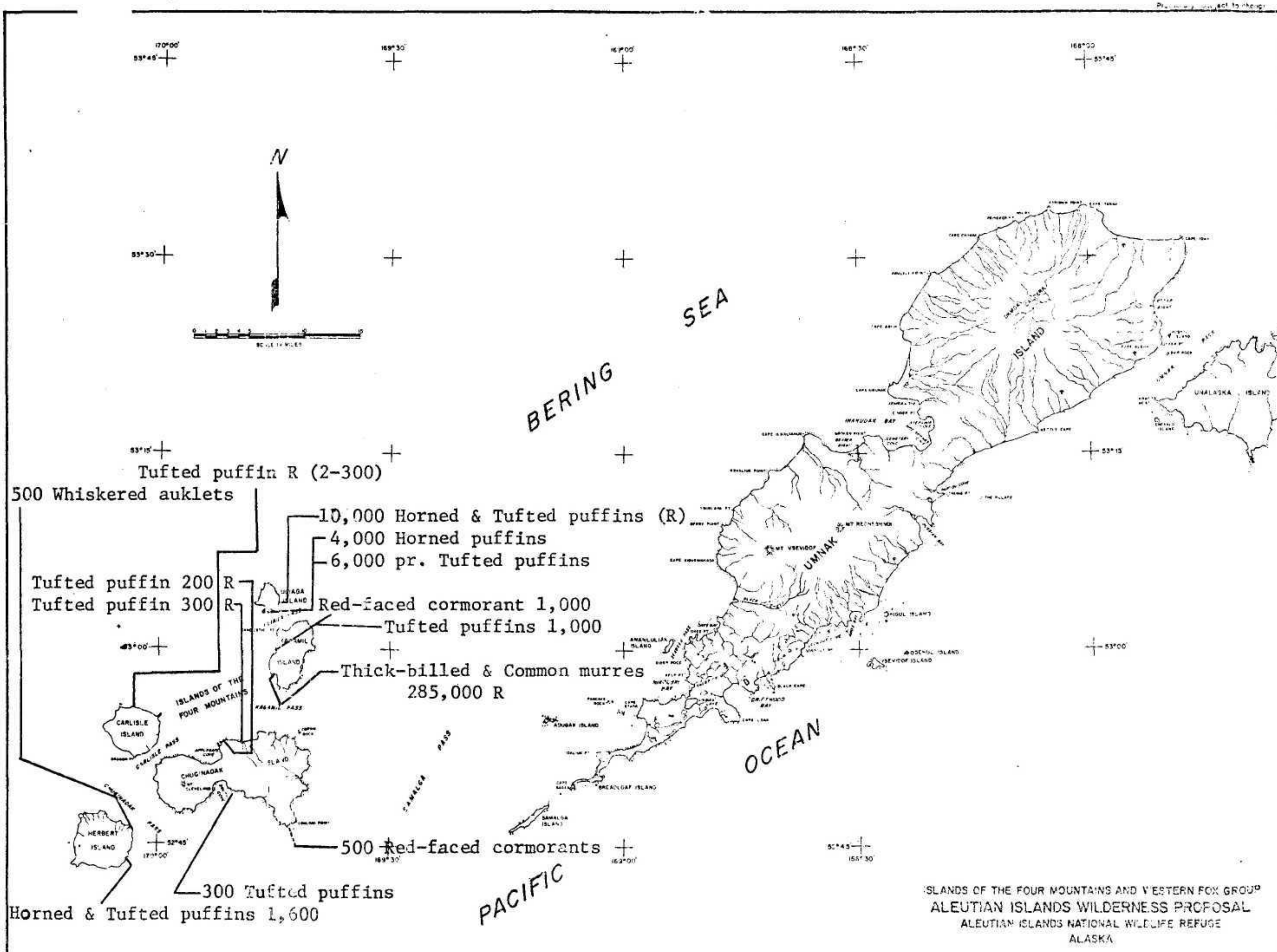


Figure 30. Pelagic Nesting Birds - 1972 Survey

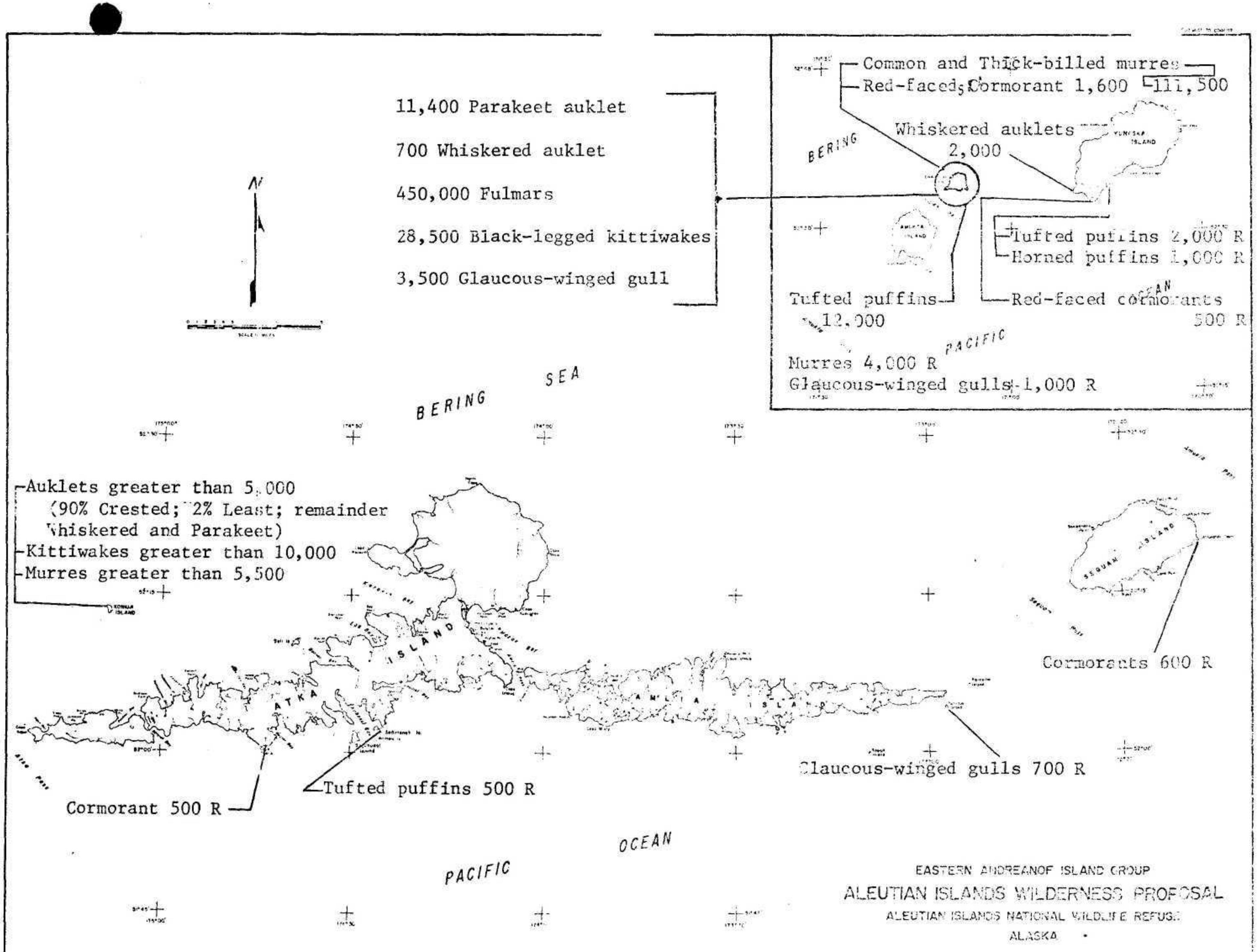


Figure 31. Pelagic Nesting Birds - 1972 Survey

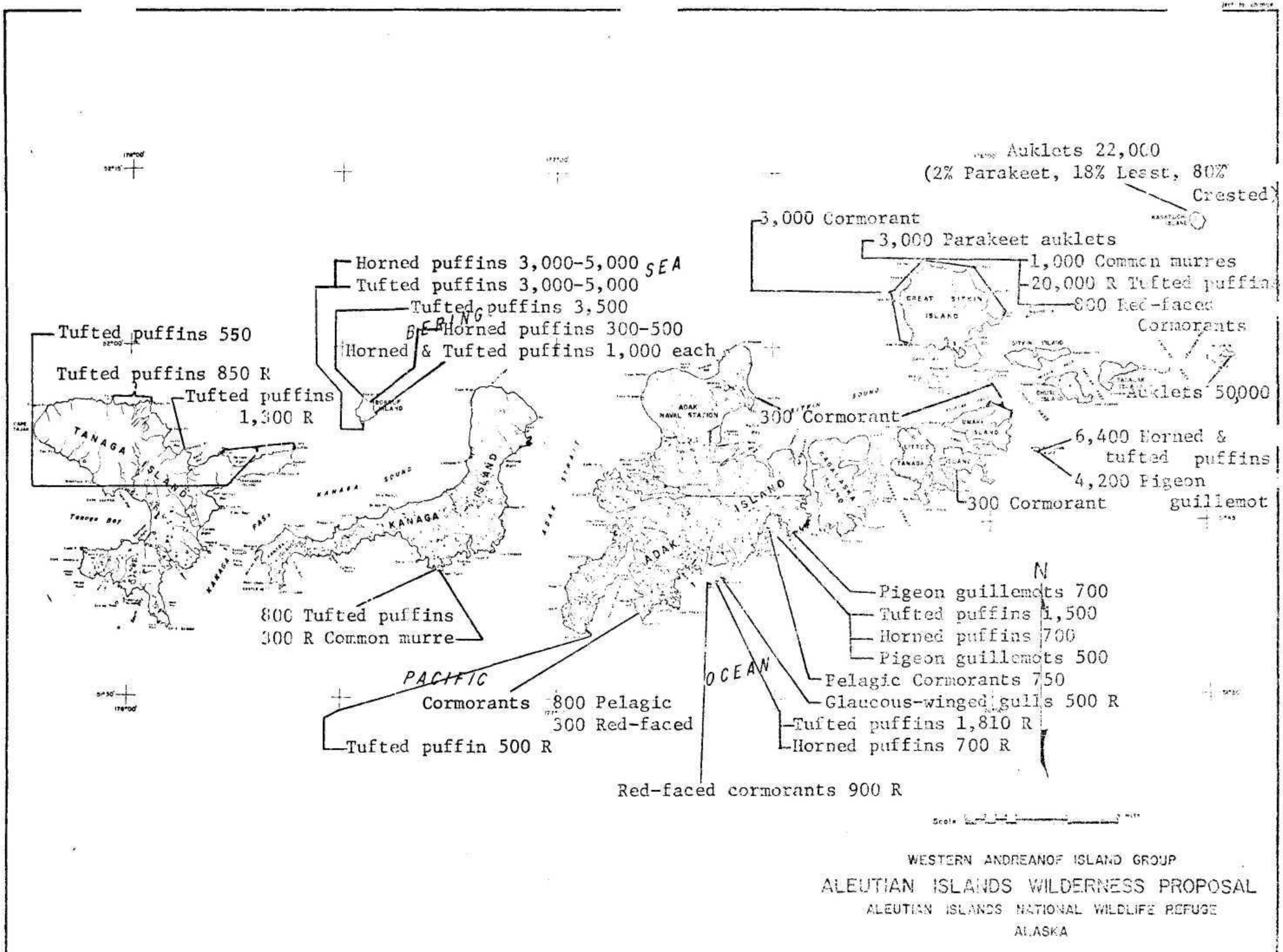


Figure 32. Pelagic Nesting Birds - 1972 Survey

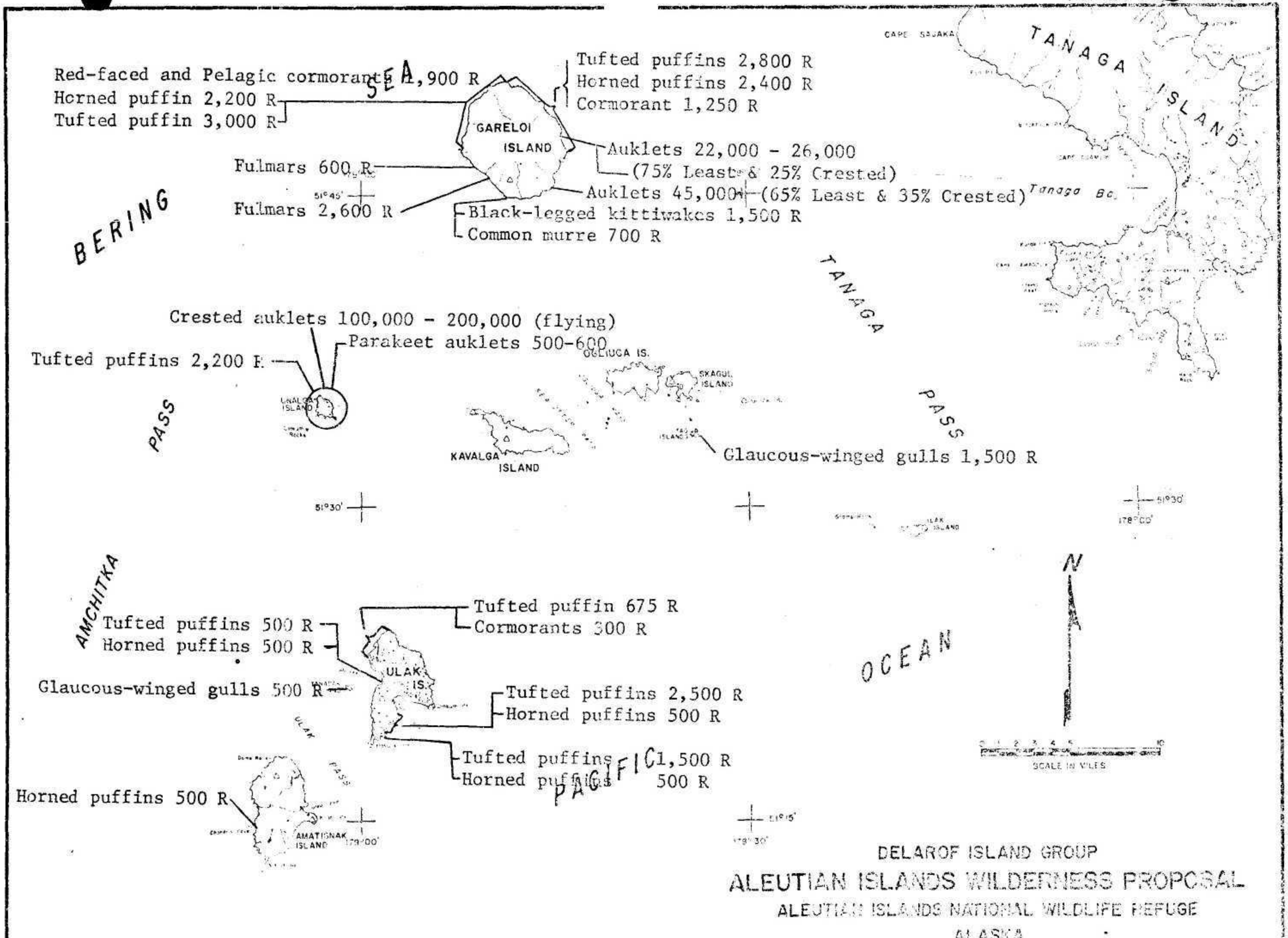


Figure 33. Pelagic Nesting Birds - 1972 Survey

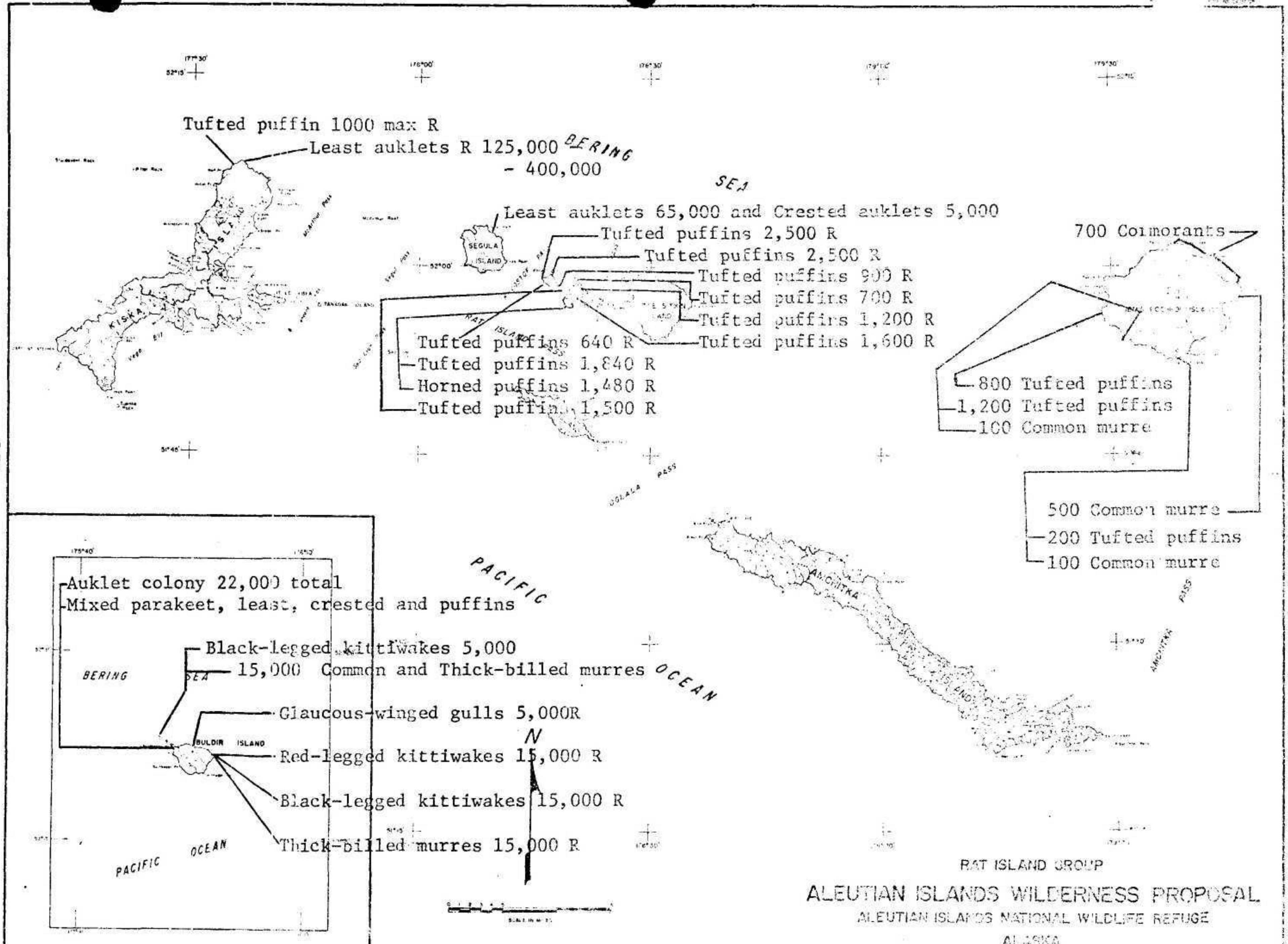


Figure 34. Pelagic Nesting Birds - 1972 Survey

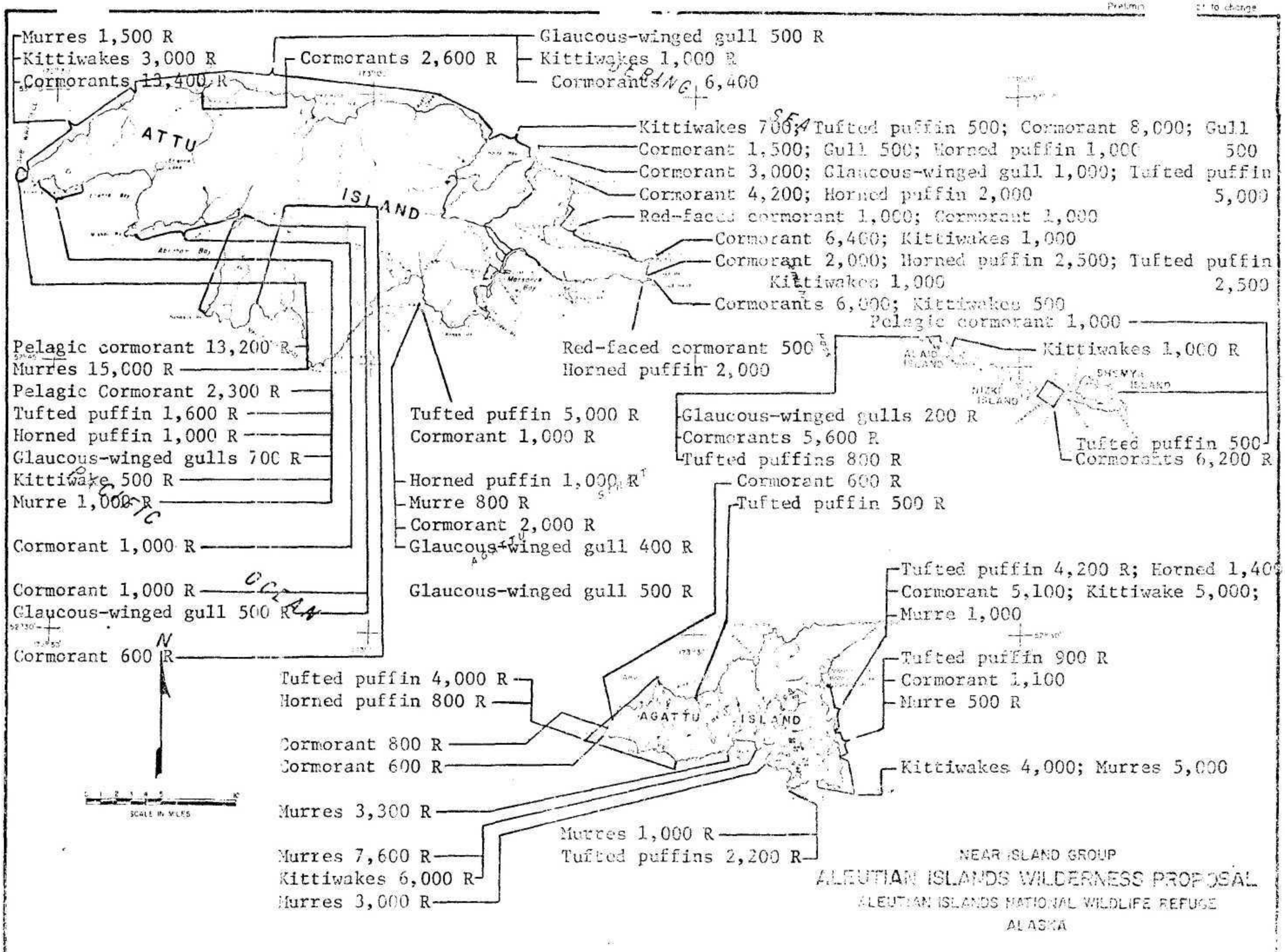


Figure 35. Pelagic Nesting Birds - 1972 Survey

2. Terrestrial Birds: Species of land bird are limited. The most common are the Lapland longspur, snow bunting, gray-crowned rosy finch, giant song sparrow, winter wren, and common raven. All nest throughout the Chain with all but the Lapland longspur wintering along the Aleutians or in other parts of Alaska.

The Lapland longspur migrates south into Canada and the contiguous U.S. for the winter period. Williamson and Emison (1969) list the estimated numbers and seasonal use for Amchitka Island from 1967-1969 as follows:

	Spring	Summer	Autumn	Winter
Lapland Longspur	20,000	38,000	20,000	0
Snow bunting	2,000	2,000	2,000	2,000
Gray-crowned Rosy Finch	2,000	2,000	2,000	2,000
Winter Wren	700	700	1,000	700
Song Sparrow	10	10	10	10
Common Raven	0	0	10	0

a. Waterfowl: The lowlands, lakes, streams, and adjacent marine waters of the Aleutians support thousands of nesting waterfowl. The common teal is most common followed by the pintail, mallard and greater scaup. The common eider is the most abundant nester of the sea ducks, followed in importance by the harlequin duck: The importance of each species varies throughout the Chain. For example, the common eider is most abundant in the central and western Aleutians, producing an estimated 3,800 young in the Near Island Group, whereas in the Central Aleutians the common teal is most abundant. The mallard is evenly distributed throughout the Chain. Williamson and Emison (1969) give estimated total waterfowl numbers for Amchitka Island for 1967-1969.

	Spring	Summer	Autumn	Winter
Mallard	50	50	200	50
Pintail	200	25	100	0
Common Teal	500	500	500	3-400
European Widgeon	10	10	10	0
Shoveler	10	0	10	0
Greater scaup	150	150	150	150
Tufted duck	25	0	0	0
Common goldeneye	100	10	50	4,000
Bufflehead	50	10	50	2,000
Oldsquaw	0	0	0	50
Harlequin duck	1,500	500	2,500	3,500
Common eider	1,500	1,500	500	10
White-winged scoter	10-100	10-100	10	0
Common scoter	10	20	10	0
Emperor goose	0	0	50	12,000

The Chain is host each year to thousands of migrating waterfowl. The most conspicuous is the emperor goose. This bird breeds in the Kuskokwim-kon River Delta and Soviet Siberia, and nearly the entire population (over 100,000) winters in the Aleutians. The whooper swan winters in the western Aleutians on its way to and from Siberian breeding grounds. Other common migrant visitors include mallards, pintails, greater scaup, common goldeneyes, oldsquaws, harlequin ducks, Steller's eiders, white-winged scoters, and common scoters.

b. Shorebirds: The Aleutians constitute the major breeding grounds for races of the Aleutian rock sandpiper. The rock sandpiper is a permanent resident which occurs on most of the islands. The least and wood sandpipers are the only other shorebirds that have been found to nest in the Chain. Each spring and fall thousands of migrating shorebirds frequent shorelines on lakes and lagoons. More common in the eastern Aleutians these se flocks may appear as "smoke" on the horizon. Williamson and Emison (1969) give estimated numbers for 1967-1969 on Amchitka Island.

	Spring	Summer	Autumn	Winter
American Golden plover	20	0	20	0
Ruddy turnstone	100	0	500	0
Wood Sandpiper	50	?	0	0
Wandering tattler	50	0	100	0
Lesser Yellowlegs	0	10	0	0
Rock Sandpiper	3,000	3,000	3,500	3,000
Bar-tailed godwit	100	0	0	0
Whimbrel	0	Accidental	0	0
Baird's sandpiper	0	Accidental	0	0
Least sandpiper	Accidental	0	0	0
Dunlin	Accidental	0	0	0

c. Birds of Prey: Bald eagles and peregrine falcons are permanent residents, and occur commonly throughout the islands, except that there is no recent record of the bald eagle in the Near Group. About 200 bald eagles claimed Amchitka as home in 1967, and 40 nests were found in 1968. .arge numbers are known also to occur on Adak, Umnak, and Unimak Islands.

Only limited peregrine falcon reproductive data has been collected in the Aleutians because of the birds secretive nature. Seven eyries were recorded for Amchitka in 1968, with a total summer population estimated at 20 birds. Eyries have also been recorded at Agattu, Buldir, Rat, Segula, Kiska, Semisopochnoi, Gareloi, Adak, Kagalaska, Great Sitkin, Atka, Yunaska, Unalaska, Akutan, Unimak, and Amak Islands. Population estimates are difficult to determine but are in excess of 200 birds.

The snowy owl is a common year-round resident on Attu and Shemya Islands. It nests mostly in the lowland areas on Attu.

Other raptors which have been recorded in the Chain are the marsh hawk, yrfalcon, rough-legged hawk, pigeon hawk, and short-eared owl. Gray sea eagles occur only infrequently in the western Aleutians.

d. Upland Game: Rock ptarmigan are distributed throughout the Chain and are common on the larger islands. Variation has resulted in classification of several subspecies (BSF&W, 1968).

Everman's Rock Ptarmigan, Lagopus mutus evermanni. Resident on Attu Island, Aleutian Islands, Alaska.

Townsend's Rock Ptarmigan, Lagopus mutus townsendi. Resident on Kiska and Little Kiska, and possibly Buldir Island, Aleutian Islands, Alaska.

Turner's Rock Ptarmigan, Lagopus mutus atkhensis. Resident only on Atka Island, Aleutian Islands, Alaska.

Yunaska Rock Ptarmigan, Lagopus mutus atkhenyunaskensis. Resident on Yunaska Island, possibly also Amukta Island and Islands of Four Mountains, Aleutian Islands, Alaska.

Chamberlain's Rock Ptarmigan, Lagopus mutus chamberlaini. Resident only on Adak Island, Aleutian Islands, Alaska.

Sanford's Rock Ptarmigan, Lagopus mutus sanfordi. Resident on Tanaga and Kanaga Islands, Aleutian Islands, Alaska.

Amchitka Rock Ptarmigan, Lagopus mutus gabrielsoni. Resident on Amchitka, Little Sitkin, and Rat Islands, Aleutian Islands, Alaska.

3. Rare and Endangered Species: The Committee on Rare and Endangered Wildlife Species has classified several avian species in the Aleutians as Rare and Endangered in the United States (1968):

Endangered

Aleutian Canada Goose

Prospects of survival and reproduction are in immediate jeopardy. Its peril may result from one or many causes--loss of habitat or change in habitat, overexploitation, predation, competition, disease. An endangered species must have help, or extinction will probably follow.

A remnant breeding population of approximately 200 to 300 of these birds rently utilizes Buldir Island (Smart, 1972 and Jones, 1963). They are believed to migrate to either Japan or down the west coast of North America to California.

The Aleutian Canada goose was formerly thought to nest in the Aleutian Islands from Yunaska to and including the Near Island Group. Clark (1910) reported large numbers on Agattu Island during his visit in 1906. Murie (1959) reports that in 1963 and 1937, "... they had disappeared on most of the islands, and our total observations indicated that only a few pairs remained in the Aleutians." Observations subsequently have supported this view.

Introduction of the arctic Fox is thought to be the major factor in the decline of the Aleutian Canada goose (Murie, 1959 and Jones, 1963). Indigenous to Attu (Bancroft, 1886), this animal was introduced to all of the refuge islands except Unimak, Anagaksik, Buldir, Chagulak, Davidof, Khvostof, Carlisle, Ikiginak, Oglodak, Koniuji, and Little Kiska, plus a few smaller islets near Umnak and Unalaska. By 1936, the refuge was essentially a large fox farm. The effectiveness of the fox as a ground predator is unequaled. Soon after introduction it had eliminated most bird nesting populations except those in inaccessible cliff areas.

To restore the Aleutian Canada goose to former population levels, the Bureau of Sport Fisheries and Wildlife initiated a program of fox eradication on certain islands. In 1956 and 1957, poison pellets were scattered around the periphery of Amchitka Island. No fox have been seen for several years, and it is thought that they have been eliminated. In April 1964, 50,000 waterproof strychnine pellets and 50,000 waterproof pellets containing

1080 were scattered over Agattu and Kiska Islands, respectively. Ground parties visited Agattu in 1964 and 1967 and eliminated most of the remaining foxes. No follow-up occurred at Kiska and fox populations are again relatively high.

In preparation for goose restoration to islands freed of foxes, the Bureau visited Buldir Island in 1963 to catch 18 goslings and 1972 to capture 22. The goslings were taken to Bureau research facilities in Maryland for propagation and for subsequent return and release to those islands containing no foxes.

In 1972, the Bureau released 75 geese on Amchitka Island. The geese promptly disappeared, however, with only a few scattered unverified reports of individuals or groups of 2 to 5. Plans for future introductions are still being developed.

Arctic Peregrine Falcon

Peripheral Birds. The United States is at the edge of its natural range; is rare or endangered within the United States although not in its range as a whole.

Green-throated Arctic Loon
Red-faced Cormorant
Whiskered Auklet

Status Undetermined

Species or subspecies that have been suggested as possibly endangered, but about which more information is needed.

Steller's Eider
Spectacled Eider
Evermann's Rock Ptarmigan
Townsend's Rock Ptarmigan
Turner's Rock Ptarmigan
Yunaska Rock Ptarmigan
Chamberlain's Rock Ptarmigan
Sandford's Rock Ptarmigan
Amchitka Rock Ptarmigan
Red-legged Kittiwake
Aleutian Tern
Attu Winter Wren
Stevenson's Winter Wren
Unalaska Winter Wren
Kiska Winter Wren
Tanaga Winter Wren
Sequam Winter Wren
Aleutian Gray-Crowned Rosy Finch
Giant Song Sparrow
Amak Song Sparrow

Table 5. Bird List of the Aleutian Islands National Wildlife Refuge

The number(s) following a particular status indicate(s) that the status only applies to those areas indicated by the numbers. If no numbers are present, the status applies to the entire refuge. The relative abundance applies to the occurrence of a bird in its preferred habitat. The codes used in the list follow:

LEGEND

Relative Abundance	Status
C - Common	M - Migrant
U - Uncommon	PR - Permanent Resident
R - Rare	SR - Summer Resident
	WR - Winter Resident
	V - Vagrant
	[] - Offshore

Distribution (See Figure 36)   *Known Breeder

(1) Eastern Aleutians (Unimak Island to Amukta Pass)

(2) Central Aleutians (Seguam Island to Kiska Island)

(3) Western Aleutians (Buldir Island to Attu Island)

Common Loon*	U-PR
Arctic Loon	U-WR, R-M
Red-throated Loon*	U-PR
Red-necked Grebe	R-SR(1&2), U-WR
Horned Grebe	U-WR(1&2), R-M(3)
Black-footed Albatross	[U-SR]
Laysan Albatross	[U-SR]
Fulmar*	C-SR, U-WR
Sooty Shearwater	[U-SR]
Slender-billed Shearwater	[C-SR]
Scaled Petrel	[R-SR]
Fork-tailed Petrel*	C-SR
Leach's Petrel*	C-SR
Double-crested Cormorant*	C-SR (1)
Pelagic Cormorant*	C-PR
Red-faced Cormorant*	C-SR, U-WR
Whooper Swan	U-WR (2&3)
Whistling Swan*	C-M(1), U-SR(1) R-WR(1)
Canada Goose (Cackling)	U-M(1)
Canada Goose (Taverner's)	C-M(1)
Canada Goose (Aleutian)*	R-SR(3), R-M
Black Brant	C-M(1), R-V(2)
Emperor Goose	C-WR
White-fronted Goose	R-M(1)
Mallard*	C-PR
Gadwall*	U-SR(1), R-WR (1&2), R-M
Pintail*	U-PR
Common Teal*	C-PR
Green-Winged Teal*	C-SR(1), U-WR(1), R-V(2)
European Widgeon	U-M, R-WR
American Widgeon	R-M, R-WR
Shoveler	R-M
Common Pochard	R-M
Canvasback	R-WR(2)
Greater Scaup*	C-WR, U-SR
Tufted Duck	R-PR(2&3)
Common Goldeneye	C-WR, U-SR

Bufflehead	C-WR
Oldsquaw	C-WR, R-SR
Harlequin Duck	C-PR
Steller's Eider	C-WR(1), R-WR(2)
Common Eider*	C-PR
King Eider	C-WR(1), R-WR(2)
White-winged Scoter	C-WR, U-SR
Surf Scoter	R-WR
Common Scoter	C-WR, R-SR
Smew	R-M(2&3)
Common Merganser*	U-PR(1), U-WR(2&3)
Red-breasted Merganser*	U-SR, C-WR
Rough-legged Hawk*	U-SR(1), R-M(2)
Bald Eagle*	C-PR(1&2), R-V(3)
Marsh Hawk	R-V
Gyrfalcon	U-WR, R-SR
Peregrine Falcon*	C-PR
Pigeon Hawk	R-V(1&2)
Willow Ptarmigan*	C-PR(1)
Rock Ptarmigan*	C-PR
Sandhill Crane	U-M
Black Oystercatcher*	C-PR(1&2)
Semipalmated Plover	U-SR(1)
American Golden Plover	U-M
Black-bellied Plover	R-M
Ruddy Turnstone	C-M,U-SR
Common Snipe	R-M(1)
Whimbrel	R-M
Wood Sandpiper*	R-SR(2), R-M
Wandering Tattler	U-M, R-SR
Lesser Yellowlegs	R-V(2)
Rock Sandpiper*	C-PR
Sharp-tailed Sandpiper	R-M
Pectoral Sandpiper	R-M
Baird's Sandpiper	R-M
Least Sandpiper*	C-M(1), U-SR(1)
Dunlin	R-M
Western Sandpiper	C-M(1)
Bar-tailed Godwit	U-M
Sanderling	U-WR
Red Phalarope	[C-M(1), U-M(2&3)]
Northern Phalarope*	U-SR, C-M
Pomarine Jaeger	R-M, [U-SR]
Parasitic Jaeger*	C-SR(2&3), U-SR(1)
Long-tailed Jaeger	R-M
Glaucous Gull	R-WR
Glaucous-winged Gull*	C-PR
Slaty-backed Gull	R-V
Herring Gull	R-WR
Mew Gull	U-WR(1&2)
Black-headed Gull	R-M

Black-legged Kittiwake*	C-SR, U-WR
Red-legged Kittiwake*	C-SR(3), R-M
Sabine's Gull	[R-M(1&2)]
Arctic Tern*	C-SR
Aleutian Tern*	U-SR
Common Murre*	C-PR
Thick-billed Murre*	C-PR
Pigeon Guillemot*	C-PR
Marbled Murrelet	C-SR(1&2), R-WR(1&2)
Kittlitz's Murrelet*	U-SR, R-WR
Ancient Murrelet*	C-SR, R-WR
Cassin's Auklet*	U-SR(1&2), R-SR(3)
Parakeet Auklet*	C-SR, R-WR
Crested Auklet*	C-SR, U-WR
Least Auklet*	C-SR, R-WR
Whiskered Auklet*	C-SR
Horned Puffin*	C-SR, U-WR
Tufted Puffin*	C-SR, U-WR
Snowy Owl*	U-PR(3), R-WR(1&2)
Short-eared Owl*	U-SR(1), U-M
Belted Kingfisher	R-V(1)
Bank Swallow*	U-SR(1)
Black-billed Magpie	R-V(1)
Common Raven*	C-PR
Dipper*	U-PR(1)
Winter Wren*	C-PR
Hermit Thrush	R-SR(1)
Water Pipit*	U-SR(1), R-WR(1)
	R-V(2)
Northern Shrike	R-V (1&2)
Yellow Warbler*	U-SR(1)
Wilson's Warbler	R-SR(1)
Gray-crowned Rosy Finch*	C-PR
Common Redpoll*	C-SR(1), R-V
Savannah Sparrow*	C-SR(1)
Golden-crowned Sparrow*	R-SR(1)
Fox Sparrow*	C-SR(1)
Song Sparrow*	C-PR
Lapland Longspur*	C-SR
Snow Bunting*	C-PR, C-M
McKay's Bunting	R-WR(1)

Casual or Accidental

Yellow-billed Loon

Short-tailed Albatross

Pale-footed Shearwater

Knot

Great Knot

Rufous-necked Sandpiper

Cook's Petrel
Bean Goose
Spotbill Duck (Chinese)
Falcated Teal
Garganey
Baikal Teal
Blue-winged Teal
Barrow's Goldeneye
Spectacled Eider
Hooded Merganser
Goshawk
Golden Eagle
Gray Sea Eagle
Steller's Sea Eagle
Osprey
Sparrow Hawk
American Coot
Surfbird
Black Turnstone
Far Eastern Curlew
Common Sandpiper
Greater Yellowlegs
Spotted Redshank
Greenshank
Yellowhammer

Long-billed Dowitcher
Semipalmated Sandpiper
Black-tailed Godwit
Ruff
Bonaparte's Gull
Common Tern (Asiatic)
Rhinoceros Auklet
Oriental Cuckoo
Tree Swallow
Barn Swallow
Cliff Swallow
Eye-browed Thrush
Wheatear
Siberian Rubythroat
Arctic Warbler
Gray-spotted Flycatcher
White Wagtail
Gray Wagtail
Yellow Wagtail
Bohemian Waxwing
Brambling
Hawfinch
Slate-colored Junco
Rustic Bunting

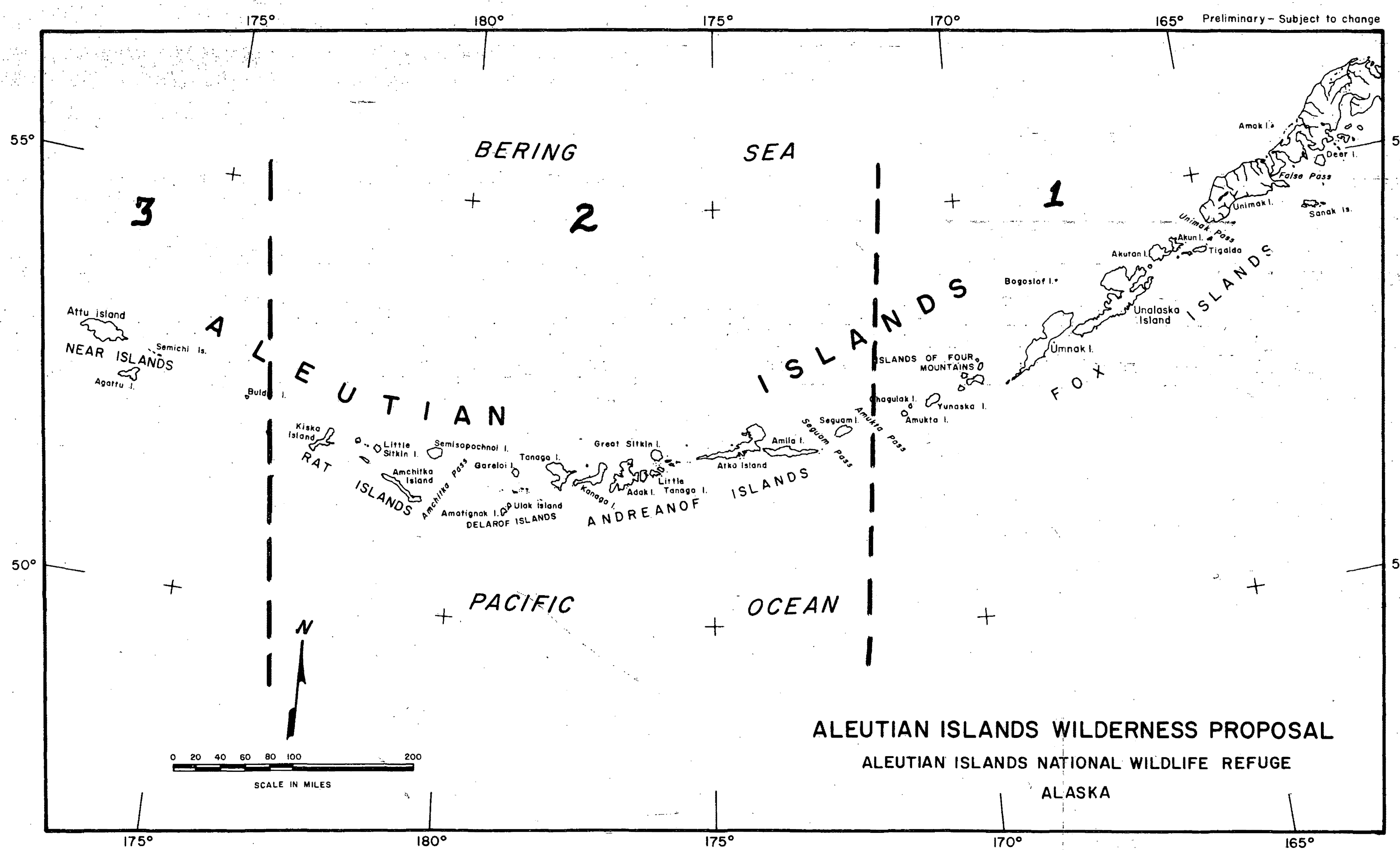


Figure 36. Bird List Distribution Map

B. Mammals: A total of 39 species of mammals has been recorded on the Aleutian Islands, including the extinct Steller's sea cow. Marine mammals account for 21 of the total and terrestrial mammals for 18 (Table 8). Unimak Island is the natural western limit of caribou, brown bear, wolf, wolverine, ground squirrel, and weasel. Almost all terrestrial forms of mammals west of Unimak have been introduced by man. Only the fox is thought to be indigenous to a few of these islands.

1. Terrestrial Mammals: a. Caribou and Reindeer. The barren-ground caribou was established on Adak Island by a transplant of 23 calves in 1958 and 1959. The herd grew in size such that harvesting was initiated in 1967. The herd now numbers between 200 and 300 animals, and an annual harvest is made in an attempt to maintain it at a summer level of 200. Caribou range over the entire island. The lack of biting insects, low population, and abundant forage allows them to reach tremendous size and they are now considered to be the largest caribou in North America. One adult male shot in September 1968 weighed 700 pounds.

There are between 2,500 and 3,500 reindeer on Atka Island. The animals were introduced there in 1914. They are harvested mostly by the Atkans, although hunting groups from Adak have hunted them in the past few years. There is no closed hunting season or limit on this herd, but fewer than 200 are harvested each year.

b. Fox; Ancestrally, the blue fox was native to the Commander Islands and to Attu (Bancroft, 1886), and red foxes, in the various color phases, were native to the Fox Group (Berkh, 1823). The origin of the remaining foxes, mostly blue, on the intervening islands has been in doubt. The earliest records do not specifically provide an answer, but the listings of the early fur cargoes shipped to Russia (before the organization of the Russian-American Company) are significant in that some include Arctic foxes, others various phases of the red fox, and a total absence of all types of foxes in still others (Bancroft 1886; Berkh, 1823).

By 1936 the Aleutian Islands National Wildlife Refuge had actually become a large fox farm with 70 islands having produced 25,641 pelts, valued at $1,162,826. New policies governing refuge fox-farming permits were adopted in 1937 once it was recognized that fox farming was not in accord with refuge purposes. The essential feature of the new policies was the revocation of certain existing permits to protect the wildlife of particular islands. Introduction of these policies was subsequent to a declining fur market, for fox fur prices had declined steadily, after 1929 and had reached a point where many pelts could not be sold. Trapping activities were ended in the Aleutians by World War II. Since the end of the War, trapping was conducted on a major scale only in 1947, but no market existed for the furs.

By the late 1940's, all the major islands and nearly all of the smaller ones were inhabited by foxes. Because of its effectiveness as a ground predator, the fox substantially reduced the islands bird populations. In re-establishing the Aleutian Canada goose to its former ranges, it was necessary to eliminate the fox from Amchitka Island and substantially reduce its numbers on Agattu. Other than these two islands, fox populations have been little affected in the Chain. No plans have been formulated for future fox eradication.

c. Other mammals: The Norway rat has been introduced into all of the larger human settlements. On Amchitka it thrives along the rocky shorelines, but not necessarily away from human habitations. The rat was so abundant at Atka village that gardens were not possible, forcing the villagers to plant their gardens on adjacent Amlia.

Collared lemmings are reported from no further west than Umnak Island. Meadow mice are also found in this range and ground squirrels have been introduced and established on Unalaska, Umnak, and Kavalga Islands.

2. Marine Mammals

a. Sea Otter: This marine mammal inhabits shallow coastal waters that are generally no greater than 40 fathoms in depth. Sea otters are most abundant where extensive kelp beds occur, although they can be found in open ocean up to 30 miles or more offshore. Their primary food is marine invertebrates or bottom fish. Studies have indicated that abundance of food is a primary factor limiting most sea otter populations.

This animal is unafraid of humans, and therefore highly susceptible to hunting. Sea otters once inhabited the entire refuge area, but the early Russian period of exploitation which extended from 1742 to 1799 resulted in a decimation of sea otter populations throughout the Aleutian Islands. Early Russian fur hunters were hunting sea otter in the Aleutian Islands nearly a century before trappers roamed the Rocky Mountains in quest of beaver (Lensink, 1957). Based on harvest data, Lensink (1957) estimates a population of about 75,000 animals for the period 1770 to 1777, compared with an estimated 38,000 today. The heyday of the sea otter trade ended about 1825 although remnant otter populations still yielded between 1,000 and 2,000 pelts annually.

The acquisition of Alaska in 1867 by the U.S. opened a new era of sea otter hunting. During the next 40 years enough sea otter pelts were harvested to exceed in value the $7,200,000 cost of the purchase. This extensive hunting, over a period of 170 years, by the Russians, Europeans, and finally the Americans resulted in near extermination of the sea otter.

In 1911, the sea otter was placed under the protection of an international convention subscribed to by the United States, Russia, Japan, and Great Britain. As a result of the protection guaranteed under this convention, a gradual recovery of the population has occurred from small remant groups that survived the various onslaughts of the fur hunters. By 1936 sea otters had been observed in nearly all of the areas that they are recorded in today (Lensink, 1957).

Transplants of sea otters to other habitats were initiated in 1951 by the BSF&W in hopes that the new breeding colonies would survive and become established, and serve as centers from which the animals could disperse throughout their original range.

The early transplant attempts failed. The first success was in 1959 when 7 animals were successfully transplanted to St. Paul Island from Amchitka. Some of these were reported to have survived for 2 years. Subsequent transplants were carried out in 1965 and 1966 by the Alaska Department of Fish and Game in cooperation with the AEC and BSF&W. In 1968, a total of 359 sea otters was transplanted to six different locations in Southeast Alaska and one location in the Pribilof Islands. A similar transplant operation involving 160 animals was conducted in 1969 with the animals relocated to Southeast Alaska, Washington state and British Columbia. Four of these animals were donated to the Point Defiance Aquarium in Tacoma, Washington.

In 1970, 50 more animals were transplanted from Amchitka, 30 to the Washington coast and 20 to the Oregon coast. Between 1967 and July 1970, nearly 1,250 sea otters were transplanted from Amchitka. This number included losses during capture and handling, in harvest and for experimental use.

The sea otter is presently distributed throughout the Aleutian Islands, being more common in the Sanak area, the Central Andreanofs, the Delarof and Rat Island Groups. The Alaska Department of Fish and Game (1973) estimated the sea otter population of Alaska in excess of 90,000 animals. The estimate for the Aleutian Islands, including Amak and Sanak Islands, is approximately 65,400-78,400. Thus sea otters are second in abundance only to sea lions in the Aleutians.

Sanak Island Group

Sea otters were reported in this group of islands in low numbers as early as 1922 by McCracken (1957). Surveys in the late 1950's and early 1960's indicated a substantial population in the group and the population has been expanding since. Sea otters are distributed from the south shore of Unimak Island to the Pavlof Islands, including offshore islands. The

Alaska Department of Fish and Game estimates from 2,000 to 4,000 animals in this area. Continued growth in this population is expected to contribute significantly to the repopulation of the remainder of the Fox Island Group.

Unimak-Amak Islands

The Bering Sea area north of Unimak Island and in the vicinity of Amak Island is quite shallow with depths of 20 fathoms or less out to about 8 miles from the shore, and with the 30-fathom contour extending to about 15 miles offshore. These shallow waters extend northwesterly along the Alaska Peninsula and into the Bristol Bay area, and their exposure to the elements provides little shelter for sea otters. The animals in this area seldom come ashore but have been seen up to 26 miles offshore. At least 4,000 otters are estimated for this area and there is a good possibility there may be many more. Because of its vastness the area is difficult to survey. One pod of 1,000 sea otters was noted just immediately north of Unimak Island. It is felt that this population along with that in the Sanak Island-Sandman Reef area may also be significant in the repopulation of the remainder of the Fox Island Group.

Fox Islands

Although a great deal of sea otter habitat exists in this group, there are at present few sea otters with the population estimated at about 300. Because of this scarcity of sea otters, but with the availability of good sea otter habitat, it is felt that the populations from the Unimak-Amak and Sanak-Sandman Reef areas will gradually move eastward, thereby repopulating the Fox Island Group.

Islands of Four Mountains

Due to the isolation of this area, very few observations have been made in the past. The first sea otter sighting was in 1969, but the 1972 Bureau expedition to the islands indicated no otters even though the survey was made under optimum field conditions. There is no significant population within the group, but it is felt that with an increase in population in the Eastern Andreanofs the population of the Islands of Four Mountains may build up through a period of time. Sea otter habitat is definitely lacking in this area and will most certainly limit the population.

Andreanof Island Group (excluding the Delarof Group)

The Andreanof Islands contain large areas of good sea otter habitat. Early harvesting activities had reduced the sea otter population in this group to near extinction. Karl Schneider (1972) lists the repopulation of the Andreanofs in a step-wise manner: "Tanaga probably was populated by excess animals from the Delarof Islands in the 1930's. When Tanaga's population reached a peak, large numbers then moved to Kanaga. Kanaga's population peaked, then animals moved to Adak. In this way, each island from east to west has had a rapid increase, then a decline as the animals moved to the next island. At present this spearhead of expansion has reached the west end of Atka Island. Smaller numbers have been found on the south side of Atka and Amlia Islands and around Seguam Island."

The Alaska Department of Fish and Game (1973) estimates the population of the Andreanofs from 36,000 to 38,000 animals. It is felt that the populations in the Andreanof Islands now equal or exceed those prior to the Russian period.

Delarof Island Group

This group of islands contains an area of excellent sea otter habitat. It has extensive shallow marine waters interspersed with many submerged or partially submerged rocks. Russian exploitation reduced the population of these islands to a low level. Kenyon (1969) notes that following this heavy harvest, these were among the first of the Aleutians to be repopulated. Kenyon further estimates that the population peak was in 1930-40 and that this peak population enabled the migration to Tanaga Island to take place, thereby repopulating Tanaga, Kanaga, and Adak.

Rat Island Group

The Rat Islands also contain much excellent sea otter habitat. Again, Russian exploitation reduced the population levels of sea otter in this group to a very low level. Recovery from these low levels peaked in the mid-1930's. It is felt that by 1947 the Amchitka population had exceeded the carrying capacity of the marine habitat and that the population then declined because of over-utilization of the otter's food resources. The Alaska Department of Fish and Game (1973) estimates at the present population of the Rat and Delarof Island Groups from 23,000 to 32,000 animals. Studies conducted on Amchitka by various agencies and universities have indicated that the islands reached their maximum carrying capacity in the 1930's and it is postulated that the pre-Russian sea otter population was not significantly larger than at present.

Near Island Group

Historical records indicate excellent sea otter populations in pre-Russian days. It is thought that the otters were probably exterminated in 1900.

None were found during the U.S. Navy's Alaska Survey Expedition of 1932.

Recent surveys in this group indicate at least 25 sea otters on Attu Island in the area of Chichagof Harbor, and 6 sea otters in Otkriti Bay on Agattu Island. The Alaska Department of Fish and Game (1973) estimates the population at about 100 animals and they feel that the area has potential to sustain a population of 4,000 to 5,000 animals.

b. Northern Sea Lion

The northern or Steller's sea lion is the most abundant pinniped in the Aleutian Islands. Kenyon and Rice (1961) consider the Chain to be the center of abundance for this species and estimate the population level at 100,205 animals (Table 6 and Figures 37 to 45). Sea lions are distributed throughout the area with concentrations at Ugamak, Akutan, Agattu, and Attu Islands. The Alaska Department of Fish and Game (1973) feels that the present population is near the maximum carrying capacity of the area.

These marine mammals flourish in remote island areas which contain extensive clear shallow water, rocky bottoms, and abundant fish life. Although they will range widely in search of food waters of less than 50 fathoms are favored. Offshore rocks, small islets, exposed points, and sandy or rocky beaches are used for hauling grounds and rookeries. Refuge areas above the line of mean high tide are also commonly used.

c. Harbor Seal

These marine mammals are common throughout the Aleutian Islands, but are not so numerous as on the Alaska Peninsula. Harbor seals are commonly

Table 6. Steller Sea Lion Populations in the Aleutian Islands

Map Ref. No.	Location of Hauling Ground or Rookery	Estimated Number of Sea Lions 1959 (Kenyon & Rice, 1961)	1965 (Kenyon & King, 1965)	Sekora (1969-72)
	NEAR ISLANDS			
1	Attu (Cape Wrangell)	5,000	4,000	6,900
2	" (Chirikof Point)	10		1,500
2a	" (south side)			85
2b	" (Chichagof Harbor)			900
3	Agattu (Gillan Point)	3,000		750
4	" (Otkriti Bay)	100	1,300	
5	" (Cape Sabak)	3,300		8,635
6	Alaid (west end)	1,500	2,500	2,500
7	Shemya (rocks off north shore)	2,500	2,000	650
	RAT ISLANDS			
8	Buldir (south shore)	2,500	3,500	4,350
9	Kiska (Cape St. Stephen)	1,000		
10	" (Vega Point)	400	1,485	
10a	" (Sirius Point)			65
11	Tanadak	50		
11a	Segula (Gula Point)			133
11b	" (Chugul Point)			115
11c	Little Sitkin (Patterson Point)			335
12	Rat Island (eastern point)	750	650	305
13	Amchitka (Bird Rock)	50		
14	" (islet off Chitka Point)	50		
15	" (Ivakin Point)	300	710	750
16	" (East Cape)	200		
17	" (St. Makarius Islet)	50		
18	" (southwest islets and rocks)	600		
19	Semisopochnoi (rocks off SW shore)	500		0
20	" (Pochnoi Point)	2,000	1,100	1,120
20a	" (northern shore)			50
	DELAROF ISLANDS			
21	Amatignak (Nitrof Point)	200	0	1
22	" (Knob Point)	50	0	0
23	Unalga (Dinkum Rocks)	350	520	0
24	Ulak (south point)	1,500	300	1,195
25	Gareloi (south shore)	2,500	100	0
25a	" (north shore)			165
26	Skagul (rocks off south point)	500		2
27	Tag Island	400	100	1,412
28	Ugidak	400		0
29	Gramp Rock	700	75	

Table 6 (cont.) Steller Sea Lion Populations in the Aleutian Islands

Map Ref. No.	Location of Hauling Ground or Rookery	Estimated Number of Sea Lions 1959 (Kenyon & Rice, 1961)	1965 (Kenyon & King, 1965)	Sekora (1969-72)
	ANDREANOF ISLANDS			
30	Tanaga (Sasmik Cape)	75		
31	" (north side of Cape Sajaka)	100	130	356
31a	Kanaga (Cape Miga)			260
32	Adak (Argonne Point)	1,000		0
33	" (Hook Point)	1,500		20
34	" (Cape Yakak)	800	610	
34a	" (Luke Point)			700
35	" (rock off Cape Moffett)	50		6
36	Little Tanaga (Tana Point)	450	281	
37	Great Sitkin (Swallow Head)	650		440
38	Anagaksik	700	475	145
39	Igitkin (southwest point)	700		
39a	Oglodak (west end)			55
40	Kasatochi (north point)	200		1,200
40a	Koniuji (northern point)			15
41	Ikiginak	500		0
42	Atka (North Cape)	550		
43	" (Cape Korovin)	100	4,900	
44	Salt Island	100		
45	Sagchudak	1,200		360
46	Amtagis	800		
47	Amlia (Cape Misty)	750		
48	" (rocks in Sviechnikof Harbor)	800	3,700	
49	" (Agligadak Point)	700		
50	Sagigik	100		
51	Tanadak	20		260
52	Agligadak	250		120
53	Seguam (southwest point)	150		125
54	" (Lava Point)	150		640
55	" (Wharf Point)	100	4,400	233
55a	" (Moundhill Point)			169
56	" (Saddle Ridge Point)	25		35
56a	" (southwestern point)			125
57	Amukta (High Rock and adjacent rocks)	600		
58	" (Amukta Point)	150		
59	Chagulak (Chagulak Point)	100		120
60	Yunaska (east shore)	800	350	895
	ISLANDS OF FOUR MOUNTAINS			
61	Carlisle Island (northwest point)	100	250	175
61a	Herbert (west and south sides)			125
62	Chuginadak (Concord Point)	700		341
63	Uliaga (northwest shore)	500		400
64	Kagamil (north point)	75		20

Table 6 (cont.) Steller Sea Lion Populations in the Aleutian Islands

Map Ref. No.	Location of Hauling Ground or Rookery	Estimated Number of Sea Lions 1959 (Kenyon & Rice, 1961)	1965 (Kenyon & King, 1965)	Sekora (1969-72)
	FOX ISLANDS			
65	Adugak	1,000	400	
66	Ogchul	2,000		
67	Umnak (Cape Aslik)	450		
68	" (Cape Idak)	600		
69	Unalaska (Point Tebenkof)	200		
70	" (Cape Starichkof)	100		
71	" (Spray Cape)	200		
72	" (Cape Izigan)	150		
73	" (Whalebone Cape)	1,000		
74	" (Cape Kalekta)	10		
75	Bogoslof	1,000		
76	Fire Island	100		
77	Akutan (Lava Point)	6,520		
78	" (Lava Bight to Reef Bight)	200		
79	" (Flat Bight)	2,000		
80	" (Cape Morgan)	7,000		
81	Akun (Akun Head)	2,000		
82	" (Billing's Head)	100		
83	Tanginak	600		
84	Tigalda (rock off west end)	10	650	
85	" (rock off northeast end)	750		
86	Ugamak (west end)	400	10,975	
87	" (southeast point)	1,500		
88	" (northeast point)	10,000		
89	" (north point)	1,000		
90	" (northwest point)	500		
91	Aiktak	600	100	
92	Round Island	6,000		
93	Unimak (Oksenof Point)	4,000		4,000
94	" (Cape Sarichef)	200	810	300
	AMAK GROUP			
95	Amak	350	4,100	7,500
96	Sea Lion Rock	2,000		
	SANAK GROUP			
97	South Rock	1,000		1,200
	SANDMAN REEFS			
98	Clubbing Rocks	200		
	TOTAL ON LAND	99,745		49,011
	TOTAL IN WATER	460		
	GRAND TOTAL	100,205		49,011

Preliminary - Subject to change

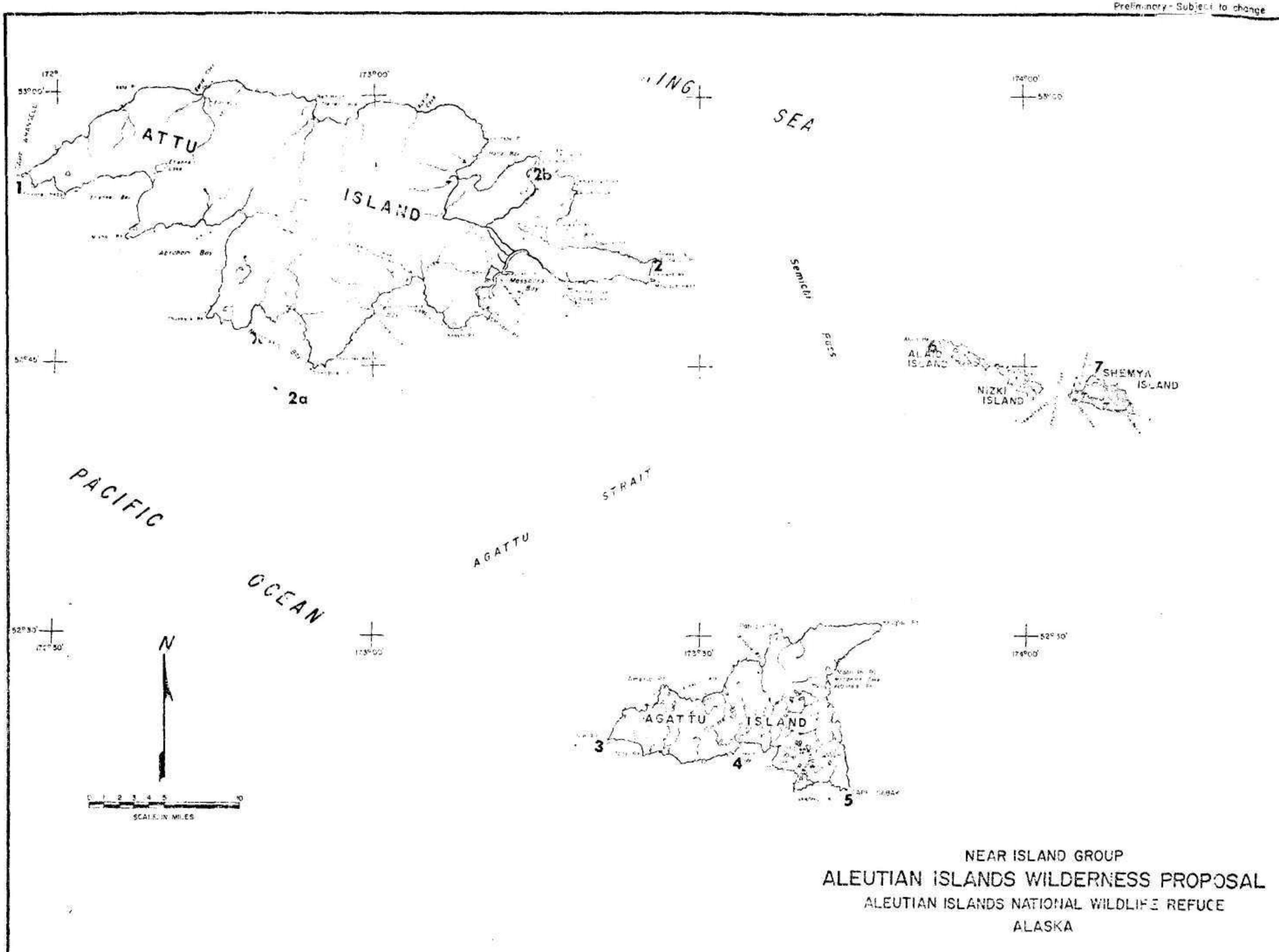


Figure 37. Sea Lion Populations

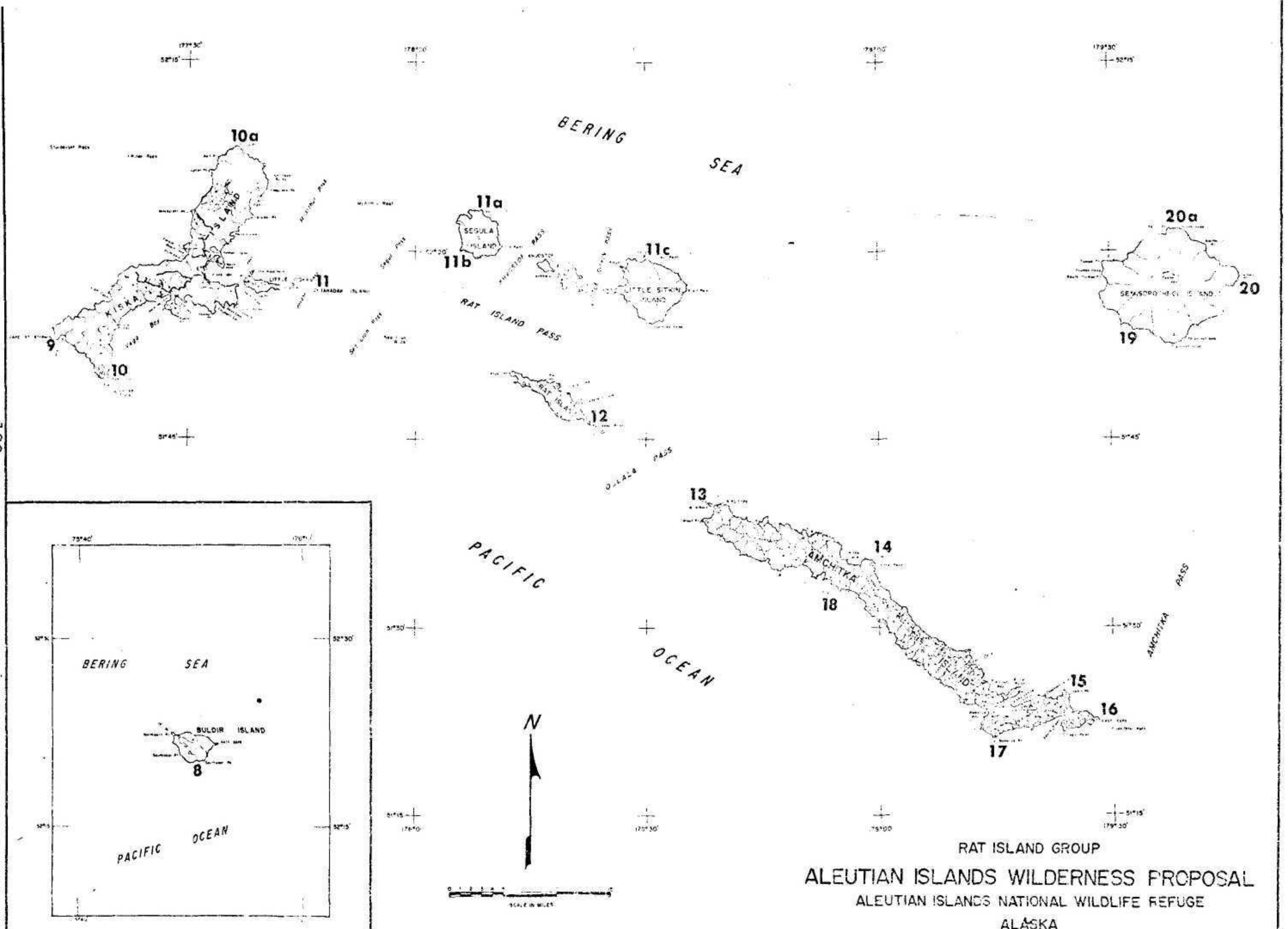


Figure 38. Sea Lion Populations

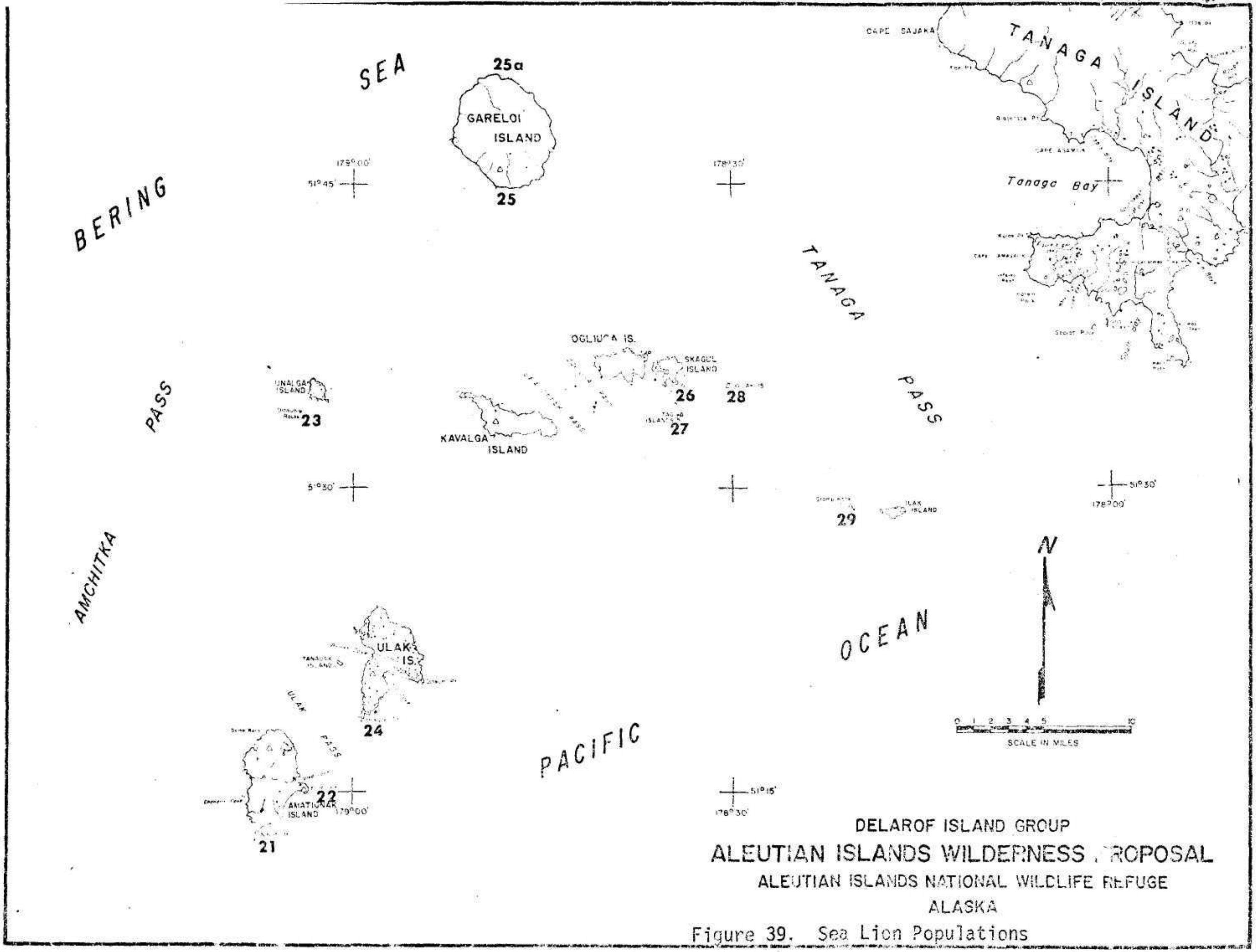
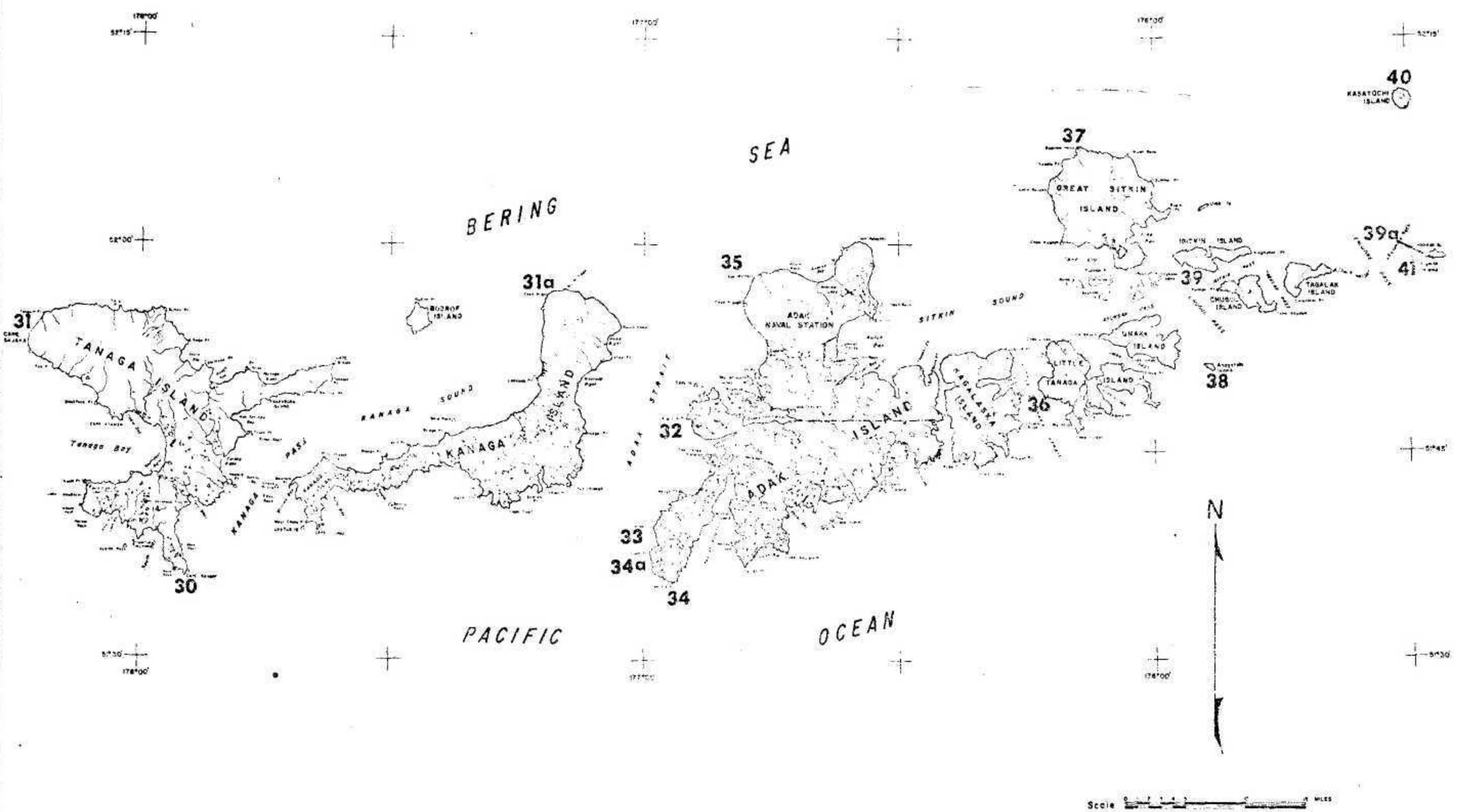


Figure 39. Sea Lion Populations



WESTERN ANDREANOF ISLAND GROUP

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 40. Sea Lion Populations

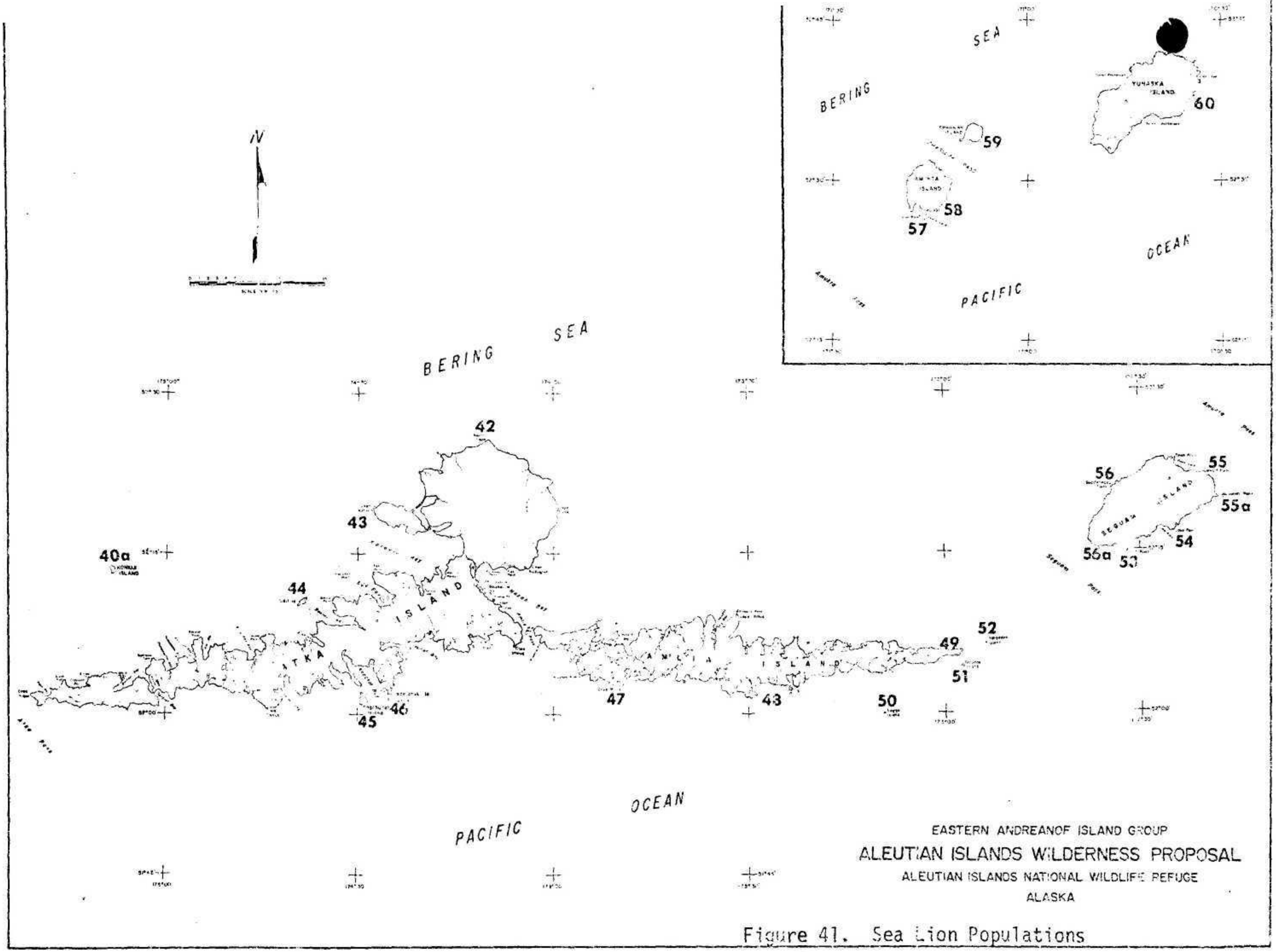


Figure 41. Sea Lion Populations

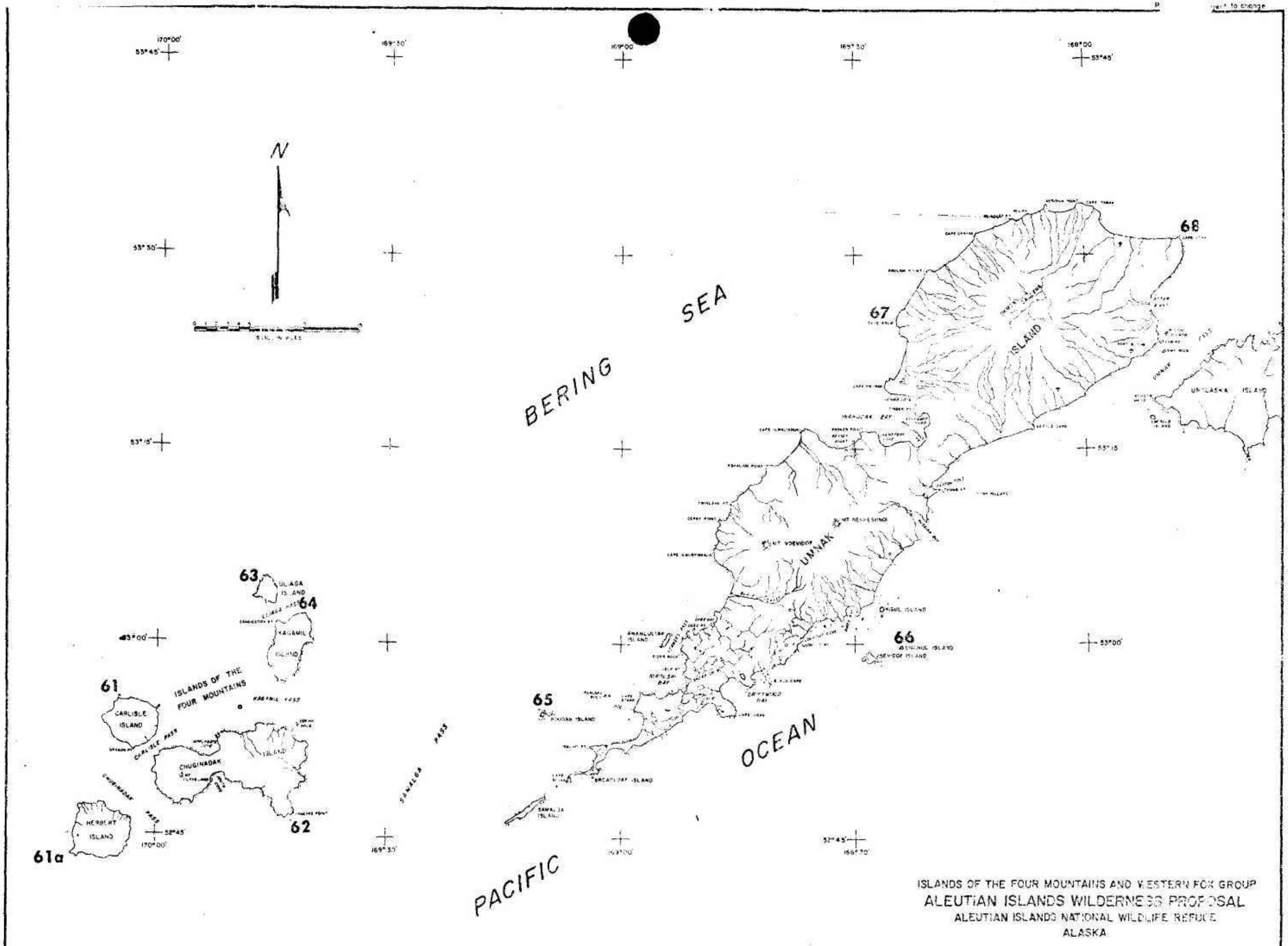


Figure 42. Sea Lion Populations.

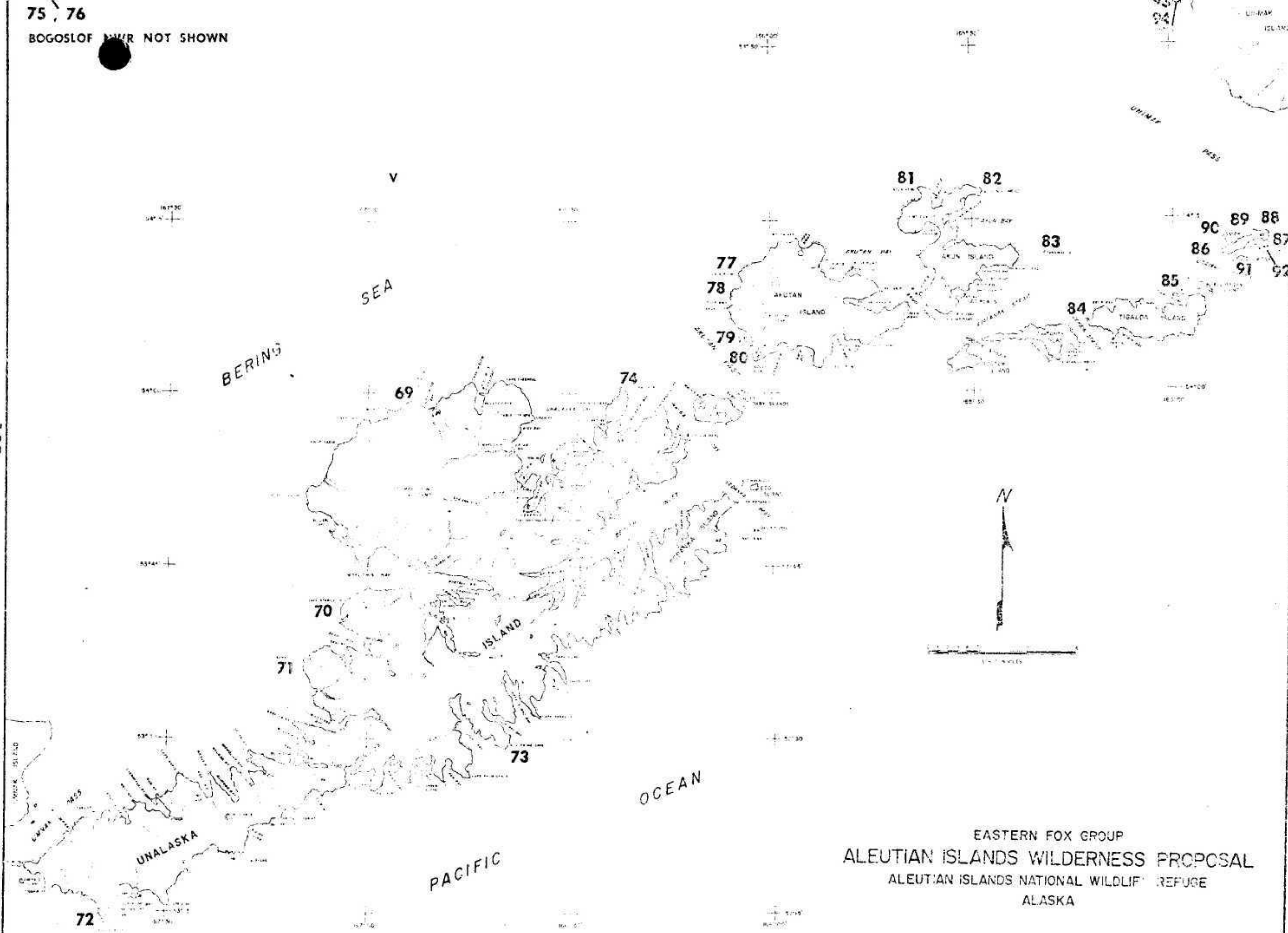


Figure 43. Sea Lion Populations

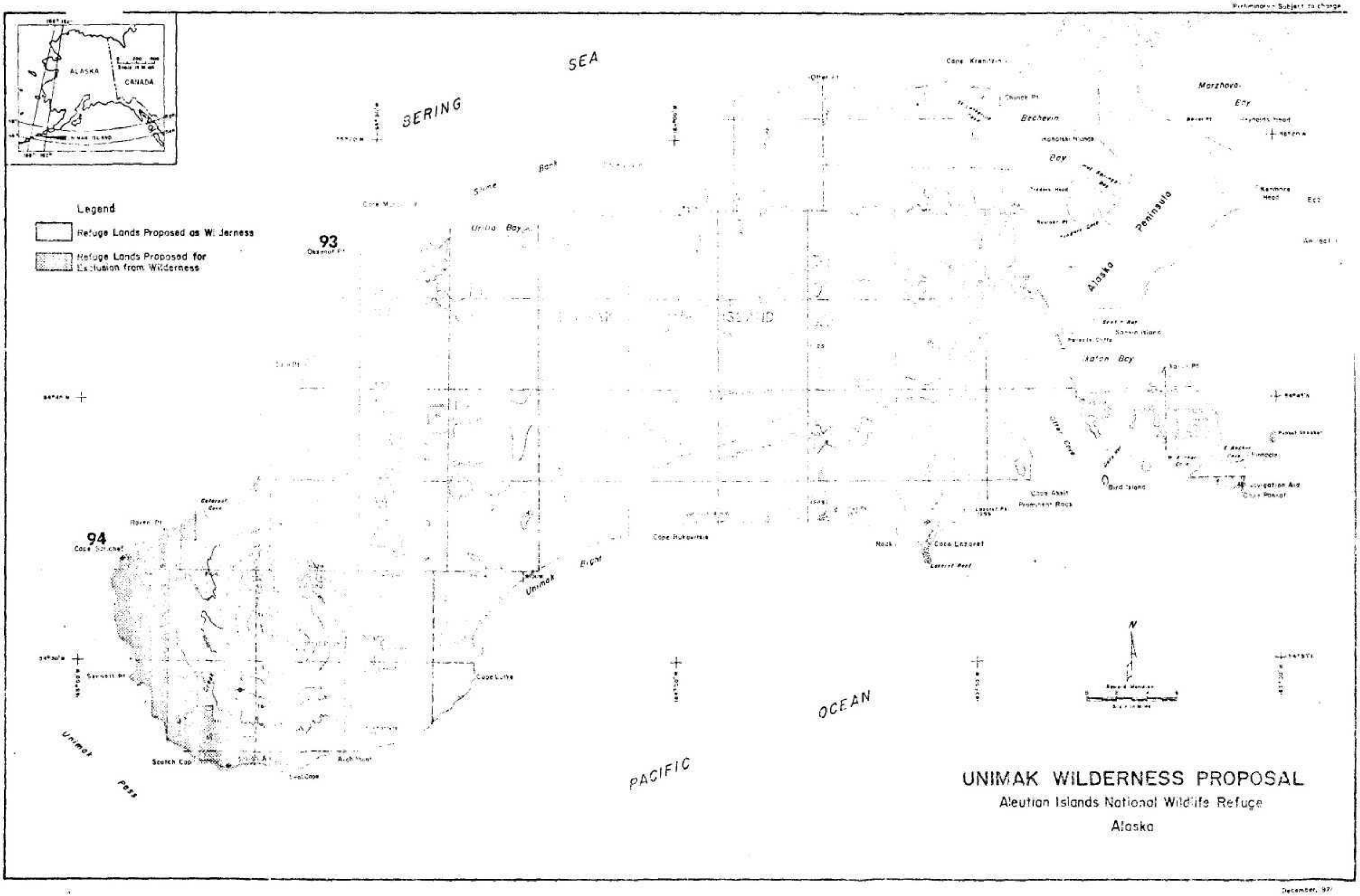
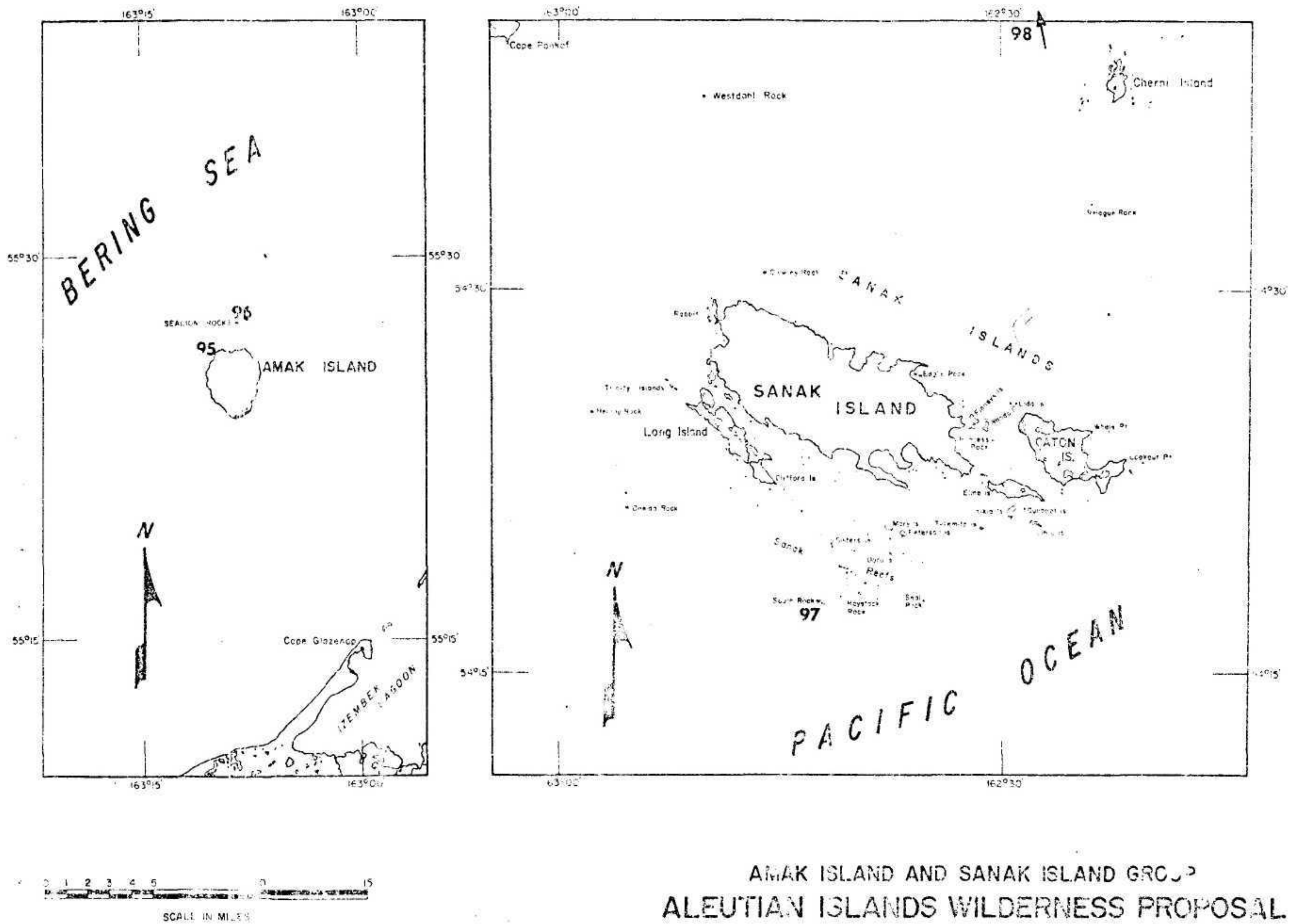


Figure 44. Sea Lion Populations



AMAK ISLAND AND SANAK ISLAND GROUP

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 45. Sea Lion Populations

found in waters less than 30 fathoms deep, and, unlike sea otters and sea lions, occupy both clear and turbid waters. Haulout areas are usually offshore rocks and sandbars, sand beaches, and large rock outcrops.

No total population estimates have been made for the Aleutian Islands. Karl W. Kenyon (Letter of December 8, 1964 from Karl W. Kenyon, BSF&W to Refuge Supervisor David Spencer, BSF&W) made estimates of harbor seals during aerial surveys of sea otters in the Chain (Table 7.).

d. Northern Fur Seal. The annual migration of northern fur seals occurs in waters adjacent to the Aleutian Islands. This fur seal breeds on St. Paul and St. George Islands, and Sea Lion Rock on the Pribilof Islands, approximately 210 miles north of the Chain. Rookeries also exist on the Copper and Bering Islands of the Commander Islands (USSR) and Robben Island (USSR), off Sakhalin. Baker, Wilke, and Balzo (1963) indicate that scientists believe that a third or more of the fur seals found off Japan's coast in winter and spring come from the Pribilofs. It appears highly probable that many of these animals pass through the western Aleutians in their travels. Fur seals migrating to their central California wintering grounds commonly use Unimak Pass in passing through the Aleutians.

Fur seals *rarely return* to land during their migration. One notable exception was the sighting of 100 bachelors hauled out on Samalga Island in 1947. Henry Swanson (Personnel communication, 1969) of Unalaska reports 300 adult fur seals hauled out on the eastern end of Samalga for a period of two weeks, July 15-30, 1939. There are no known regular haul-out

Table 7. Harbor Seals Estimated in Certain Alaska Areas (Karl W. Kenyon)

Date	Location	Method[1]	Field Estimate	Guess Total
19 May 1959	Near Islands	AS	None	2,000[2]
19 May 1962	Amchitka I.	SS	770	1,200[2]
19 May 1959	All other Rat I.	AS	None	1,600[2]
19 May 1959	Delarof I.	AS	None	1,000[2]
19 May 1959	Andreanof I.	AS	None	7,000[2]
3 Mar 1960	Islands of Four Mtns.	AS	140	1,000
3-4 Mar 1960	Fox Islands (+ Amak I)	AS	2,526	10,000
10 Apr 1962	Sanak-Sandman Reef area	AS	3,000	5,000
July 1964	Izembek Bay	SS	700	700[3]
June 1960	Simeonof Island	SS	450	1,500
April 1962	Remainder Shumagin I.	AS	None	3,000
Totals			7,586	34,000

Probably not fewer than 15,000
Probably not more than 50,000

[1]AS = aerial survey; SS = surface survey

[2]No estimates recorded during survey. Total estimated on basis of general field observation after survey.

[3]Shoreline counts and estimates in sample areas. Izembek Bay data from C. Peter McRoy.

areas or rookeries in the Aleutians. The possibility does exist, however, but because of the Chain's inaccessibility and the lack of observers, it may be a long time before this can be definitely determined.

e. Pacific Walrus. Sightings of Pacific walrus in the Aleutian Islands are restricted to the area around Amak Island and False Pass. Prior to this century, walrus hauled out regularly on Amak Island and it probably constituted the major source of ivory for Aleuts prior to 1741. The population was subsequently exploited until walrus nearly disappeared from the area. Kenyon recorded about 100 adult male walrus hauled out on the east shore of Amak Island on April 8, 1962. On May 8, 1965, he saw 5 walrus near the west shore of Amak and an additional 75 off Cape Glazenap near Izembek Lagoon. During the winter of 1968-69, the Alaska Department of Fish and Game noted approximately 100 walrus in the waters near Amak. Live Pacific walrus have been sighted in False Pass and carcasses are not uncommon on the Bering Sea beaches of Unimak Island.

Occurrence of walrus further west in the Aleutian Islands would be expected only during years of extreme southern movement of the ice pack.

f. Whales. Whales commonly occur in the marine waters throughout the length of the Chain (Nishiwaki, 1967 and Evans and Rice, 1972). Although not within refuge boundaries, whales are considered to be within the realm of the refuge because they are affected by the status of the adjacent land mass, i.e., the extent of its contamination or development.

The endangered blue whale, largest mammal on earth, occurs in the North Pacific principally in the area southeast of the Aleutian Islands. Rarely are they found in the Bering Sea. Another baleen whale, the fin whale, is widely distributed in the Pacific Ocean and is found as far north as the Aleutians. The endangered sei whale is also found south of the Chain but rarely north of it. The minke whale is considered to be one of the most widely distributed whales in the eastern Pacific. Their summer range extends from the Bering and Chukchi Seas south to Central Mexico. Their range in the Chain is unknown, although they are considered abundant in Alaskan waters.

The right whale is found on both sides of the Chain but in relatively low numbers. The endangered gray whale can be seen traveling through the Aleutians to and from the Bering and Chukchi Seas and its breeding grounds in Baja California. The endangered humpback whale is found primarily in the eastern North Pacific south of the Chain. The commercially valuable and endangered sperm whale is widely distributed during the summer months in the North Pacific, and is found both north and south of the Aleutians. Its major summering grounds are in the southwestern Bering Sea. The giant bottlenose whale or Baird's beaked whale is recorded as occurring but not commonly seen. The goose-beaked whale or Cuvier's beaked whale occurs from the Bering Sea south to the tip of Baja California and is recorded as probably more abundant than other whales in the eastern North Pacific. The Bering Sea beaked whale ranges from Oregon to the Bering Sea but its Aleutian distribution is unknown.

The killer whale is considered to be the most abundant whale in the Aleutians. The short-finned pilot whales are distributed in the temperate seas of the eastern North Pacific. The records do not consider them in the Aleutian Islands except for a single record from the Alaska Peninsula, though BSF&W recorded them as common at Adak, especially in the Bay of Islands and in the harbor area.

The Pacific white-sided dolphin occurs principally in the eastern Aleutians, but is uncommon and often confused with Dall's porpoise which is abundant throughout the Aleutian Islands. Dall's porpoise is also commonly found throughout the eastern Pacific Ocean from the Aleutian Islands to Baja California. Distribution of the harbor porpoise in the eastern Aleutians is unknown, although it ranges from California to Point Barrow. This porpoise may be abundant in the Bering Sea, although little is known about the animal.

g. Steller's Sea Cow. Although extinct, this marine mammal is now known to have occurred in the waters of the western Aleutians. Gard, Lewis and Whitmore (1972) report the finding of Steller's sea cow bones in interglacial beach sand and gravel in South Bight on Amchitka Island. Dating indicated an age of about 135,000 years. Their records also indicate that a rib of a Steller's sea cow was found on Attu in 1842 or 1843 by a Russian, Ilia G. Wosnesenski. The finding of this rib does not prove conclusively that the animal once existed there, but the supporting evidence from Amchitka makes it quite probable. These are the only two records of this sea mammal's existence in other than the Commander Islands off Siberia.

Table 8. A list of those mammals observed on the Aleutian Islands National Wildlife Refuge or in adjacent waters. Common and scientific names follow Miller and Kellogg, List of North American Recent Mammals, 1955, U. S. National Museum Bulletin 205.

Order INSECTIVORA	
Cinereous shrew	Sorex cinereus
Dusky shrew	S. obscurus
Order RODENTIA	
*Ground squirrel	Citellus parryii
Collared lemming	Dicrostonyx hudsonius
Meadow mouse	Microtus oeconomus
Norway rat	Rattus norvegicus
Jumping mouse	Zapus hudsonius
Order CETACEA	
Suborder ODONTOCETI (toothed whales)	
Giant bottlenose whale	Berardius bairdi
Bering Sea beaked whale	Mesoplodon stejnegeri
Culver's beaked whale	Ziphius cavirostris
+Sperm whale	Physeter catodon
Pacific white-sided dolphin	Lagenorhynchus obliquidens
Killer whale	Grampus rectipinna
Short-finned pilot whale	Globicephala macrorhyncha
Harbor porpoise	Phocoena sinus
Dall's porpoise	Phocoenoides dalli
Suborder MYSTICETI (baleen whales)	
+Gray whale	Eschrichtius robustus
Fin whale	Balaenoptera physalus
+Sei whale	B. borealis
Minke whale	B. acutorostrata
+Blue whale	B. musculus
+Humpback whale	Megaptera novaeangliae
Right whale	Balaena glacialis
Order CARNIVORA	
*Wolf	Canis lupus
Arctic fox	Alopex lagopus
Red fox	Vulpes fulva
*Brown bear	Ursus arctos
*Weasel	Mustela erminea
*Least weasel	M. rixosa
*Wolverine	Gulo luscus
Otter	Lutra canadensis
Sea otter	Enhydra lutris

Order PINNIPEDIA

Northern fur seal	*Callorhinus ursinus*
Northern sea lion	*Eumetopias jubata*
Pacific walrus	*Odobenus rosmarus*
Harbor seal	*Phoca vitulina*

Order SIRENIA

Steller's sea cow (extinct)	*Rhytina stelleri*

Order ARTIODACTYLA

*Barren-ground caribou	*Rangifer arcticus*
Reindeer	*R. tarandus*

*Natural western limit occurs on Unimak Island

+Endangered species

C. Fish

Sockeye, chum, pink, and coho salmon all use Aleutian Island freshwater streams for spawning. Major runs occur on Unimak, Unalaska, and Attu Islands. Total contribution of this fishery is unknown since time, remoteness, and adverse weather have precluded surveys. Pink and chum salmon are thought to be most common, with coho and sockeye least abundant. Although king salmon occur offshore there are no recent records of their spawning in the Aleutians. The sea-run Dolly Varden trout is present in most freshwater streams throughout the chain.

Of great significance is the use of marine waters in the Aleutian's by large numbers of migrating salmon. Hartt (1966) reports that tag returns and associated data indicate that pink salmon occupying Aleutian waters are from three principal sources, i.e., East Kamchatka, Northwest Alaska, and the Aleutian Islands. Chum salmon found in the Aleutian waters are thought to originate from the coast of Asia between Hokkaido and the Anadyr River, from Kotzebue Sound to Unimak Island in Alaska, and from nearby Aleutian Islands. Red salmon are mostly from western Alaska, principally Bristol Bay, with the balance from Kamchatka.

Salmon originating in areas other than those mentioned above are relatively rare in the Bering Sea or within 50 miles of the southern Aleutian Islands. Comparison of purse seine catches has revealed that all species tend to move westward along the south side of the Aleutian Chain, with those destined for the coastal areas of the Bering Sea turning northward through the various Aleutian passes and then eastward or westward in the Bering Sea towards their rivers of origin. Hartt (1966) notes the following sequence in Aleutian waters: The number appear to be low prior to June 1st after which the mature red, chum, and pink salmon begin to appear in increasing numbers. This builds up to a peak and declines by early July with some variation by species and geographic location. With the decline of mature salmon, immature red and chum salmon begin to appear in varying abundance until September or later.

Silver and king salmon, and steelhead trout also occupy the Aleutian waters but in relatively small numbers. Tag returns indicate very long migrations. Four silver salmon that were tagged south of Atka and Adak Islands were returned from the Kamchatka River, a distance of 900 miles. One king salmon tagged south of Adak in 1956 was recovered in the Salmon River, Idaho, in 1957, having come by the way of the Columbia River. The minimum distance traveled by this fish was 2,400 miles. One steelhead tagged south of Atka was recovered in Chahalus River, Washington, a distance of approximately 2,000 miles.

The following is a list of fishes commonly found in adjacent marine waters which are of economic importance and are harvested by foreign fishery fleets. Common and scientific names follow Bailey et.al. (1970) American Fisheries Society, Special Publication No. 6.

Table 9. Salt Water Fish Commercially Harvested by Foreign Fishery Fleets

COMMON NAME	OTHER COMMON NAMES	SCIENTIFIC NAME
Blackcod	Sablefish	Anoplopoma fimbria
Chinook salmon	King salmon	Oncorhynchus tschawytscha
Chum salmon	Dog salmon	Oncorhynchus keta
Coho salmon	Silver salmon	Oncorhynchus kisutch
Dover sole		Microstomus pacificus
English sole	Lemon sole	Parophrys vetulus
Flathead sole		Hippoglossoides classodon

Table cont.

ON NAME	OTHER COMMON NAMES	SCIENTIFIC NAME
Halibut	Pacific halibut	Hippoglossus stenolepis
Herring	Pacific herring	Clupea harengus pallasii
King crab		Paralithodes camtschatica
Lingcod		Ophiodon elongatus
Masu salmon	Cherry salmon	Oncorhynchus masou
Pacific cod	True cod	Gadus macrocephalus
Pacific ocean perch		Sebastodes alutus
Petrale sole	Brill	Eopsetta jordani
Pink salmon	Humpback salmon	Oncorhynchus gorbuscha
Pollock	Pacific pollock, Walleye pollock, whiting	Theragra chalcogrammus
R le		Glyptocephalus zachirus
Rock sole		Lepidopsetta bilineata
Shrimp	Pink shrimp	Pandalus borealis
Sockeye salmon	Red salmon	Oncorhynchus nerka
Starry flounder		Platichthys stellatus
Turbot	Arrowtooth flounder	Atheresthes stomias
Yellowfin sole		Limanda aspera

The following list of inshore fishes collected at Amchitka by the Fisheries Research Institute, University of Washington is included as an indication of the diversity and productivity of a natural inshore fishery. Common and scientific names follow Bailey, et.al.(1970), American Fisheries Society Special Publication No. 6.

Table 10. Inshore Marine Fishes, Amchitka Island

Common Name	Scientific Name
	Class Chondrichthyes
	Order Squaliformes
	Family Lamnidae
Salmon shark	Lamna ditropis
	Order Rajiformes
	Family Rajidae
Roughtail skate	Raja(Bathyraja)trachura
Alaska skate	Raja (B.) parmifera
	Class Osteichthyes
	Order Salmoniformes
	Family Salmonidae
Chum salmon	Oncorhynchus keta
Sockeye salmon	O. nerka
Chinook salmon	O. tshawytscha
Pink salmon	O. gorbuscha
Coho salmon	O. kisutch
Dolly Varden	Salvelinus malma
	Family Bathylagidae
Stout blacksmelt	Bathylagus milleri
California smoothtongue	B. stilbius
	Family Melanostomatidae
Longfin dragonfish	Tactostoma macropus
	Family Chauliodontidae
Pacific viperfish	Chauliodus macouni
	Order Myctophiformes
	Family Alepisauridae
Longnose lancetfish	Alepisaurus ferox
	Family Myctophidae
lifornia headlightfish	Diaphus theta
...rthern lampfish	Stenobrachius leucopsa
------	S. nannochir
------	Hierops thompsoni

Table 10 cont.

Common Name	Scientific Name
	Order Gasterosteiformes
	Family Gasterosteiformes
Threespine stickleback	*Gasterosteus aculeatus*
	Order Gadiformes
	Family Gadidae
Pacific cod	*Gadus macrocephalus*
Walleye pollock	*Theragra chalcogramma*
	Family Corphaenoididae
Roughscale rattail	*Coryphaenoides acrolepis*
	Family Macrouridae
Filamented grenadier	*Coryphaenoides filifera*
	unidentified sp.
	Order Perciformes
	Family Trichodontidae
Pacific sandfish	*Trichodon trichodon*
	Family Bathymasteridae
Northern ronquil	*Ronquilus jordani*
Searcher	*Bathymaster signatus*
Alaskan ronquil	*B. caeruleofasciatus*
	Family Ammodytidae
Pacific sandlance	*Ammodytes hexapterus*
	Family Pholidae
Crescent gunnel	*Pholis laeta*
Strippled gunnel	*P. dolichogaster*
	Family Stichaeidae
Mosshead warbonnet	*Chirolophis nugator*
Trident prickleback	*Gymnoclinus cristulatus*
Whitebarred prickleback	*Poroclinus rothrocki*
Stone cockscomb	*Alectrias alectrolophus*
High cockscomb	*Anoplarchus purpurescens*
Ribbon prickleback	*Phytichthys chirus*
	Family Zaproridae
Prowfish	*Zaprora silenus*
	Family Scorpaenidae
Rougheye rockfish	*Sabastes aleutianus*
Pacific ocean perch	*S. alutus*
Redstripe rockfish	*S. proroger*
Flag rockfish	*S. rubrivinctus*
Northern rockfish	*S. polyspinis*
Dus[illegible]ckfish	*S. ciliatus*
Shc[illegible]ine thornyhead	*Sebastolobus alascanus*

Table 10. cont.

Common Name	Scientific Name
	Family Anoplopomatidae
Sablefish	*Anoplopoma fimbria*
	Family Hexagrammidae
Atka mackerel	*Pleurogrammus monopterygius*
Rock greenling	*Hexagrammos lagocephalus*
Kelp greenling	*H. decagrammus*
	Family Cottidae
Blackfin sculpin	*Malacocottus kincaidi*
	M. zonorus
	Triglops sp.
Spectacled sculpin	*T. scepticus*
Ribbed sculpin	*T. pingeli*
Scissortail sculpin	*T. forficata*
	Hemitripterus villosus
Bigmouth sculpin	*H. bolini*
Yellow Irish Lord	*Hemolepidotus jordani*
Red Irish Lord	*H. hemilepidotus*
Armorhead sculpin	*Gymnocanthus galeatus*
	G. pistilliger
	Myoxocephalus sp.
Great sculpin	*M. polyacanthocephalus*
Calico sculpin	*Clinocottus embryum*
Sharpnose sculpin	*C. acuticeps*
Silverspotted sculpin	*Blepsias cirrhosus*
Slim sculpin	*Radulinus asprelius*
	Icelus canaliculatus
	Family Agonidae
Aleutian alligatorfish	*Aspidophoroides bartoni*
Sturgeon poacher	*Agonus acipenserinus*
Fourhorn poacher	*Hypsagonus quadricornis*
Tubenose poacher	*Pallasina barbata*
	unidentified sp.
	Family Cyclopteridae
Pacific spiny lumpsucker	*Eumicrotremus orbis*
Smooth lumpsucker	*Aptocyclus ventricosus*
	Lethotremus muticus
	unidentified sp.
Smalldisk snailfish	*Careproctus gilberti*
	C. phasma
	Liparis magacephalus
Spotted snailfish	*L. callyodon*
Lobefin snailfish	*Polypera greeni*
Blotched snailfish	*Crystallichthys cyclospilus*

Table 10. Cont.

Common Name	Scientific Name
	Order Pleuronectiformes
	Family Pleuronectidae
Greenland halibut	*Reinhardtius hippoglossoides*
Rock sole	*Lepidopsetta bilineata*
Arrowtooth flounder	*Atheresthes stomias*
Rex sole	*Glyptocephalus zachirus*
Pacific halibut	*Hippoglossus stenolepis*
Flathead sole	*Hippoglossoides elassodon*

D. Water.

A wide diversity of water types is found in the Aleutian Islands, from a great interspersion of lakes and streams, such as on Amchitka, (eastern end) to islands having no fresh (surface) water whatsoever, as is the case of small, rocky islands such as Chagulak and Amak. Actually little is known of such surface waters in the Aleutian Islands because of low demand for water use.

Fresh water can be found either in ponds, lakes, streams or underground. Runoff is moderate in Aleutian lowlands although rather high in the mountain areas. Runoff fluctuates greatly, characterized by peaks after rains and relatively fast recessions. The quality of surface waters is good, and usually meets public health standards for potable water except where human contamination has occurred. Sediment concentration is relatively low in lowland waters, but higher in mountain areas.

Ground water is present in the lowlands, but relatively low amounts are available in mountainous areas and on some low islands.

Near Island Group - Nearly all water types are found in the Near Group. Attu for example contains few lakes but numerous streams the larger of which provide spawning beds for salmon in Temnac, Massacre, Sarana, Holtz, Etienne and Abraham bays, and Chichagof Harbor. Many fresh-water streams deeply dissect the mountainsides and in many places end in waterfalls. These effectively block the upstream passage of any spawning fish.

Within the Near Island Group the Semichi Islands have few streams. Several small shallow lakes are interspersed in the area, however, as is the case with the southeastern portion of Agattu which is covered with lakes and small streams. Agattu's fresh-water streams are relatively small with those in McDonald Cove, Armeria Bight, and Okriti Bay and Aga Cove capable of providing spawning beds. It is thought that the lakes on Agattu and the Semichi Group are the result of glaciation which created numerous small basins.

Rat Island Group - Lakes commonly occur on the northern portion of Kiska Island and the southwestern portion of Amchitka Island. No major lake other than Fenner Lake on Semisopochnoi, occurs within this group. The Fenner River on Semisopochnoi Island is the only major stream in this group. The remainder of the group's islands are extremely mountainous, with streams dissecting the mountainsides before entering marine waters.

Andreanof Island Group - The Andreanof Group can be broken into two distinct types, the lowlands and the mountainous areas. Within this group, the lowlands are contained in the southwestern portion of Adak, the southern portion of Kanaga and Tanaga, and the central Delarof Islands. Within these lowlands there is an interspersion of shallow lakes and small streams.

There are no major rivers within this area but larger streams do occur on Adak Island. The mountainous portion of Adak contains many radial streams which dissect the mountainsides and often end in waterfalls as they empty into the adjacent marine waters.

East of Yunaska Island and west of Unalaska Island there are few lakes, and those are quite small and shallow.

Islands of Four Mountains - These islands as described in the geology section are nothing more than volcanic peaks rising above the surface of the water. There are no lowlands to speak of and no lakes. The only surface water is in small streams, which are continuous around the periphery of each island, and none of which provide salmon spawning beds.

Fox Island Group - The Fox Islands generally are mountainous, although a few shallow lakes do exist. Streams on Unalaska provide major salmon spawning beds, as do those on Unimak Island. The remainder of the islands have typical shore and high gradient streams, characterized by waterfalls.

Volcanic activity throughout the Chain has provided natural basins for lakes in many of the extinct craters and calderas. Hot springs are common throughout the Chain and reported hot springs are discussed in the Geothermal Section of the Geology Chapter.

Even aside from lakes and streams, the Aleutians can be called wet. Because of the persistent rainfall, high humidity, and the soaking action of the heath or tundra, the Chain is often referred to as a giant sponge. One notable characteristic of most streams throughout the Chain is that their mouths are frequently blocked with debris, or rocks and gravel from the action of the sea. These are opened and closed periodically and at times can hamper the upstream migration of spawning salmon.

Human use of the water occurs only at the various military sites, navigational-aid sites, Native villages and hunting and fishing sites used by Natives from the various villages. The following is a table summarizing the water source used by the various government sites and Native villages. Also included is the return of these waters, including the treatment and effectiveness of sewage systems.

Table II. Water Utilization and Treatment

Location	Water Source	Sewage Treatment
Attu (LORAN Station)	Reservoir (creek suction is used in emergency)	Septic tank, the overflow of which is leached and finally dispelled into the creek.
Shemya Air Force Station	Percolation System	Newly constructed sewage lagoon (EPA-approved, 95% BOD reduction)
Amchitka AEC Activities	Ground water, lake water	Settling lagoons
Adak Communications Station	North Lake	Presently into marine waters; building secondary treatment plant
Adak LORAN Station	Lake	Directly into marine waters; planning secondary treatment plant
Adak LORAN Station	Lake	Septic tank, overflow leached
Atka Village	Reservoir-stream	Directly into marine waters

Estuaries

For purposes of this report estuaries within the Aleutian Islands, are considered to be the lagoon areas where there is substantial interchange of fresh and salt waters. Bay areas which are numerous throughout the Chain, are not considered estuaries.

The two major estuaries in the Chain are Clam Lagoon on Adak Island and Salmon Lagoon on Kiska. Clam Lagoon is located on the northeast side of Adak, and is separated from Sitkin Sound on the east by a narrow strip of land. It has a narrow-mouth opening into Kuluk Bay on the south. The

Adak Naval Communication Station is located on the northwest shore of the Lagoon. The lagoon is a natural breeding area for numerous shellfish and other aquatic life. Various species of waterbirds use the lagoon for feeding, resting, and nesting. Clam Lagoon is exposed at low tides, providing excellent feeding habitat for shorebirds and waterbirds. Calculations of incoming and outgoing tidal waters indicate a daily flow of approximately 113 million cubic feet, or 847,500,000 gallons of water.

Present sewage treatment at the Adak Naval Communications Station is completely lacking and discharge is directly into marine waters. A secondary sewage treatment plant which is EPA-approved and has a BOD reduction of 95% is presently being built, however, a report by Morer Wallace and Kennedy, Inc. for the Naval facilities Engineering Command in July 1971 concludes that the proposed outfall in Clam Lagoon will disperse the treated sewage from the secondary sewage treatment plant efficiently, so there will be no deleterious effects on Clam Lagoon or its environs.

There is little data on the Salmon Lagoon area. It is separated from the marine waters by a thin strip of land. There is considerable daily change in the tidal water inflow and outflow. Salmon Lagoon is much deeper than Clam Lagoon, and only a small part of its shoreline is exposed during low tides. The area is considered important to various species of waterbirds and secondarily important to shellfish and other aquatic life.

Although both of these estuarine areas are outside the refuge boundaries and under the jurisdiction of the State of Alaska, they are important to the total ecology of those immediate areas.

F. Vegetation

The Aleutian Islands belong to the same floral and vegetational province as the Kamchatka Peninsula of Siberia (Hulten', 1960 and 1968). This relationship is most prominent in the Near Islands while the eastern Aleutian Islands show floristically closer relationships to the North American continent and more specifically to the Alaskan Peninsula. The flora of the middle Aleutians is generally of lower growth than that found on either the western or eastern island groups.

The vegetative composition is of arctic-alpine species, dominated by the heath family (Ericaceae). The Chain is essentially treeless except for those few spruce trees introduced by the early Russians, and by the Americans during World War II. Vegetation occurs mostly from sea level to about 800 to 1,000 feet. Above 1,000 feet the wind plane as described by Dr. Hulten' severely suppresses plant life and those plant communities that are found resemble those of alpine locations at lower latitudes. Shacklette (1966) notes that below the 1,000 foot elevation the land surface is blanketed with a thick mat of vegetation composed of over 500 species of vascular plants, bryophytes, and lichens.

The vegetation of the Aleutians is classed as a terrestrial-maritime, tundra ecosystem. Amundsen (1972) states of Amchitka that the "...isolation of the island, maritime conditions and the low energy climate have predominated in the development of a rather uniform vegetation of relatively few important species." This is probably true of the remainder of the Aleutian Islands except for Unimak Island where alder dominates much of the surface.

Amundsen (1972) identifies the following three general plant communities whose classification are primarily dependent on exposure and soil moisture drainage:

1) the beach area; The beach community is dominated by beach rye, (Elymus arenarius mollis), but also contains reedgrass (Calamagrostis nutkaensis), fescues and bluegrasses. Intermingled and also occurring below the grass zone are the decumbent succulent herbs: beach pea (Lathyrus maritimus), sea bluebell (Mertensia maritima), Honkenya peploides, and senecio (Senecio pseudo-arnica). The bluff areas are almost entirely beach rye with scattered cow parsnip (Heracleum lanatum), angelica (Angelica lucida), cinquifoil (Potentilla villosa), geum (Geum macrophyllum), and some sedge (Carex spp.).

2) the lowland tundra; Lowland marshes contain mostly sedges with secondary species of reedgrass, bog blueberry (Vaccinium uliginosum), marsh marigold (Caltha palustris), yellow-monkey flower (Mimulus guttatus), horsetail (Equisetum arvense), and rushes (Juncus spp.). The drier lowland sites are blanketed by crowberry (Empetrum nigrum), reedgrass, mosses (Sphagnum), caribou lichen (Cladonia spp.), sedges, cranberry (oxycoccus spp), and prostrate willow (salix spp.), burreed (Sparganium hyperboreum) and rushes dominate most freshwater lakes. Other species commonly found are: mare's tail (Hippuris vulgaris), buttercup (Ranunculus spp.), water milfoil (Myriophyllum spicatum), and pondweed (Potamogeton spp.).

3) the upland tundra: The upland areas are dominated by crowberry, willow, lichens, mosses, and sedges. As the elevation increases the predominant lichen carpet thins and is increasingly interspersed with patches of bare

rock and gravel. In the mountainous areas of the Near Islands several Asiatic species are found that do not go any further east. These constitute the last easterly outpost of the luxuriant, high-grown vegetation of South Kamchatka. Such species are; false hellebore (Veratrum album oxycepalum), goatsbeard (Aruncus sylvestre), Cacalia auriculata, groundsel (Senecio palmatus), thistle (Cirsium kamtschaticum); and Siberian mountain ash (Sorbus sambucifolia). The eastern Aleutians contain certain species which occur westward only as far as Unalaska Island, these being elderberry (Sambucus racemosa), salmonberry (Rubus spectabilis), and alder (Alnus crispa).

The adjacent cold, clear marine waters contain large growths of marine vegetation. Much of this vegetation is utilized by certain mammals, birds, fish, and invertebrates. Most common is the algae or rockweed Fucus. It is a slippery, mucilaginous plant with thick, pimply structures and smooth bladders found on the rocks at low tide. A kelp called Alaria is generally found in deeper waters. The other most common plant is sea lettuce or Ulva, used to a great extent as a forage plant by emperor geese. The marine algaes or seaweeds are washed ashore in abundance during the various seasons. This is of special significance in that they provide a media in which an enormous amount of insect life is produced. The insects in turn serve as food for many terrestrial birds, as well as for the arctic fox.

In 1805 the first trees were planted in the Chain at Unalaska Island when spruce were brought from Sitka. Ten are still standing, 6 of which are alive and 4 dead. They range in height from 24 to 28 feet. Several spruce were also introduced to other islands by the military during World

War II, and small groves of trees can still be found at False Pass, Unalaska, Chernofski, Fort Glen on Umnak, Nikolski on Umnak, Atka, Adak, Amchitka, Shemya and Attu Islands. These trees are short, ranging anywhere from 2 to 12 feet in height, rather stunted and non-productive.

Areas disturbed by World War II and subsequent activities have been more or less revegetated, depending upon the amount of disturbance. Several areas still remain devoid of vegetation, even after all these years. The most complete revegetation has taken place on berms along roads and around quonset huts where reedgrass, sedges, and fescue grass are the pioneer plants. Areas where soil was removed in the formation of the berms is generally poorly vegetated. Initial revegetation has been by Deschampsia beringensis, Agrostis exarata, A. alaskana, beach rye (Elymus arenarius mollis), timothy (Phleum commutatum), lupine (Lupinus nootkatensis), Festuca rubra, and Luzula multiflora.

F. Geology

The geology of the Aleutian Islands has been only superficially investigated because of remoteness, inaccessibility, extreme climatic conditions, limited resource potential and low human populations. The only exception to this is Amchitka Island and adjacent islands where detailed geological work related to the Atomic Energy Commission's activities has been accomplished.

The first extensive geologic survey began in 1945 when the Army requested the U.S. Geological Survey to begin a program of systematic geologic and geophysical investigations of the Chain. The survey resulted in the U.S.G.S. Bulletin 1028 series, the most comprehensive report to date on the geology of the Aleutian Islands. It is from that series that most of the information for this section is drawn.

Little geological data exists for the Krenitzin Islands, Islands of Four Mountains, and many of the Andreanof Islands. In order to present as complete a geological picture for the Aleutian Region as possible, we are including a description of the islands adjacent to the refuge boundary, i.e., Umnak, Unalaska and Bogoslof Islands.

Generally speaking, the Aleutian Islands are composed of Tertiary volcani-clastic, pyroclastic rocks, basaltic/andesitic dikes and sills, composite/shield, Tertiary and Quaternary volcanic cones, and Quaternary sediments. Varied topographic features such as symmetrical volcanoes, glacially-dissected mountains, and elevated marine terraces result from volcanism, tectonism and glacial and marine erosion. Recent geological investigations in the Near, Rat an Delarof Islands indicate that these island-group blocks may be considered structural units.

A line of 57 volcanoes of which 27 are reported as being active, progresses from 2,000 to 9,000 feet above sea level along the northern side of the Aleutian Islands. These volcanic cones are of two types, shield and composite. Extensive caldera formations are also in evidence. Many of the ancient craters and calderas serve as perfect, natural basins for subsequent lakes. Radial streams deeply dissect the mountainsides plunging into the seas over precipitous cliffs as waterfalls. Existing hot springs, steaming vents, and frequent eruptions spewing forth lava flows attest to the continuing volcanic activity in this region.

Wave-cut and intertidal platforms border many of the islands. Emerging as parts of tilted fault blocks less than 600 feet above sea level, they consist mainly of faulted and folded Cenozoic volcanic rocks, both intrusive and extrusive. Metamorphic and sedimentary rock formations are also included.

Both the broad gently rolling plains and the towering volcanoes apparently underwent extensive glaciation during the Pleistocene Epoch. Even today the highest of these mountains yet bear icecaps, smaller glaciers, and a few retain cirque glaciers. Glacial erosion has carved deep fiords, U-shaped valleys, horns, aretes, cirques, cols and basins. The retreating glaciers deposited moraines and outwash plains of unstratified till with melt-water filling the basins, forming numerous small lakes, which now drain into the seas. Not one of the Aleutian Islands was left untouched by the sculpturing fingers of the mighty glaciers.

Over the past centuries, the post-glacial lakes have been drying up into marshes. Several of the resulting streams intermittently run underground.

Still, with the persistent rainfall, high humidity, and tundra-like vegetation acting like a giant sponge, the Aleutians could be correctly called wet. Due to much warmer temperatures than in the Arctic, permafrost is non-existent. Alluvial fans have been deposited at the base of newly-formed V-shaped stream valleys. Unconsolidated, smoothly rounded rocks line the river banks and beaches. Sea stacks, caves, and arches result from the relentless attack by the surrounding sea waters. On the other hand, the oceans act as a builder, creating sand spits, bay barriers, tidal inlets and tomboloes.

1. General

a. Fox Island Group

Nestled between the Alaska Peninsula and the Islands of Four Mountains are the Fox Islands. Extending about 290 miles in a southwest-northeast direction this group contains the largest of the Aleutian Islands. Strangely enough, the geology of this area is the least known, except for that of Islands of Four Mountains. Because of the paucity of published information, only Umnak, Bogoslof, and Unalaska are included in this section.

Umnak Island, 675 square miles in area, is divided into two topographically contrasting sections, the northeastern and the southwestern, that are connected by a narrow isthmus at Inanudak Bay. The rocks consist of late Tertiary and Quaternary volcanic rocks that rest on a basement complex of probable early-to-middle-Tertiary plutonic and low-grade metamorphic rocks. The isthmus contains low, rugged volcanic mountains, rising to about 2,500 feet above sea level. Lava flows, vent breccias, and associated irregular shallow intrusive bodies crop out over a large area. Rocks were erupted from vents northeast of Hot Springs Cove. They include both hydrothermally altered and fresh unaltered volcanic rocks.

Rugged Southwestern Umnak contains two heavily glaciated, andesitic stratovolcanoes, Mt. Recheschnoi, elevation 6,510 feet, and Mt. Vsevidof, 6,920 feet, in the northern part; south of these two mountains lies a gently rolling, piedmont plain called Nikolski Plain, with a relief of less than 300 feet. It has been suggested that the Nikolski plain is an uplifted portion of the submerged continental shelf that has been modified by extensive glaciation. Small lakes, less than a mile long, abound on the plain. Recheschnoi is a deeply dissected remnant ridge, while Vsevidof displays the classical symmetry of a composite volcano.

Nine major valley glaciers are present today on both summits, as well as several other smaller glaciers and perennial snowfields. Outwash plains in the valleys of Recheschnoi extend themselves seaward from the glacial fronts, while a composite glacier flowing from Mts. Vsevidof and Recheschnoi drains into the two forks of Black Creek; these two glaciers are divided by a medial moraine. Late or post-Wisconsin glaciers deposited terminal moraines on the piedmont plain, before receding high into the mountains. The mighty glaciers advanced once more, reaching a maximum 100 to 300 years ago; following this maximum extent, the glaciers again receded to their present position.

Northeastern Umnak is occupied almost entirely by Okmok Volcano, a low shield volcano 3,519 feet in altitude, that contains a colossal caldera 6 miles in diameter. The catastrophic eruption that gave birth to Okmok Caldera represents two phases of volcanism. The earlier phase appears to have been peleean and consisted of red-hot, glowing, gas-charged avalanches (nuees ardentes) of molten bombs charging down the slopes of Okmok Volcano. When the avalanches came to rest they had forged continuous beds of welded agglomerate close to the source vents. The later phase seems to have been violently vulcanian and constituted showers of ash, bombs, lapilli, and huge xenolithic blocks of earlier basalt and palagonitized rock to slatter a widespread blanket as much as 300 feet thick near the source vents. The summit collapsed under this cataclysmic volcanic attack, forming Okmok Caldera. Several cinder cones and pit craters are on the floor of the caldera. An arcuate patch of glacial ice, probably stagnant, remains along the southern rim. Its northeast rim is breached by Crater Creek Gorge 600 feet deep; the gorge is the result of the downcutting of the outlet of a lake that once filled Okmok Caldera. Parasitic cones occupy the south flank of Okmok, the largest being Mt. Tulik, 4,111 feet in altitude. One of the nested cones has been active during historic times.

Another fascinating example of volcanism is Bogoslof Island, oftentimes referred to as the Disappearing Island. Twenty-five miles north of Umnak, Bogoslof is composed almost entirely of historic lavas. Russian navigators placed the island on the map in 1768, naming it Ship Rock. Captain Cook charted the tiny pinnacle of rock in 1778-79, as did Billings in 1802; at that time, its name was changed to Ship Island. In May of 1796, Baranof provided a vivid description of the natural phenomenon experienced at Unalaska, as an eruption of explosive debris and extrusion of a viscous lava dome built an island about a quarter of a mile south of Ship Rock. The new island was entitled Bogoslof by the Russians.

By 1802, its activity had ceased; then in 1806, lava flowed from the summit, increasing the size and height of the island. Veniaminof in 1823, reported that this growth ceased. This lava dome later became known as Old Bogoslof and still later as Castle Rock. No further activity occurred until 1882, when steam was reported rising somewhat north of Ship Rock. In that exact position, a new volcanic dome was observed rising in 1883, followed by a violent eruption. New Bogoslof and Grewingk were suggested names for the newly-born island. By 1887, the three Bogoslof islands were connected by bars of volcanic debris and boulder and sand beaches. The new island was a craggy 500 feet in altitude; Old Bogoslof had been greatly reduced by marine erosion. Ship rock still existed but had begun to disintegrate; it had completely fallen by 1890. In 1891, steam and sulfur fumes were reported escaping from New Bogoslof, and a channel had opened up between Old and New Bogoslof. New Bogoslof continued vigorously steaming until about 1895 or 1896. Another extrusion of viscous lava appeared in 1906 midway between Old and New Bogoslof; this new island was called Metcalf Cone. A 1907 explosion destroyed half of the cone, but another dome, McCulloch Peak, grew into an island connecting Metcalf Cone with Old Bogoslof.

In September of 1907, McCulloch Peak disappeared in a powerful explosion. A new conical-shaped island, Tahoma Peak, was pushed up in 1909-10 in the bay created by the destruction of McCulloch Peak. Activity on Tahoma Peak continued, but by 1922, explosion, collapse, and erosion removed all traces of both McCulloch and Tahoma Peaks. New Bogoslof was renamed Fire Island. and Old Bogoslof, Castle Rock; both had become diminished in size by erosion, sand and gravel had accumulated around them, and a wide channel of open water separated the two. Another conical lava dome arose during the winter of 1926-27. Explosion debris connected the new dome, Fire Island, and Castle Rock. This circular dome was about 200 feet high and 1,000 feet in diameter; it remained active until at least 1931. By 1935, another open water channel separated Fire Island from the 1927 dome and Castle Rock. The name Bogoslof was officially applied to the larger island that comprised Castle Rock, the pyroclastic rocks of the 1926 eruption, and the 1927 dome. The only activity reported since has been of vigorous and relentless erosional work upon the remaining two islands.

The second largest island in the Fox Island Group is Unalaska, whose total area includes about 1,200 square miles; it is 85 miles long and 39 miles wide. The oldest rocks, the Unalaska formation, were deposited in the middle Tertiary and consist of altered and andesitic intrusive and extrusive rocks, and sedimentary rocks derived from similar igneous rocks. Conspicuous, bulbous igneous masses whose diameters range from a few feet to several hundred feet were intruded into and possible extruded upon muds and are associated with pillow lavas, the batholiths are granodiorite. Basalt and andesite flows and pyroclastic rocks of the Makushin volcanics unconformably cap the Unalaska formation and plutonic rocks.

The island is of largely rugged mountainous terrain, with a coastline deeply indented by fiords; the southwestern section is hilly and less deeply indented by bays. Makushin Volcano, the most conspicuous landform, remains presently active and exhibits a broad, glacier-capped, truncated cone soaring to 6,680 feet in altitude; the summit contains a caldera 1 1/2 miles in diameter. Several small parasitic, cinder and composite cones; mudflows; and young lava flows, that retain details of their constructional forms, are associated with the Makushin volcanics: Pakushin, a basaltic, composite cone with a multi-cratered summit is the largest, reaching an elevation of 3,395 feet. A line of ten small cones and explosion pit craters lies on the rift zone trending N. 75° W. northwest of Makushin Volcano; several of these display multiple craters or elongated fissures. The emission of gases at active fumaroles and existing hot springs are the only signs of historical volcanic activity. Several of the fumaroles are scattered around the main vent in Makushin's summit caldera. A large fumarole and hot springs area is active at the head of Glacier Valley, 3 miles southeast of the summit vent, and another smaller active area lies 2 miles south of the summit. Hot springs are again found on the eastern side of Summer Bay Valley.

Topography evidencing glacial erosion is prominent on Unalaska. U-shaped valleys and passes, cirques, aretes, rock-basin lakes, and ice-scoured features of every size are in the mountainous areas. Small glaciers yet exist today to fill the basins in the highest peaks of the Shaler Mountains: an ice field of 15 square miles caps Makushin Volcano. The toes of these residual glaciers probably fluctuated twice within the last few centuries, as witnessed by the fresh appearances of lateral and terminal moraines.

Most of the glacial till was deposited beyond the present shore of Unalaska. Postglacial stream erosion has carved steep-walled, narrow-bottomed ravines and gorges.

Characteristic of the larger valleys, excluding those draining glaciers, is their long, stepped profile, broken by rock spurs. Alluvial fans have been deposited on the floors of the main valleys. The braided streams draining the glaciers of Makushin Volcano are burdened with outwash; their valleys are wide and flat bottomed, and the constantly shifting river channels keep resurfacing the valley floors. The upper reaches of many of the larger valleys are flanked by terrace remnants of outwash gravels. Surficial deposits are derived largely from an admixture of material from the mechanical disintegration of rock, ground moraine, and layers of volcanic ash, lapilli, and cinders. Creeping and sliding mantle is extensive due to the excessive moisture and steep slopes. Steep sea cliffs surround most of Unalaska Island, and hanging valleys abound along most of the headlands. Wave-cut rock benches, emergent at low tide, are present along moderately protected shores. Beach deposits, ranging from boulders to sand, are prominent in the heads of all but the most sheltered bays; narrow beaches separate tidal benches from the sea cliffs. Bars and spits have been constructed across several of the shallow bays.

List of Rock Types at Umnak, Bogoslof and Unalaska Islands

Southwestern Umnak

Surficial deposits -- Younger till, glacier ice, glacial outwash gravel, alluvium, talus and other colluvium, beach deposits, dune sand, and older till

Igneous and metamorphic rocks --

Volcanic rocks of Mt. Vsevidof -- Youngest flows, including historic latite flows, andesite and rhyodacite pyroclastic beds and vent complex, basaltic andesite and andesite flows

Cinder cone deposits undifferentiated

Volcanic rocks of Mt. Recheschnoi -- Youngest hypersthene andesite flows, lava flows, pyroclastic flows, rhyolite domes, quartz-bearing olivine andesite flow, hypersthene andesite, hypersthene-bearing labradorite andesite and hypersthene-bearing aphyric andesite flows and minor pyroclastic interbeds, pyroclastic beds and vent complex, mafic phenocryst basalt of Kshaliuk Pt., anorthite-olivine-augite basalt flows,

Plutonic rocks -- Diorite, quartz diorite, quartz monzonite, and granophyre

Albitized sedimentary and igneous complex, bedded argillite and tuff, Keratophyre flows, and albitized intrusive rocks

Volcanic rocks of central Umnak -- Bedded volcanic rocks hydrothermally altered in places, vent and intrusive complex altered and unaltered, intensely silicified, potassium feldspathized rocks

Northeastern Umnak

Surficial deposits -- Till, glacier ice, talus and other colluvium, alluvium, beach deposits, dune sand

Basalt flows outside Okmok Caldera

Vent lava, undifferentiated, cinder cone deposits, lava plugs

Basaltic flows later than Caldera Lake -- Basalt flows from cone A in 1945; pre-1945 basalt flows from cone A; basaltic andesite flows from cone B; wall-fissure flows; basalt flows from cone E basalt flows from cone F

Rocks contemporaneous with Caldera Lake -- Bedded volcanic sediments; plagioclase basalt flows from cone C and D; early post-caldera pyroclastic rocks

Okmok volcanics -- Pyroclastic rocks deposited by caldera-forming eruption of Okmok volcano. Also includes possibly older pyroclastic rocks in north and east arcuate ridges

Crater Creek basalt

Plagioclase-olivine basalt of satellitic vents, plagioclase-olivine basalt flows, vent complex or volcanic neck

Aphyric and feldspathic basalt, aphyric and feldspathic basalt flows, aphyric and feldspathic basalt intrusives

Volcanic rock of minor vents -- Vitreous andesite, rhyolite

Ashishik basalt -- Mafic phenocryst basalt, palagonitized pyroclastic rocks

Bogoslof

Beach deposits,-- Sand and boulders

Igneous rocks-- Basaltic dome, basaltic ash and agglomerate, vent agglomerate, hornblende andesite, bytownite-salite-hornblende basalt, hornblende basalt of Fire Island.

Unalaska

Surficial deposits -- Alluvial, beach, and eolian deposits, till of terminal and ground moraines, glacier ice

Eider Point basalt -- Includes olivine, two pyrozene basalt and minor rhyodacite porphyries, dominantly pyroclastic rocks and lava

Makushin volcanics -- Basalt and andesite lava, pyroclastic rocks, and minor sedimentary rocks, basalt, plugs, sills, and dikes

Granodiorite batholith -- Includes contrasting border facies and associated plutons, granodiorite, diorite and minor granitic border facies and small pluton, gabbro border facies and small plutons

Unalaska formation -- Slightly altered andesite and basalt extrusive rocks, sills, and sedimentary rocks ranging in coarseness from argillite to conglomerate, andesite and basalt dikes, including dikes of undetermined age

Table 12. VOLCANOES AND CALDERAS OF THE FOX ISLAND GROUP

Volcanoes

NAME	APPROXIMATE HEIGHT IN FEET	GEOGRAPHIC LOCALITY
Roundtop	6,140	Unimak Island
Isanotski	8,435	Unimak Island
Shishaldin	9,978	Unimak Island
Fisher	3,590	Unimak Island
Westdahl	5,035	Unimak Island
Pogromni	7,500	Unimak Island
Akun	4,244	Akun Island
Akutan	4,244	Akutan Island
Table Top	2,710	Unalaska Island
Makushin	6,680	Unalaska Island
Bogoslof	300	Bogoslof Island
Tulik	4,111	Umnak Island
Okmok	3,519	Umnak Island
Recheschnoi	6,510	Umnak Island
Vsevidof	6,920	Umnak Island

Calderas

NAME	APPROX. DIAMETER IN MILES	GEOGRAPHIC LOCALITY
Fisher	7 x 9	Unimak Island
Makushin	2 x 1 1/2	Unalaska Island
Okmok	7 1/4	Umnak Island

Table 13. VOLCANIC HISTORY OF THE FOX ISLAND GROUP

Unimak Island Volcanoes	
Roundtop	1825 ash eruption, probably some eruptions reported for Isanotski should be credited to Roundtop
Isanotski	1795 ash eruption, 1830 ash eruption, 1845 active (perhaps these are Roundtop eruptions)
Shishaldin	1775-1778 active, 1790 smoke, 1824-1826 ash eruption, 1827-1830 ash eruption, 1830 ash eruption, 1842 ash eruption, 1865 smoke, 1880-1881 smoke, 1883 ash eruption, 1897 smoke, 1898 ash eruption, 1922 ash eruption, 1925 ash eruption, 1928-1929 ash eruption, 1946-1953 ash eruption, 1955 ash eruption
Fisher	1826, perhaps ash eruption
Westdahl	1963 lava and ash eruption
Pogromni	1795 ash eruption, 1796 lava flow, 1820 ash eruption, 1827-30 ash eruption
Akun Island Volcano	steams intermittently
Akutan Island Volcano	1790 smoke, 1828 smoke, 1838 active 1848 ash eruption, 1852 active, 1865 active, 1867 lava eruption, 1908 lava eruption, 1911-12 ash eruption; 1927-28 ash eruption, 1929 lava flow, 1931 ash eruption, 1946 ash eruption, 1948-53 ash eruption, presently active intermittently
Unalaska Island Volcanoes	
Table Top	Probably no historic activity
Makushin	1768-1769 ash eruption, 1790-1792 smoke, 1802 violent ash eruption with earthquakes, 1818 smoke, 1826 ash eruption, 1827-1838 smoke, 1844 smoke, 1845 smoke, 1865 active, 1867 smoke, 1883 ash eruption, 1907 active, 1912 active, 1926 ash eruption, 1938 ash eruption, 1951 ash eruption, 1952 smoke, presently steaming intermittently
Bogoslof Island Volcano	1796 lava eruption, 1800-1815 rising but no smoke, 1806 lava eruption, 1814 ash eruption, 1820 smoke, 1882 ash eruption, 1883 lava eruption, 1890-1891 explosions, 1906 lava eruption, 1907 lava eruption, 1909 lava eruption, 1910 explosions, 1913 smoke, 1926 ash eruption, 1926-1927 lava eruption, 1931 ash eruption, 1951 ash eruption
Umnak Island Volcanoes	
Tulik	Probably no historic activity

Okmok------------------------1817 ash eruption, 1824-1830 active, probably a lava flow, 1899 ash eruption, 1931 ash eruption, 1936 smoke, 1938 lava flow, 1945 lava flow, steaming since
Recheschnoi------------------Probably no historic activity
Vsevidof---------------------1784 smoke, 1790 smoke, 1830 active, 1878 ash eruption, 1880 smoke, 1957 smoke

b. Islands of Four Mountains

These islands are of recent volcanic origin and are essentially volcanoes emerging from the ocean. They are the classical cylindrical shield cone.

Table 14. Volcanoes and Their Activity - Islands of Four Mountains

Volcano Height Island and Activity

Kagamil Vol., 2,920 feet alt., located on Kagamil Isl., 1929 active, intermittent steaming

Tana Vol, 3,840 feet alt., located on Chuginadak Isl., probably no historic activity

Cleveland Vol., 6,500 feet alt., located on Chuginadak Isl., 1893 active, 1929 ash eruption, 1932 smoke, 1938 active, 1944 ash eruption, steaming intermittently

Uliaga Vol., 2,910 feet alt., located on Uliaga Isl., probably no historic activity

Carlisle Vol., 6,200 feet alt., located on Carlisle Isl., 1774 active, 1828 active, 1838 smoke

Herbert, 4,235 ft., Herbert Isl., probably no historic activity

Yunaska, 3,119 ft., Yunaska Isl., 1817 smoke, 1824 ash eruption, 1830 ash eruption, 1929 smoke, 1937 ash eruption

Chagulak, 3,750 ft., Chagulak Isl., probably no historic activity

Amukta, 3,463 ft., Amukta Isl., 1786-91 active, 1876 smoke

There is a caldera on Yunaska Isl. whose diameter is 1 3/4 x 1 1/2 miles.

C. Andreanof Island Group. The Andreanof Islands extend west from Amukta Pass about 310 miles to Amchitka Pass. Discussed below are three of the larger Andreanofs, i.e., Great Sitkin, Adak, and Kanaga. There is virtually no geologic information regarding the other islands.

Great Sitkin is a deeply dissected, tortuously rugged island approximately 11 miles in diameter; the greater part of the northern half is occupied by 5,740-feet-high Great Sitkin Volcano. The asymmetrical cone displays a crater 1/2 mile x 3/4 mile in diameter on its western flank at the 4,000 foot level in which a steaming basaltic lava dome has recently formed. An explosive eruption in recent years blasted out this crater and blanketed the island with pumice and rock fragments, ranging in depth from a few inches to more than 20 feet. The nearly flat-lying remnants of an ancient shield volcano forms most of the southern part, which is fringed on its southern and eastern coasts by small areas of even older volcanic rocks.

The geologic record of Great Sitkin Island probably begins in late Paleozoic time, and comprises at least four stages of volcanism designated as Finger Bay, Sand Bay, peak volcano, and crater volcano. Deep, steep-walled, U-shaped valleys radiate from the island's center and are headed by cirque-like amphitheaters. Five small glaciers yet exist on the upper slopes of Great Sitkin Volcano, of which the two largest have deposited large moraines. The crater itself is partly filled with ice.

Pleistocene glaciers probably covered parts of the southern half of the island and almost certainly a small ice cap lay on the cone. Erratic boulders occur on the valley floor of Big Fox Creek. Several large streams and numerous small creeks drain the island. Small-sized lakes occupy depressions, and two rock basin lakes are known. The rocky coastline is irregular, with 1,000-foot sea cliffs and narrow sandy beaches.

A few low marine terraces line the southern coast and suggest recent uplift. A large group of active hot springs, mud pots, and fumaroles occurs at the 2,000-foot level, near the head of the west fork of Big Fox Creek. Extrusion of the crater dome marks the latest phase of volcanic activity of Great Sitkin. The lava dome is believed to have been formed in March of 1945, at which time a glow was visible at night from the Army Post on nearby Adak Island. Clouds of steam were noted rising from the crater, and a strong earthquake was felt at the Naval installation on Sand Bay. Activity since then has been limited to steam and smoke emissions.

Largest of the Andreanofs is 289-square-mile Adak Island, which is 32 miles long and 21 miles wide. Northern Adak comprises two physiographic and geologic divisions; a vigorously glaciated southern area of folded, faulted, and intensely altered volcanic rocks of probably Paleozoic age, intruded by gabbro and rocks of intermediate composition; and a mountainous northern area consisting of remnants of three basaltic volcanoes of Tertiary or Quaternary Age. Five volcanic domes of probably early Tertiary Age occupy the northern part of the southern area; they cannot be correlated with any of the three recognized volcanic centers of the northern area. Minor amounts of sedimentary rocks are associated with the volcanoes; a small area of fossiliferous marine sandstone crops out on Cape Adagdak. The volcanoes themselves have been trimmed by marine erosion and locally dissected by subaerial and glacial erosion. The Pleistocene glaciers have disappeared altogether. Ash from volcanoes on nearby islands covers most of the lowlands. Southern Adak is composed of Finger Bay volcanics of probable Tertiary age, an altered andesitic and basaltic sequence of marine pyroclastic deposits and lava flows with minor argillite and graywacke beds, intruded by composite granodiorite, quartz-diorite, diorite, and gabbro plutons of probable middle-to-late-Tertiary age; many aphanitic dikes and sills, generally altered, which cut plutonic rocks and Finger Bay volcanics; and surficial deposits, mostly volcanic ash and soil which obscure much of the bedrock below elevations of 1,500 feet. Remnants of a composite marine platform are found in the southwestern part of the island. All but the northernmost part of Adak is characterized by bold mountains, diversely trending ridges, broad rolling lowlands, numerous rock basin lakes, and a coast line deeply indented by fiords; this topography has been developed largely by intense glaciation. Northernmost Adak has been constructed mostly by volcanic activity originating from three main centers -- Mt. Moffett (3,876 feet altitude), with a parasitic cone on its northeastern flank (alt. 3,250 feet); Andrew Bay Volcano, a truncated cone whose central vent was located west of the present eastern shore of Andrew Bay; and Mt. Adagdak (elevation 2,072 feet). It also includes areas of lagoons, tidal flats, and sand dunes. The mountain areas, unrelated to constructional volcanism, resulted from glacial and stream erosion. Prior to valley glaciation, which appears to have originated on Mt. Moffett, an ice cap covered most of the island. In the southern sector, the scoured appearance of glaciated terrain is immediately apparent, with abundant striae, roches moutonnees, and cirques; till, recessional terracing, and lateral and ground moraines are more common in the northern section. Mt. Moffett has been deeply dissected; numerous valleys descending from open, steep-walled cirques narrow downstream into deep V-shaped canyons cut by glacial melt-water and later streams. Vigorous wave action has created majestic sea cliffs as high as 2,500 feet, jagged sea stacks, and rugged offshore rocks and islets. Longshore currents are presently building impressive tomboloes and spits that enclose three major lagoons from the sea.

Only the northern part of Kanaga has been examined by the U.S. Geological Survey. The oldest rocks are believed to be late Tertiary in age and are the remnants of an ancient volcanic cone. After the original cone was partially destroyed by erosion, Mt. Kanaton, a basaltic shield volcano, was erected nearby; on its flanks, at least two more composite basaltic cones were built. Near the end of the Pleistocene the shield volcano and its parasitic cones collapsed during a violent eruption, leaving a great caldera. Subsequent activity within the caldera constructed the present symmetrical cone 4,305 feet high of Kanaga Volcano which has remained intermittently active throughout historic time. Lava and ash eruptions have been recorded; the present activity is mild and fumarolic.

Brecciated fault zones containing disseminated pyrite and quartz were found in the Blind Cove area and the west shore of Beyer Bay on Adak. Also secondary copper minerals associated with a quartz-pyrite mineralized zone was located upstream from the head of Bay of Islands. Again on Adak, small iron-stained fault zones occur; disseminated pyrite is common in the Finger Bay volcanics, especially near the contacts with plutons.

Table 15. Volcanoes and Calderas of the Andreanof Island Group

Volcanoes	Approximate Height in Feet	Geographic Locality
Seguam	3,440	Seguam Island
Sarichef	1,000	Atka Island
Kliuchef	2,800	Atka Island
Korovin	3,852	Atka Island
Sergief	1,700	Atka Island
Koniuji	1,113	Koniuji Island
Kasatochi	1,018	Kasatochi Island
Great Sitkin	5,740	Great Sitkin Island
Adagdak	1,900	Adak Island
Moffett	3,900	Adak Island
Kanaga	4,416	Kanaga Island
Bobrof	2,400	Bobrof Island
Takawangha	4,600	Tanaga Island
Tanaga	6,972	Tanaga Island

Calderas	Approximate Diameter in Miles	Geographic Locality
Kliuchef	2 2/3	Atka Island
Great Sitkin	1 1/2 X 1	Great Sitkin Island
Kanaton	2 1/2	Kanaga Island
Takawangha	2	Tanaga Island
Tanaga	6 2/3	Tanaga Island

Table 16. Volcanic History of the Andreanof Island Group

Seguam Island Volcanoes	
Seguam	1786 activity reported until 1790, 1827 smoke, 1891-92 ash eruptions, 1902 ash eruptions, 1927 smoke.
Atka Island Volcanoes	
Atka Peak	1760 smoke
Sarichef	1812 active, 1907 ash eruption
Kliuchef	Probably no historic activity
Korovin	1828-30 smoke, 1844 smoke, 1951 smoke, intermittent steaming
Sergief	Probably no historic activity
Koniuji Island Volcano	1760 active & rising, 1827-28 smoke
Kasatochi Island Volcano	1899 crater lake disappeared, and steam rose from crater, lake later reappeared
Great Sitkin Island Volcano	1760 smoke, 1784 smoke, 1792 ash eruption, 1828-29 smoke, 1904 smoke, 1933 ash eruptio 1945 lava eruption, 1949-50 ash eruptions, 1963-71 intermittent steaming.
Adak Island Volcanoes	
Adagdak	Probably no historic activity
Moffett	Probably no historic activity
Kanaga Island Volcano	1786 ash eruption, 1790-91 active, 1827 smoke, 1829 smoke, 1904 lava flows, intermittent steaming.
Bobrof Island Volcano	No historic activity
Tanaga Island Volcanoes	
Takawangha	No historic activity
Tanaga	1763-70 active, 1791 smoke, 1829 smoke, 1914 lava flow, intermittent steaming.

List of Rock Types in the Andreanof Islands Group

1. Great Sitkin

Sedimentary Rocks - alluvium dune and beachsands, mudflow, glacial moraine

Igenous rocks - pumice; basalt dome; ash; basalt plugs; basalt and andesite flows; agglomerate; Finger Bay volcanics, undifferentiated flows, flow breccia, tuff, and dikes

2. Adak

Northern Section:

A widespread, thin blanket of well-stratified basaltic ash and pumice.

Sand dunes; unconsolidated beach, delta, lagoon, and alluvial deposits; marine terrace boulder gravel; glacial drift, including till, lateral moraines and mudflows.

Southwestern area, which includes Mt. Moffett and its parasitic cone:

Basalt flows and domes, tuff-breccia cone and its andesite vent filling, tuff breccia, fine-grained olivine gabbro plug and associated basalt vent-agglomerate

Northeastern area, which includes north of Andrew and Clam Lagoons and Mt. Adagdak:

Basalt and andesite domes and flows, hornblende andesite tuff-breccia, hornblende andesite flows, hornblende andesite lapilli-tuff, tuffaceous sandstone, fossiliferous marine sandstone which includes some conglomerate and shale, bouldery conglomerate containing many giant talus blocks.

Rocks of Andrew Bay Volcano - flows and tuff-breccia of olivine-, hypersthene- and hornblende-bearing andesite

Andesite porphyry domes - includes andesite porphyry, dacite porphyry, hornblende basalt porphyry, quartz-hornblende basalt porphyry, and hornblende-biotite basalt porphyry

Gabbro - locally includes hornblende gabbro and augite-quartz syenite

Finger Bay Volcanics - basalt and hornblende basalt tuff, flow breccia, agglomerate and basalt dikes, and subordinate rhyolite tuff and quartz porphyry dikes.

Southern Section:

Alluvial deposits

Andesite and dacite - probably includes basalt in small dikes and sills. Generally altered.

Granodiorite, quartz diorite and gabbro - in stocks, sills, and dikes

Mixed rocks - contains Finger Bay volcanics intimately injected by granodiorite, quartz diorite and gabbro

Finger Bay volcanics - altered andesitic and basaltic pyroclastic deposits and lavas; minor amounts of pillow lava, volcanic wacke and argillite

3. Kanaga

Northern Section:

A blanket of well-bedded basaltic ash covers most of the area to depths of as much as 7 feet.

Alluvium, beach gravel and water-sorted pumice deposits.

Historic and late prehistoric basalt flows from Kanaga Volcano.

Older volcanic rocks of Kanaga Volcano - includes basalt and andesite flow, scoria and tuff breccia; vent agglomerate and minor intrusive rocks of later stage.

Andesitic tuff

Basalt flows and tuff breccia from ancient vent near west coast

Olivine basalt flows from ancient vent near Round Head

Olivine and hypersthene basalt and andesite flows of ancient Mt. Kanaton

Basalt dome

Agglomerate in vent older than Mt. Kanaton near north coast

Basalt flows and tuff beds from vent older than Mt. Kanaton near north coast

Western Peninsula:

Ash, soil and tundra mantle

Surficial beach deposits

Extrusive rocks - tuffs, tuff-breccia and lava dominant

Intrusive rocks - porphyritic andesite sills, andesite and basalt dikes

d. Delarof Island Group. Situated between the Passes of Amchitka and Tanaga lies a group of eleven islands called the Delarofs. Within these islands are possibly two physiographic units--a major unit to the north, with Ulak and Amatignak as the secondary unit in the south.

Gareloi, the northernmost island, is dominated by the composite cone of Mount Gareloi. It constitutes the only active volcano in the island group and rises to 5,160 feet. The island is roughly circular, averaging 5 to 6 miles in diameter, and is encircled by steep, rugged sea cliffs. Two periods of volcanic activity have occurred, separated by a lengthy time of erosion and quiescence. Both the younger and older volcanic rocks are of basically the same composition, i.e., olivine basalt flows and scoria. The historic eruption of 1929 created a series of thirteen explosive craters, aligned along a fissure trending in a southeasterly direction. Active today in the more northerly vent of the two summit craters, is a steaming fumarole of sulfur dioxide. Small remnants of the Pleistocene glaciers remain on either side of the saddle between the northern and southern craters of Gareloi Volcano. Glacier formed U-shaped canyons have deeply dissected the mountain sides.

The islands of Unalga, Kavalga, Ogliuga, Skagul, Ilak and adjacent islets emerged as shallow, wave-cut platforms, trending east-west along the Aleutian arc. Relatively flat, these islands were once the highlands of an older Aleutian Chain formed during early Tertiary time out of rocks of volcanic derivation. Submergence of most of the land resulted in the carving of wide wave-cut benches. The land was uplifted for a second time, followed by a period of downfaulting during which a large portion of the ancient highlands became submerged beneath the Pacific Ocean. Further leveled by marine erosion, the islands re-emerged in their present positions. Glaciation completed the erosional work, scouring the islands to resemble low, flat-topped plateaus, bounded by sheer cliffs, sea level rock benches, and fringed by narrow boulder beaches. A few youthful streams and elliptical lakes are in evidence. It has been reported that Ilak Island has a cave running its entire length.

Intensely mountainous Amatignak and gently sloping Ulak, although opposites in topography, are similar in their basic rock composition. The only difference is in rock structure. Both are at least as old as the central Delarofs.

Ulak Island is a glaciated, wave-cut platform, 6 1/2 miles long and 555 feet high. Its surface is hummocky, with numerous bedrock knobs, small depressions, ponds, streams, and lake chains. Glacial erosion has beveled off the abrupt shoulders between uplands and sea cliffs. Postglacial marine abrasion has cut low cliffs in these slopes.

Amatignak Island, 6 miles in length and 1,825 feet in elevation, was one of the two sources of the Pleistocene glaciers. It is characterized by knife-edge ridges at high altitudes, glacially striated and rounded ridges at lower altitudes, numerous rock-basin lakes, flat-floored passes, and broad U-shaped valleys. The highlands were originally erected by volcanic activity. Late Pleistocene glaciers so completely blanketed this island that any earlier shorelines or terraces were obliterated.

List of Rock Types in the Delarof Islands Group

Ogliuga and Skagul

Surficial deposits - ash-soil cover, beach deposits, dunes of largely volcanic ash

Lavas and pyroclastic deposits - includes tuff and breccia, minor sedimentary rocks, flow breccia

Intrusive rocks - andesite or basalt dikes, intrusion of porphyritic andesite, irregular shape, with feldspar and hornblende conspicuous

Kavalga

Ash and soil cover

Lavas and pyroclastic deposits - includes flow breccia, tuff and breccia, minor sedimentary rocks

Ulak

Altered pyroclastic deposits and pillow lava, with minor sedimentary beds

Fine-grained dikes and sills

Amatignak

Altered tuffaceous sedimentary beds with some coarse pyroclastic deposits

Fine and Coarse-grained dikes and sills

Ilak

Granodiorite and quartz diorite

Andesitic dikes

Unalaga

Interbedded flows, pyroclastic deposits and sedimentary rocks

Fine-grained dikes and sills

Gareloi

Pyroclastic debris

Young and old basalt flows

Table 17. Volcanoes of the Delarof Island Group

Name	Approximate height in feet	Geographic location
Gareloi	5,334	Gareloi Island

Table 18. Volcanic History of the Delarof Island Group

Gareloi Island Volcano	
Gareloi	1760 - smoke; 1790-1792 - ash eruptions; 1828 - smoke; 1873 - active; 1922 - ash eruption; 1927 - smoke; 1929 - lava flows, intermittent steaming

e. Rat Island Group. Typical terrain type in the Rat Islands is either low-lying or mountainous. Physiographic features typical of glaciated areas are present, as well as those resulting from marine and fluvial erosion.

Recent studies have shown that the islands have distinctive relict shoreline features and wave-planed terraces. Close correlations between these terrace levels indicate that this physiographic block has not experienced differential vertical displacements or tilting during at least the latter part of the Quaternary Period. A line of active or dormant volcanoes occurs on Buldir, Kiska, Segula, Davidof-Khvostof, Little Sitkin, and Semisopochnoi.

Davidof and Khvostof Islands are actually parts of two broad, submerged, coalesced cones that rise from a platform about 350 feet below sea level. An extensive submarine caldera lies between these two islands. Segula Island is in itself a single, quiescent volcanic mountain 3,800 feet high and four miles in diameter, with a cinder cone forming the highest point. Segula lacks any evidence of glaciation and the small amount of marine erosion infers its age to be late Quaternary.

Another spectacular example of volcanism is Little Sitkin Island. The island consists of two superimposed calderas, volcanic cones, lava flows, blankets of ash, and active fumaroles. Four peaks ranging from 1,303 to 2,095 feet high are apparently greatly dissected remnants of a caldera rim. Two other peaks form the single-nested cone of Little Sitkin Volcano. A large deposit of sulfur, potentially of commercial quantities, occupies an area of approximately ten acres on the south side of the present breached crater.

Semisopochnoi Island is the easternmost island in the Rat Island Group. It is a large shield basaltic volcano, 12.4 miles long by 10.6 miles wide, and bordered by high rocky cliffs, offshore reefs, and a few sandy beaches. Its descriptive name, translated from Russian as meaning seven volcanoes, denotes the seven parasitic cones of andesite and basalt outlined against the sky. Of the seven cones, Anvil Peak stands the tallest at 3,867 feet. Others vary anywhere from 2,000 to 3,000 feet in elevation.

The island is composed almost entirely of volcanic rocks and sediments derived from them of Pleistocene or Recent age. A good sized caldera, five miles in diameter, forms the central sector. Three nested composite cones have built up nearly filling the old caldera with volcanic ejecta.

Although presently in a period of quiescence, Semisopochnoi Island can still be considered for future volcanic activity. Before the collapse of the central caldera, glaciers ground out cirque basins, U-shaped valleys, and striations along some rocks. Continued volcanic eruptions have concealed much of the glacial deposition.

Westernmost of this Group is Kiska Island, with an area of about 110 square miles. Its nearest neighbor is Little Kiska Island, three square miles in area. Two major geologic elements are represented on those two islands. The southern halfs of the Kiska and Little Kiska are a part of a submarine ridge that extends south-eastward, while the northern half of Kiska is an active, composite andesitic volcano. The islands were sculptured first by marine and fluvial erosion; then the southern portions were modified by glaciation. Strangely enough, Kiska's northern portion exhibits no signs of glacial action, probably due to continuing volcanic eruptions in recent times. The entire island is thinly veneered by volcanic ash derived mainly from volcanoes on nearby islands.

Kiska is comprised of three different topographical regions: In the south, a region of strong dissection dominated by a sharp, sinuous drainage divide; in the north-central section, a region of isolated plateaus; and in the northern tip, the symmetrical cone of Kiska Volcano. The landforms of the first two regions result from destructional forces, faulting and erosion. Several of the peaks exceed 1,400 feet altitude; the highest is somewhat over 1,800 feet. Glacial features such as lake-filled cirques, roches moutonees, irregular closed bedrock depressions, and till are in evidence. Most of the surface of Kiska Volcano is constructional, slightly modified by stream erosion.

Rat and Amchitka Islands are sections of a submarine ridge that extends to the southeast from Kiska Island. Amchitka (35 miles long by 5 miles wide) displays rugged mountains, high plateaus, and swampy tableland. Rat (6 miles long by 2 miles wide) is a partially dissected terrace ranging from 125 to 404 feet in altitude, with a strongly dissected ridge rising to 1,127 feet in the eastern half. Both islands resemble one another in such shoreline features as wave-cut benches 6 to 8 feet above sea level, pebble and boulder benches caused by present wave action, and high turf-covered sea cliffs. A marine platform approximately one meter below present mean sea level surrounds most of Amchitka. The oldest rocks of Amchitka are volcanic emplaced under the sea. Volcanic rocks of both subaerial and submarine emplantation also make up Rat Island. Their surfaces have been slightly dissected by stream erosion and modified by Pleistocene glaciation. Interestingly enough, the highlands of Rat show the effects of glacial action more than do the mountains of Amchitka with their cirque-shaped valley heads, smoothed rock knobs, and undrained rock depressions. In contrast, the plateaus on Amchitka display more glacial erosion and deposition than do the lowlands of Rat.

Bedrock exposures reveal grooves and striations, while some outcrops have the form of roches moutonnees. Glacial till and gravel are present, and some of the cobbles and boulders in the till are striated or faceted.

The Atomic Energy Commission activities on Amchitka have resulted in very comprehensive geological studies and hence a better understanding of the structure of this part of the Chain (Carr, et.al., 1971). Previous geologic investigations have consisted primarily of surface exploration. Work on Amchitka has included geologic mapping, isotopic dating, deep drilling, geophysical surveys, hydrologic investigations and post-test-effects examinations.

Investigations on Amchitka indicate that there have been three separate volcanic episodes, i.e., (1) the Amchitka Formation of andesitic to latitic breccias, monolithologic glassy breccias and pillow lavas, and local tuffaceous beds, mostly of submarine formation, overlain by (2) the Banjo Point Formation, consisting of breccias and minor sedimentary rocks and pillow lavas, mostly of basaltic composition, deposited on the submerged flanks of a large volcano, overlain nonconformably by (3) the Chitka Point Formation of subaerial lava flows, flow breccias, pyroclastic rocks and minor conglomerate, all of andesitic composition.

List of Rock Types of the Rat Island Group

Semisopochnoi

Dune sand

Aluvium, eluvium and talus

Recent composite volcanic basaltic cones

Early postcaldera cone - basaltic tuff-breccia and tuffaceous sand w/minor basaltic flows

Late Pleistocene basaltic cones - lave flows and pyroclastic rocks later than or interbedded w/dacitic pumice of caldera eruption

Early subsidiary cones - pyroclastic rocks and lava flows; includes crystalline vent plugs of cones

Old volcano - Pochnoi volcanics which includes tuff breccia, lava flows, and agglomerate largely basaltic of shield shaped volcano. Locally sandstone from reworked pyroclastic deposits.

Widespread blanket of basaltic ash and thick deposits of pumiceous dacitic ash interbedded in part in late Pleistocene basaltic cones and lying on rocks of older formations.

Little Sitkin

Surficial deposits - alluvium, beach deposits, colluvium, Eolian deposits

Volcanic deposits - Little Sitkin dacite: sequence of low-silica dacite flows

Patterson Point formation - dacitic ash and pumice and dacitic and andesitic pyroclastic debris

Double Point dacite - sequence of high-silica dacite flows containing many microlitic inclusions of labradorite andesite, minor amounts of associated pyroclastic material

East Point formation - sequence of andesite and basalt flows

Sitkin Point fomation - water-laid pyroclastic material; tuffaceous graywacke, dacite-boulder tuff-breccia, andesitic tuff and pumiceous tuff

Williwaw Cove formation - sequence of andesite and bandaite flows with minor amounts of basalt, dacite flows and major amounts of pyroclastic material. Dikes of andesite and basalt in some areas.

Kiska

Surficial deposits - alluvium, colluvium, landslide deposits, beach deposits, and sand dunes

Rocks of Kiska Volcano - lava flows and interbedded pyroclastic rocks

Kiska Harbor formation - water-laid coarse-to-fine-grained pumice and detritus derived from volcanic rock, interbedded with breccia and flow rock

Gabbro - medium-to-coarse-grained intrusive gabbro and related rock types

Vega Bay formation - marine deposits of volcanic breccia, tuff and a few pillow lava flows, all of basaltic composition, with a few interbeds of conglomerate and sandstone of similar material

Dikes and intrusive rocks - related to Kiska Harbor and Vega Bay formations

Little Kiska

Related to Kiska Harbor and Vega Bay formations of Kiska Island

Davidof and Khvostof

Composite volcanic material

Segula

Beach deposits

Talus, alluvium and landslide deposits

Surface pyroclastic layers

Surface flows of porphyritic feldspathic basalt

Moderately well-bedded volcanic detritus

Composite volcanic material

Rat

Gunners Cove formation - tuffaceous conglomerate and sandstone, crystalvitric basaltic tuff, thin basalt flows and basaltic dikes

Rat formation - flows and flow breccias of porphyritic andesite and minor amounts of conglomerate composed of andesitic debris

Amchitka

Alluvial and eolian deposits

Glacial and interglacial deposits

Tilted sedimentary rocks at South Bight - sand and silt in tilted beds truncated at 90-foot altitude, overlain by fossiliferous beach deposit

Gravel of hornblende andesite

Chitka Point formation - flows, flow breccias and dikes of porphyritic andesite and feldspathic basalt, in part interbedded with marine conglomerate, in part subaerial deposits. Thickness exceeds 1,000 feet.

Quartz diorite - medium-grained quartz diorite and related rock in dikes, sills and a small stock. Intrudes rock of Amchitka and Banjo Point formation

Banjo Point formation - sandstone, conglomerate, tuffaceous shale and lapilli tuff of basaltic composition. Bedded near-shore marine deposits containing sparse fauna of middle Tertiary age.

Amchitka formation - volcanic agglomerate, tuff-breccia, tuff and pillow lava flows of andesitic to latitic composition. Tilted, jointed, and slightly metamorphosed in many areas. Thickness several thousand feet.

Table 19. Volcanoes of the Rat Island Group

Name	Approximate height in feet	Geographic location
Sugar Loaf	2,500	Semisopochnoi Island
Cerberus	2,400	Semisopochnoi Island
Anvil Peak	3,867	Semisopochnoi Island
Little Sitkin	3,921	Little Sitkin Island
Davidof-Khvostof	1,000	Davidof-Khvostov Island
Segula	3,799	Segula Island
Kiska	3,996	Kiska Island
Buldir	2,500	Buldir Island

Table 20. Calderas of the Rat Island Group

Name	Approximate diameter in miles	Geographic location
Semisopochnoi	4 1/2 x 3 2/3	Semisopochnoi Island
Little Sitkin	2 3/4	Little Sitkin Island
Davidof	1 1/2	Davidof-Khvostof Island
Buldir Depression	27 x 13	Underwater, west of Kiska Island

Table 21. Volcanic History of the Rat Island Group

Semisopochnoi Island Volcanoes	
Sugar Loaf	1948, steam
Cerberus	1772, smoke; 1790-1792, smoke; 1830, smoke; 1873, active
Anvil Peak	no historic activity
Little Sitkin Island Volcano	1776, active; 1828, smoke
Davidof-Khvostof Island Volcano	no historic activity
Segula Island Volcano	steaming intermittently
Kiska Island Volcano	steaming intermittently; 1963-1973, lava flows
Buldir Island Volcano	no historic activity

f. Near Island Group. The Near Group is the westernmost of the Aleutian Islands. In contrast to most of the other Aleutian Islands, the Near Group does not have any Holocene or historically active volcanoes, and its present morphological character was determined primarily by preglacial marine and subaerial erosion. The oldest rocks were deposited as a thick heterogeneous sequence in a tectonically and volcanically active marine environment during late Mesozoic, early or middle Tertiary time.

Prominent effects of heavy glaciation of Wisconsinan Age are found in these Near Islands and any evidence of earlier glaciation has been obscured or destroyed.

Two main terrain types are represented, i.e., low-lying, flat islands like Shemya and Nizki and islands of subaerial origin such as mountainous Attu. Alaid and Agattu Islands display a combination of both the above terrains.

Of the three Semichis, Shemya is the largest island, being two miles wide and four miles long. Its surface presents a gently rolling, lake-dotted, low plateau. Nizki and the lowlands of Alaid are below the 200-foot level of altitude. The west end of Alaid exhibits 600-foot hills. All of the islands are elevated wave-cut platforms of pre-Wisconsinan Age, beveled first by marine abrasion and then glaciation. It is thought that the ice sheet that covered Shemya, Nizki and the lowland part of Alaid was relatively thin and did not greatly erode these islands. Fluvial erosion is limited due to the small area and slight relief; stream deposits are almost absent. The islands' margins are ringed by narrow, boulder beaches.

The mountains of Attu (3,000 to 3,500 feet elevation) and Agattu (2,200 feet elevation) display the typical land forms of valley glaciation, i.e., cirques of varied shapes and sizes, hanging valleys, aretes, cols, U-shaped valleys and passes, rock steps at practically every valley mouth, and glacial troughs gouged by benches, grooves, and striations. Exposures of glacial deposition are few although some moraines, till, and erratics have been discovered. Small glaciers yet exist today on central Attu.

The low, rolling plateau located in the southern three-fourths of Agattu is covered with hundreds of lakes and ponds, most of which are of glacial origin. Several of these lie in rock basins. This plateau is thought to be a raised wave-cut platform and the scarp of a former sea cliff, that has undergone considerable glacial and fluvial erosion. Terraces and plateaus are common to both Attu and Agattu. Both islands are mainly marine platforms that were cut as the islands underwent intermittent emergence during pre-Wisconsinan Time. Sea level changes may have been partly of glacial eustatic origin; the different islands have not had the same history of changes of level but probably have been affected by local and differential crustal movements.

Post-glacial stream erosion has affected only a small part of the surface area. V-shaped gullies ranging in depth from a few feet to 400 feet are numerous, especially on Attu. The principal deposits on both islands occur in the broad valleys, where streams are youthful. Alluvial fans and talus cones and narrow flood plains have developed. Features of marine erosion and deposition are abundantly displayed, intruding active and inactive sea cliffs, shore platforms, and beaches (both sand and boulder).

List of Rock Types in the Near Island Group

Attu

Sedimentary and Extrusive Rocks

- alluvium
- beach deposits
- glacial till
- Faneto formation - coarse red sandstone and conglomerate
- Massacre Bay formation - basaltic and andesitic lava, and pyroclastic and coarse clastic rocks
- Chuniksak formation - fine-grained laminated siliceous, argillitic and limy sedimentary rocks
- Chirikof formation - conglomerate, sandstone, carbonaceous shale and possibly one lava flow; small outcrop on Chirikof Point. May be same age as Nevidiskov formation.

- Nevidiskov formation - coarse graywacke and conglomerate
- Basement rocks - fine-grained banded sedimentary rocks; coarse and conglomerate sedimentary rocks; volcanic rocks, including basaltic spilitic and keratophyric lava and tuff

Intrusive rocks

- hornblende andesite and dacite
- quartz keratophyre dikes
- diabase and gabbro dikes, sills and small plutons
- albite granite

Agattu

Sedimentary and Extrusive rocks

- alluvium and beach deposits
- Krugloi formation - undifferentiated which includes bedded argillite, siltstone and chert; lava which is chiefly basaltic and spilitic; tuff and tuff-agglomerate; conglomerate
- Basement rocks - undifferentiated; lava; tuff and tuff-agglomerate, conglomerate, argillite, siltstone and chert.

Intrusive rocks: dacite porphyry
diabase and gabbro

Shemya

Basalt porphyry

Hornblende porphyry - includes some porphyry rich in plagioclase phenocrysts

Andesitic and basaltic tuff and tuff-breccia

Basement rocks - siliceous and limy argillite and conglomerate; includes some tuff-breccia

2. Mineral Deposits

Although various general geology reconnaisances have been made of most of the Aleutian Islands, no mineral survey or mineral evaluation has been made. No metalliferous mineral deposits worthy of commercial exploitation have yet been found in the Aleutian Islands (Drewes, et al., 1961). Metalliferous minerals including zinc, copper, gold, silver, lead, pyrite, and chalconyrite occur in the Aleutians and have been found during the course of general geological surveys, or by private individuals.

Requests were made to the U.S. Geological Survey and the U.S. Bureau of Mines for information on the mineral potential of the Aleutian Islands (letters of March 7, 1972, from Alaska Area Director Watson to Mr. Richter, Geologist-in-Charge, U.S.G.S., Anchorage, and Mr. Service, Alaska Liaison Officer, Bureau of Mines, Anchorage). Both replied that they were unable to make an appraisal due to the lack of information and a restriction of funds needed to collect the required information (Mudge, U.S.G.S letters of 3/20/72 and 3/24/72 from Mr. Mudge, U.S.G.S. and Mr. Service, U.S.B.M., respectively, to Alaska Area Director Watson).

Within the refuge the only metalliferous minerals found to date have been secondary copper minerals along with a quartz-pyrite mineralized zone in the Bay of Islands area on Adak Island (Fraser and Snyder, 1959). Disseminated pyrite and quartz were found in the Blind Cove area and on the west shoreline of Beyer Bay. Fraser and Snyder state that no metallic deposits of economic grade have been found on Adak or Kagalaska Islands or any of the other Aleutian Islands.

Outside the refuge boundaries but within the Aleutian Islands several metalliferous mineral deposits have been recorded. Drewes et al.(1961) report a zinc deposit on Sedanka Island about 2 1/2 miles south of the abandoned village of Biorka. Sphalerite is the prominent mineral ore with pyrite abundant and some chalcopyrite and galena occurring. The zinc ore was found to contain minute quantities of copper, lead, silver and gold. There has been no development of this deposit and the potential is unknown.

Collier (1905) reported gold on Unalaska from a few auriferous quartz veins found on the northwest slope of Pyramid Peak, 1 1/2 miles south of the village of Unalaska. Evidently gold prospectors bound for Nome in about 1900 found the deposit, opened a small drift and erected a stamp mill. Although the gold assays promised very high values, this was not realized from the ore when milled. Subsequently the depos t was abandoned. Drewes and others (1961) report another auriferous quartz vein on Amaknak Island and the finding of a few minute grains of gold from two tributaries on the north side of Makushin River. Gold and silver have shown up in negligible quantities in assays of pyritic rock found in Sweeper Cove on Adak Island (Coats, 1956).

Drewes et al. (1961) found that northcentral Unalaska Island has potential for low-grade copper. Although there have been sulfur claims in the area, none for copper have been staked. The report goes on to recommend that field surveys be conducted to determine the extent of these deposits and their economic potential.

Nonmetallic minerals of the Aleutians include sulfur and possibly coal. Snyder (1959) indicates that at least four sulfur desposits of economic importance exist in Alaska. These are termed solfataras or surface deposits formed by sublimation (a mineral, or sulfur in this case, being blown up by hot gasses and being precipitated at the surface) from hot sulfurous volcanic vapors. These are situated in the belt of active and quiescent volcanoes that extend throughout the Alaska Peninsula, the Aleutian Islands, and Japan. The four deposits reported in Alaska are near Stepovak Bay on the Alaska Peninsula, Akun Island, Makushin Volcano on Unalaska Island, and Little Sitkin Island. Other deposits probably exist but have not been found and/or reported. Of these four deposits only the one on Little Sitkin Island is within the boundaries of the Aleutian Islands National Wildlife Refuge.

The sulfur deposits covering about 10 acres on Little Sitkin occur on the south side of a breached volcanic crater between 1,500 feet and Summit Lake at 2,665 feet. Traces of sulfur have also been observed in the fumarolic area south of the 1,303-foot mountain. This large deposit occurs as massive mammillary aggregates of crystals. Subsurface sulfur veins and vug linings occur in a white clay product. The surface layer is about 10 feet thick and contains approximately 95.8 per cent sulfur. The U.S.G.S. estimates a potential of 200,000 tons.

Akun Island was actively mined in 1919 and 1920. Reserves there are estimated by the U.S. Geological Survey to be 18,000-24,000 tons as compared to 100,000 tons at Makushin. No other area has been mined and no reason has been found for the termination of mining at Akun.

At present there are five claims on Akun, thirteen on Unalaska, and none on Little Sitkin. The only claim work accomplished is the assessment work. A 1946 U.S.G.S. report states that the Akun and Unalaska reserves were not economically mined due to the abundance and low cost of sulfur in Texas and Louisiana. No information was found to indicate if this reasoning is still valid.

Coal deposits extend westward along the Alaska Peninsula as far as Herendeen Bay near Port Moller, and Unga Island in the Shumagin Group. The only reports of coal in the Aleutian Islands is from Akun Island where thin seams of lignite have been found (Stone, 1905), and at Amchitka by Wosnesenski who collected specimens of lignite and fossil wood (Dall, 1896).

The closest known large coal deposit to the Aleutians is on Unga Island. This coal field is described by Atwood (1911) as tertiary lignite-bearing rocks underlying an area of about forty square-miles in the northwest part of Unga Island. A section of the deposit measured in a beach bluff included about 300 feet of poorly-cemented sand, clay, and gravel interbedded with five beds of lignite ranging from a few inches to four feet thick. The beds dip uniformly 8-10° West and are overlain by 200 feet of conglomerate. Analysis indicated low heating values and a high ash content. Some developmental work was done in 1911 but there was no significant production.

3. Oil and Gas. The Aleutian Islands are within a volcanic province and outside any known oil provinces, although the eastern Aleutians are adjacent to an oil province (Fed. Field Comm. 1968). Seismic investigations have

been conducted on both the Bering Sea and Pacific sides of the Aleutians as far west as Umnak Island and have been generally centered on the shelf area sedimentary deposits on the north side of the Chain (Wanek, 1969, personal comm.). There is no data available to indicate the oil and gas potential of this area.

The petroleum province on the Alaska Peninsula is called the Nushagak Basin, almost all of which is offshore in the Bristol Bay estuary and extends from King Salmon to Unimak Island. Mountains of the Alaska Peninsula form its southern extremity. It includes the adjacent Izembek National Wildlife Range on the Alaska Peninsula. The Alaska Peninsula has experienced sporadic oil drilling and exploration since 1902, with a total of 29 oil wells drilled between 1902 and 1972. These extend from Pavlof Bay and David River on the west to Chinitna Bay-Lake Iliamna on the east. Abrahamson (1968) has stated, "Despite encouraging showings and some oil recovered in shallow wells, the Alaska Peninsula and the area delineated has so far proven to be commercially unproductive. It may be expected that the search will continue because the proper oil-bearing geological conditions and unusually large oil seeps are existent". Gulf Oil Company's Sandy River well penetrated potential reservoir rock and encountered some minor indications of oil. Results of drilling by Pan American (Dow-Amoco) on the flank of the basins off of Port Moller are unknown. Exploration is at an early stage in the Bristol Bay area. Because of this insufficient data prevents any calculation of the areas potential.

On the Pacific side of the Peninsula, the Kodiak Tertiary sub-province extends southwest from Middleton Island past the Kodiak Islands, south to include the region around the Trinity Islands. At this time it is thought that this region does not extend any further south or southwest. Oil potential in this area is thought to be concentrated in the offshore areas. Because of the uplifting and faulting from the coastal Chugach Mountains, the possibilities of sizable petroleum deposits along the shoreline are considered limited, but by no means eliminated. Moving offshore, the geological structure becomes gentler as the distance away from the mountains becomes greater. It is evidently within this area of folding that the potential oil deposits are located. A number of these structures are thought to exist on the continental shelf in the Gulf of Alaska area, but a lack of exploration has hindered the development of data on their oil-producing capabilities. No drilling has been conducted within the area of the Alaska Peninsula that would indicate whether oil is in fact existent.

4. Geothermal Resources. The Aleutian Islands are considered to be within a geothermal resources province (Godwin et al., 1971). The geothermal Province is defined as an area in which higher than normal temperatures are likely to occur with depth, and in which there is a reasonable possibility of finding reservoir rocks that will yield steam or heated fluids to wells. The earth is an immense reservoir of energy and most of the energy is contained within the earth's core and mantle but this heat is diffused throughout a very large area. Economically significant concentrations of this energy do occur in local hot spots, where temperatures from 150° F to 650°F are found in porous rocks containing water and/or steam. These

concentrations are known as geothermal reservoirs, and are found in areas of recent volcanism, mountain building and in many sedimentary basins.

A geothermal resource is considered to be energy which can be generated by the utilization of natural steam or heat. Generally, the geothermal area is associated with the belts of young volcanism that ring the Pacific area, which includes the Aleutian Islands, and generally follows the mid-ocean ridges. In the Aleutian Islands, the area containing the geothermal resources occurs in the proximity of recent volcanic activity or where there have been intrusions of igneous rocks or faulting. The Geothermal Resources Province (GRP) is similar to a petroleum province, but is defined as an area valuable prospectively for geothermal steam and associated geothermal resources. The classification of this area is made for the future and is necessary to provide adequate protection against alienation or misuse of leasable geothermal resources. Criteria that are used to establish these provinces are (1) volcanism of late Tertiary or Quaternary age, especially caldera structures, cones and volcanic vents; (2) geysers, fumaroles, mud volcanoes or thermal springs at least 40° higher than average ambient temperatures (Table 22); (3) subsurface geothermal radiance, generally in excess of twice the normal, as reflected in deep-water wells, oil well tests and other test holes (Godwin et al., 1971).

Present-day use of geothermal energy includes the generation of electricity, manufacturing, agricultural and space heating. Future use of this energy in the Aleutian Islands would be expected to be principally with the generation of electricity and space heating. The Geothermal Steam Act of 1970 (Public Law 91-581) directs that lands shall be classified as Known

Table 22. Thermal Springs in the Aleutian Islands (Waring, 1965)

Location	Water Temp. (°F)	Flow (in gpm)	Assoc. Rocks	Remarks
Attu	Warm	---	Lava	Water rises in pools
Little Sitkin	Hot	---	Lava	Near solfataric volcano
Semisopochnoi	Hot	---	Lava	---
Hot Springs Bay, Tanaga	Hot	---	Lava	---
Volcano Base, Kanaga	219	---	Lava	Hot springs and fumaroles. Used for cooking food.
Near White Volcano, Adak	Hot	---	Lava	---
Great Sitkin	190-208	---	Lava	12 main springs; mud pots and fumaroles at 2,000 feet.
Near Conical Volcano, Atka	Hot	---	Lava	Mud pools, some boiling
Near Klivchef Volcano, Atka	Hot	---	Lava	---
About 5 miles from Korovin Bay, Atka	167	---	Lava	---
Seguam	Hot	---	Lava	Springs and hot mud pools
Base of volcano, Chuginadak	Hot	---	----	---
Kagamil	Hot	---	Lava	Springs and fumaroles
NE of Vsevidof Volcano - Umnak	43-68	52,000	Lava	16 springs, 1 geyser, fumaroles
Central part of Umnak*	214	---	Lava	Small geyser
Hot Springs Cove, Umnak*	95-215	---	Lava	28 springs, several small geysers
Bogoslof*	Hot	---	Lava	Steam vents
Makushin Volcano, Unalaska*	94	---	Lava	Springs and solfataras
Akutan*	181	---	Lava	Springs and steam vents
Islet NW of Akutan*	Hot	---	Lava	---
Islet SE of Akutan*	Hot	---	Lava	Springs at beach level
Pogromni Volcano, Unimak	Hot	---	Lava	Springs, hot marshes

*Not within the Aleutian Islands National Wildlife Refuge

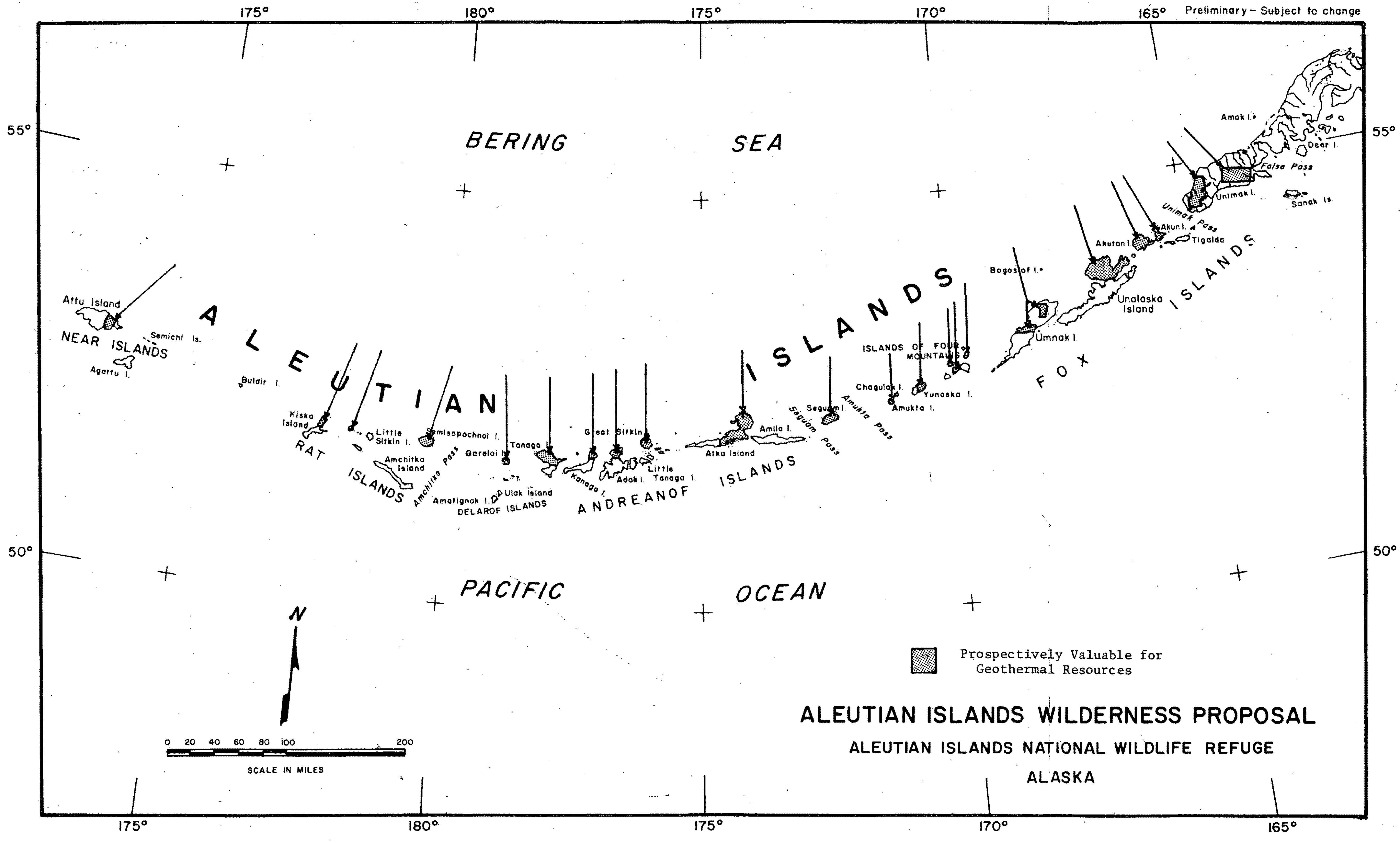


Figure 46. Areas Within the Aleutian Islands Classified As Prospectively Valuable for Geothermal Resources

Geothermal Resources Area (KGRA) when the prospects of extraction of geothermal steam or associated geothermal resources from an area are good enough to warrant expenditures of money for that purpose. Although the Act does identify the responsibilities of the U.S. Geological Survey in identifying these areas for potential leasing as provided for under Section 3, Section 15(c)(3) provides that geothermal leases shall not be issued for lands administered by the Secretary of the Interior including fish hatcheries, wildlife refuges, wildlife ranges, game ranges, wildlife management areas, waterfowl production areas, or for lands acquired or reserved for the protection and conservation of fish and wildlife that are threatened with extinction.

Figure 46 illustrates those areas within the Aleutian Islands that have been identified as prospectively valuable for geothermal resources by U.S.G.S. At present, only the Geyser Spring Basin and Okmok Caldera on Umnak Island are classified as a Known Geothermal Resources Area. There are no K.G.R.A.'s as yet within the refuge. Although only one area in the Aleutians has been specified as such, designation of additional areas will depend upon additional geological information being collected and analyzed. Based upon the present volcanic activity within the Chain, however, the geothermal potential is considered to be significant.

5. Seismology. The Aleutian Islands along with southern Alaska constitute one of the world's most active seismic zones (Figure 47). The Alaskan zone is but a part of the vast, continuous, seismically active belt that circumscribes the entire Pacific Ocean basin and is known as the Pacific Earthquake Zone. Ground breakage, mud and sand emission, volcanic eruptions,

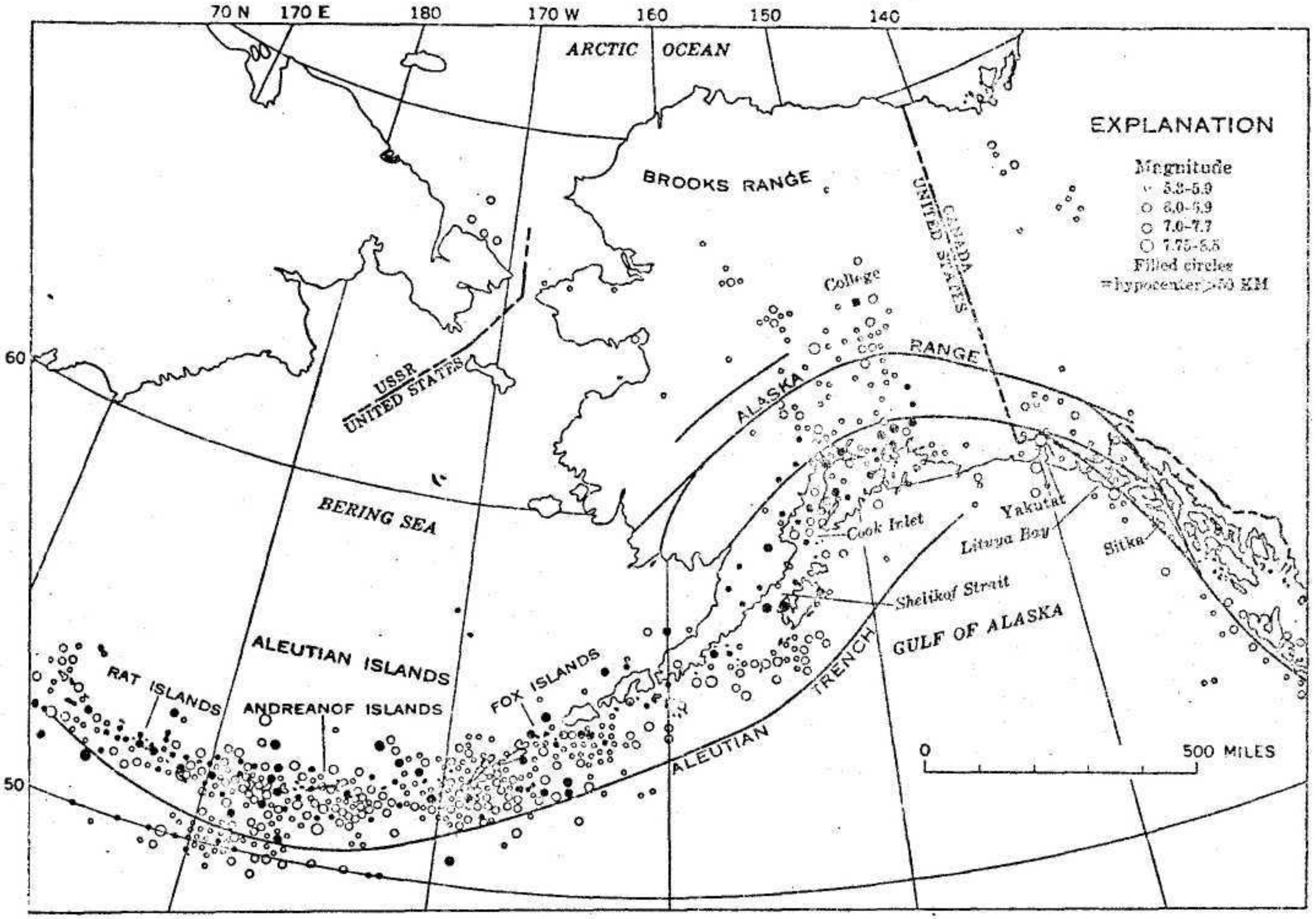


Figure 47. Epicenters of Major Alaskan Earthquakes 1898-1961

The Alaska Earthquake March 27, 1964:
Field Investigations and Reconstruction Effort
U.S. Geological Survey Professional Paper 541.

seawaves, tsunamis, land level changes, and submarine and land slides are the result of the normal functioning of this zone.

Two earthquake sub-zones are found in the Alaskan segment, one following a line northwest through Vancouver Island and southeastern Alaska, and the second from the Copper River Valley westward along the Alaska Peninsula and the Aleutian Islands to the Kamchatka Peninsula. Most of the Alaskan earthquakes occur in this latter zone, along with six per cent of the world's large shallow earthquakes (Figure 47).

Geologists now theorize that this seismic activity is probably due to earthcrust movements which are described as continental drift, sea-floor spreading and plate tectonics (the idea that the earth's crust consists of plates that are created at one edge and destroyed at the other). The Aleutian Trench is thought to be the point at which the Bering plate is moving under the Pacific plate, hence the resulting friction between the plates causes numerous earthquakes. This is supported by the fact that the majority of the earthquakes occur south of the Chain, in the vicinity of the trench.

Carr and others (1971) agree in general with Gates and Gibson (1956), Coats (1962), and Gates and others (1954) that the Aleutian Arc is a zone of crustal shortening developed not by underthrusting of the Pacific floor or by southward movement of the insular ridge, but by a southward drift of a large tectonic plate comprising the Bering Sea and adjacent area. Initial uplift of the insular ridge is thought to be from widespread syntectonic plutonism during the Miocene. Major faulting occurred during this period and again in the Pliocene in association with volcanism on the north side of the Aleutian Arc. This has resulted in the Sunday Basin and Buldir Depression and the major canyons indenting the insular ridge, such as Adak Canyon and the canyons in the Amchitka Pass area. It is thought that although Amchitka Island is in a seismically active area, it has been structurally stable during recent geologic time.

Morris (1971) suggests that displacement in the western Aleutians in late Pleistocene and Holocene has been minor, except for Attu Island, where the marine terraces have been displaced 10 to 20 feet. Elsewhere the displacement probably has not exceeded 5 to 10 feet since the beginning of the late Pleistocene time.

In 1874, the Aleutian Trench was first recorded when the U.S.S. Tuscarora, returning home from Japan, obtained soundings which indicated a depression on the south side of the Aleutian Islands (Murray, 1946). One sounding near Attu Island indicated a depth of 4,037 fathoms. Sporadic exploration followed until about 1930, when the United States Coast and Geodetic Survey took a series of about 45,000 soundings. The trench extends about 2,200 statute miles from Yakutat Bay to Attu Island, and varies in depth from 2,000 to 4,000 fathoms. The floor of the trench lies about 20 to 70 miles from the edge of the continental shelf. The maximum elevational difference between the floor of the trench and the nearby land features occurs off Unimak Island, where the greatest depth is about 32,500 feet, or six miles below the summit of Shishaldin Volcano, 9,978 feet high.

Tidal waves (tsunamis) are not uncommon in the Aleutians. These often accompany major earthquakes and can affect such distant places as Hawaii, Japan, the west coast of North America and South America and the South Pacific area. This was true of the tidal wave of April 1, 1946, which was generated by an earthquake registering 7.4 on the Richter scale whose epicenter was immediately south of Unimak Island. This earthquake generated a seismic sea wave (tsunami) over 100 feet high which totally destroyed the Scotch Cap lighthouse on Unimak Island killing all five occupants. The Sanak Island Group experienced a 20 foot wave 10 minutes after the main shock. This inundated all but the main island and two of the smaller but higher islands. This sea wave was felt throughout the Pacific area and was most severe in Hawaii, causing heavy damage and a great loss of life.

A warning system is now operated by the U.S. Coast and Geodetic Survey for monitoring earth movements and possible resultant tidal waves. Within this system is the Alaska Tsunami Warning System which has seismic stations located at Shemya, Adak and Nikolski, and tide gauges at Shemya, Adak, and Unalaska. All of these are monitored by the Palmer Seismological Observatory at Palmer, Alaska.

CHAPTER VII

PUBLIC USE

Recreational use of the Aleutian Islands Refuge is almost entirely restricted to those areas containing existing human populations. Because of the isolation, inaccessibility of most of the refuge, and persistent inclement weather, public use is minor, and is generally limited to those area that can be easily reached by either foot or boat. Use has increased as the population has increased and this trend is expected to continue in the future. The high transportation cost into the Aleutians severely limits tourism and will continue to do so until those costs are reduced. Almost all present use is by the residents of the area. In 1972 an estimated 3,065 visitors spent about 32,260 hours in recreational endeavors on refuge lands with fishing and hunting the most popular of 11 major activities. These activities are listed below.

Activity	Number of Participants	Total Hours
Fishing	890	13,100
Hunting	830	6,300
Wildlife observation	390	4,400
Sightseeing	220	2,200
Horseback riding	180	360
Photography	165	1,650
Camping	150	1,200
Walking and hiking	100	1,700
Beachcombing and fruit picking	85	1,000
Clamming/crabbing	50	100
Trapping	5	250
TOTALS	3,065	32,260

Fishing is the most common recreational use made of the refuge. An estimated 890 fresh and saltwater fishermen spent about 13,100 hours fishing on or adjacent to the refuge in 1972. Greatest fishing efforts normally occurs at Adak during the summer period, May through September. Attu Island has an outstanding sea-run Dolly Varden and salmon fishery. This fishery is so outstanding that military personnel from Shemya Island travel to Attu on Friday and stay until Monday, spending the weekend enjoying the excellent fishing opportunities. Fishing on Shemya is limited to introduced rainbow trout and kokanee salmon in fresh-water lakes, and like all other refuge islands, to saltwater fishing. The latter yields mostly flounder, perch, Irish lords, and halibut throughout the Chain.

An estimated 830 hunters spent about 6,300 hours in 1972 in pursuit of their favorite quarry. Caribou are hunted on Adak with reindeer infrequently hunted on Atka. Migratory waterfowl and upland game bird hunting is permitted only on Atka, Great Sitkin, Adak, Shemya, and Attu Islands. Limited fox hunting occurs on Adak. The Marine Mammal Protection Act of 1971 prohibits sport hunting of seals and sea lions. This does not affect the Native subsistence hunting.

Beachcombing and hiking are also popular pastimes and often yield unexpected finds and experiences. Glass balls from Japanese and Soviet fishing nets are commonplace and are eagerly sought by beachcombers.

The beauty and wildlife of the Aleutians is a mecca for the photographer, wildlife observer and general sightseer. Some camping does occur although it generally is associated with either hunting or fishing activities.

Other uses include limited trapping, berry picking, clamming, horseback riding and mountaineering.

The Aleutian Islands are considered to be a unique ecosystem and as such, they have been the subject of many scientific investigations. The most intensive of these occurred at Amchitka during the Atomic Energy Commission's activities. Other studies have occurred throughout the Chain but most have been centered on or near Amchitka Island. Studies generally concern fish and wildlife ecology, archeology or geology.

CHAPTER VIII

MANAGEMENT AND DEVELOPMENT

Management Responsibility

The Bureau of Sport Fisheries and Wildlife is responsible for the administration and management of the Aleutian Islands National Wildlife Refuge. Exceptions to this jurisdiction are primary land withdrawals for military and navigational-aid purposes on portions of Attu, Adak, and Ugamak. Refuge withdrawal on these areas is secondary, as recognized in the Attu withdrawal; "...this order shall take precedence over but not otherwise affect the existing withdrawal for wildlife purposes.", and in the Adak withdrawal; "The reservation made by this order shall be the dominant reservation except for purposes of wildlife conservation and management, as to which Executive Order 1733 of March 3, 1913, shall be the dominant one."

The Department of Defense and the Coast Guard in the Department of Transportation have appropriate responsibilities for the areas primarily withdrawn for their purposes. The administration of those areas on Attu, and Shemya, used by the Departments of Defense and Transportation, under use agreements between those agencies and the Bureau of Sport Fisheries and Wildlife, is still the responsibility of the latter agency.

The Alaska Department of Fish and Game has responsibility for management of species of resident wildlife, and both sport and commercial fisheries in the Aleutian Islands. The Departments broad management policy is stated as follows: "The Alaska Department of Fish and Game recognizes the constitutional mandate of the State of Alaska to manage all species on the sustained-yield principle for the benefit of the resource and the people of the state, and also recognizes that national and international interests must be considered." (Alaska Dept. of Fish and Game, 1973).

The state's activities in the Aleutians to date have been very limited and primarily concerned with sea otter research, census and harvest, caribou surveys on Adak Island, and surveys and enforcement activities relating to salmon and shellfish fisheries throughout the Chain.

Refuge Management

The National Wildlife Refuge System Administrative Act of 1966 (16 USC 668d-668ee) consolidates the various authorities relating to the administration of the National Wildlife Refuge System. This Act provides that no person may enter, use, or otherwise occupy any national wildlife refuge for any purposes unless such activities are permitted by the Secretary or by express provision of law, proclamation or establishing order. It further provides that the Secretary may authorize the use of any area in the system for any purposes, including but not limited to hunting, fishing, public recreation and access whenever he determines that such uses are compatible with the major purposes for which the area was established.

The authority of the Secretary is redelegated through the Director of the Bureau of Sport Fisheries and Wildlife, the Alaska Area Director, and finally the Refuge Manager--the man in the field in charge of the refuge. The Secretary's authority is diminished as it passes to the Refuge Manager and is accompanied by various constraints as determined by the mission and objectives of the National Wildlife Refuge System, and finally by the objectives of the individual refuge.

Title 50 of the Code of Federal Regulations set forth the general primary objectives of the National Wildlife Refuge System as follows:

"All wildlife refuge areas are maintained for the fundamental purpose of developing a national program of wildlife conservation and rehabilitation. These areas are dedicated to wildlife found thereon, and for the restoration, preservation, development, and management of wildlife habitat; for the protection and preservation of endangered or rare wildlife and their associated habitat; and for the management of wildlife, in order to obtain maximum production for perpetuation, distribution, dispersal and utilization."

Title 50 then effectuates these primary objectives through regulation to meet the obligations of treaties and various Legislative acts and to provide for public enjoyment of refuge areas. An annotated listing of the statutes and regulations pertaining to the administration of the National Wildlife Refuge System is included in the Appendix.

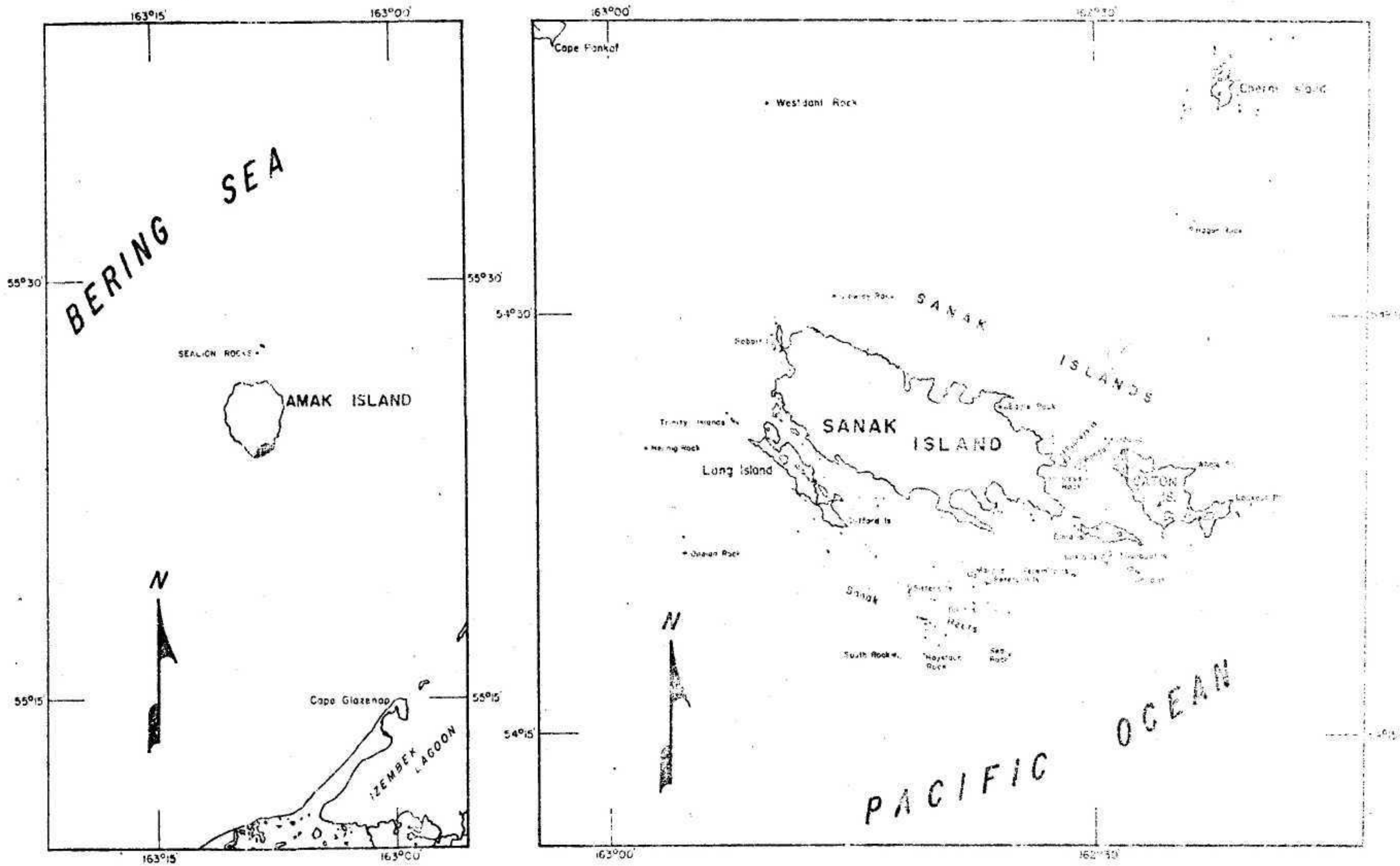
There is no master or refuge management plan for the Aleutian Islands National Wildlife Refuge. The Refuge objectives were developed from a management objectives prospectus. Past refuge administration has been of the "caretaker" category and has consisted of infrequent visitation concentrated primarily on Shemya, Agattu, Amchitka, and Adak. Past management efforts have been involved primarily with sea otter research, re-establishment of the Aleutian Canada goose in the western Aleutians, establishment of caribou on Adak and the monitoring of the Atomic Energy Commissions' activities on Amchitka. Isolation difficulty of access, and the high operational costs, have resulted in this areas being largely ignored. Relocation of refuge headquarters from Cold Bay on the Alaska Peninsula to Adak should permit the Bureau to better fulfill refuge management objectives on the Aleutians in the future.

Wildlife management goals at present are directed primarily at monitoring populations and their habitats, enforcement of state and federal wildlife laws, and re-establishment and protection of the endangered Aleutian Canada goose. Surveys and patrols are by foot, boat, and aircraft conducted from base camps of three types, i.e., temporary tent camps, the 65' Motor Vessel Aleutian Tern and established villages or government camps.

There are no plans to manipulate existing habitats, but to maintain them by preserving the existing wilderness-wildlife environment. Vast amounts of buildings, equipment and material have been placed in the Aleutian Islands with much accompanying surface disturbance. World War II-associated-operations in particular resulted in huge amounts of refuse left in place on many of the islands. Most military sites were completely abandoned at the war's end and no attempt made to remove any of this refuse. A minor amount has been removed since by the federal government authorizing private companies to salvage what they could. This was accomplished during the 1950's, but only the major installations were affected. Some minor cleanup has also occurred through normal maintainence and cleanup operations on presently active government bases. Only on Adak Naval Station has this been particularly significant, and the area's esthetics have been greatly improved as a result.

The areas of military refuse are delineated in Table 23 and Figures 48 through 55 as either major installations or minor installations. The former are those areas having runways, more than 20 quonset huts, large storage buildings, oil storage tanks, construction equipment, and extensive road systems. Minor installations are those with less than 20 quonset huts, a very limited road system or none at all, and relatively small items of refuse such as 55-gallon fuel drums, telephone poles, etc. Removal of major installations will most probably require congressional action, whereas removal of minor installations can be accomplished over a period of time by refuge personnel in cooperation with the military. It is refuge policy to destroy or assist the disintegration of this refuse when and where possible. With limited manpower, budgets, and with higher priority projects however, only a minute fraction of the total has been affected.

Disintegration of non-organic materials occurs slowly in the Aleutian environment and items such as metal and building material will require hundreds of years to finally disappear. Quonset huts built over 20 years ago are only now disintegrating. During wind storms the danger to personnel from these flying materials is quite great. Alaskan Senator Ted Stevens is currently preparing a bill to provide authorization for the military to cleanup refuse in the Aleutians, but the particulars of the bill are unknown at this time. One consideration of great importance in refuse removal is the danger that environmental damage could be done in areas where access is difficult and if heavy equipment is used. In many cases it is deemed best to allow deterioration to do the job.



AMAK ISLAND AND SANAK ISLAND GROUP
ALEUTIAN ISLANDS WILDERNESS PROPOSAL
ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA

Figure 48. Areas of Military Refuse

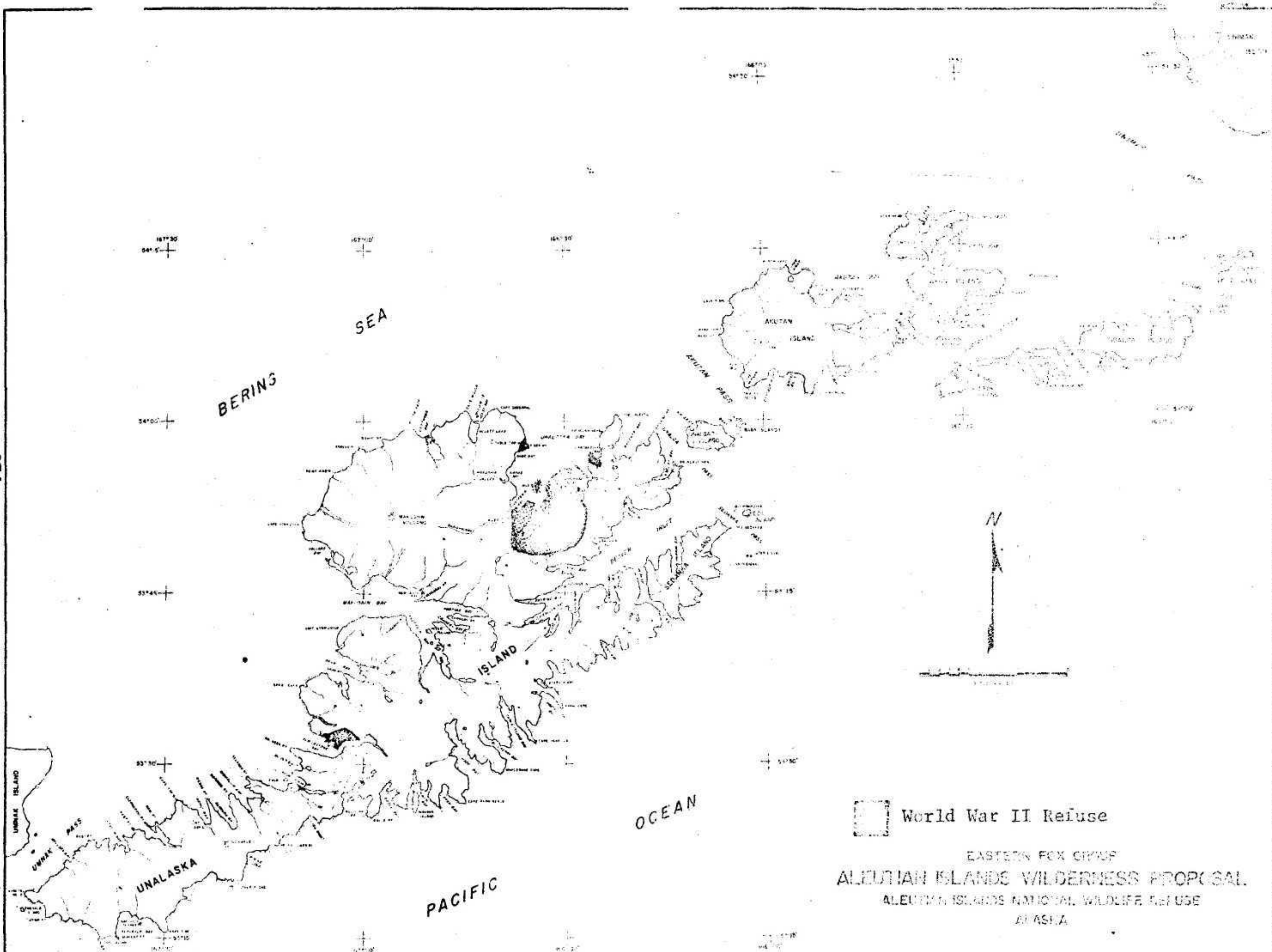


Figure 49. Areas of Military Refuse

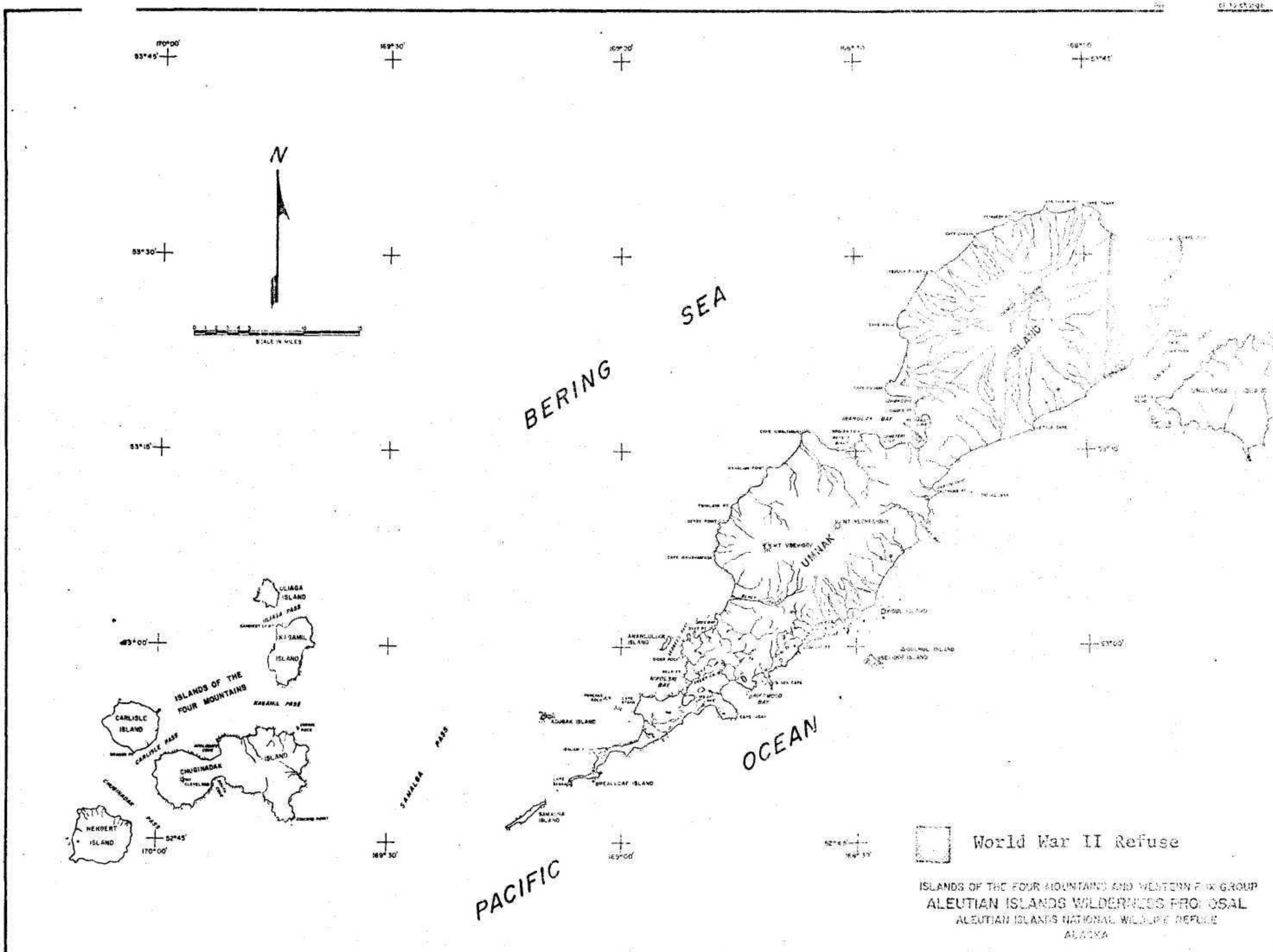


Figure 50. Areas of Military Refuse

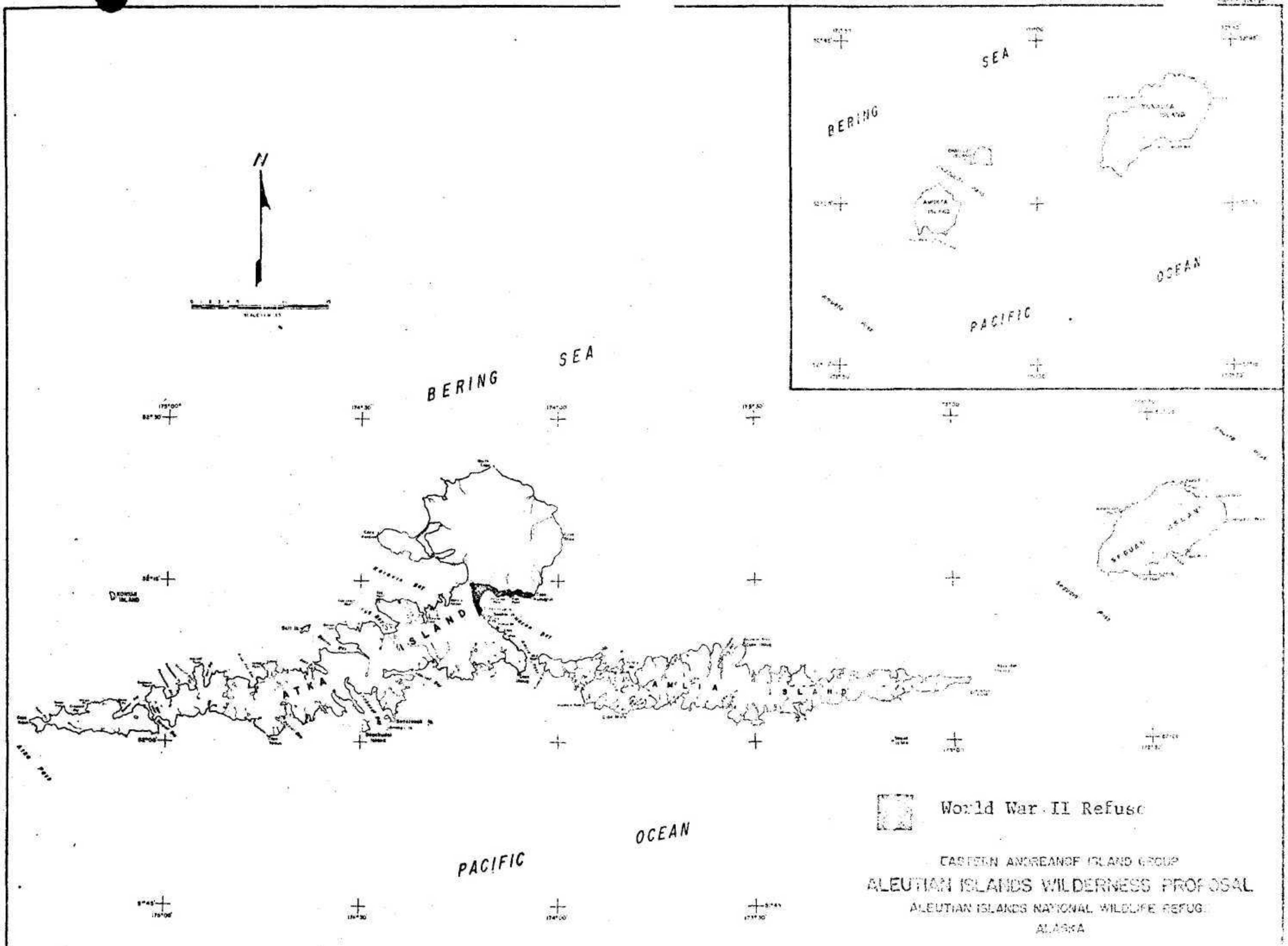


Figure 51. Areas of Military Refuse

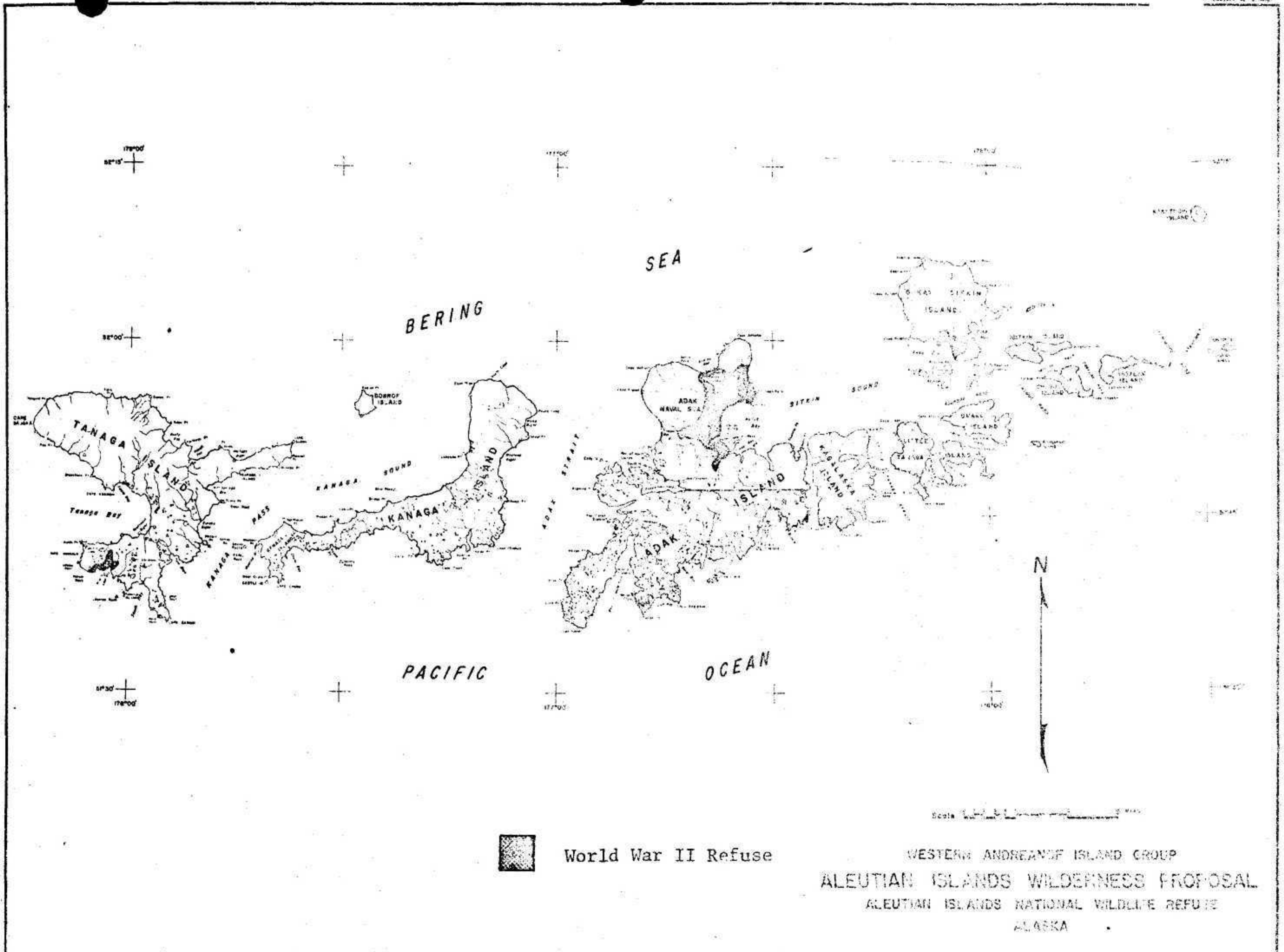


Figure 52. Areas of Military Refuse

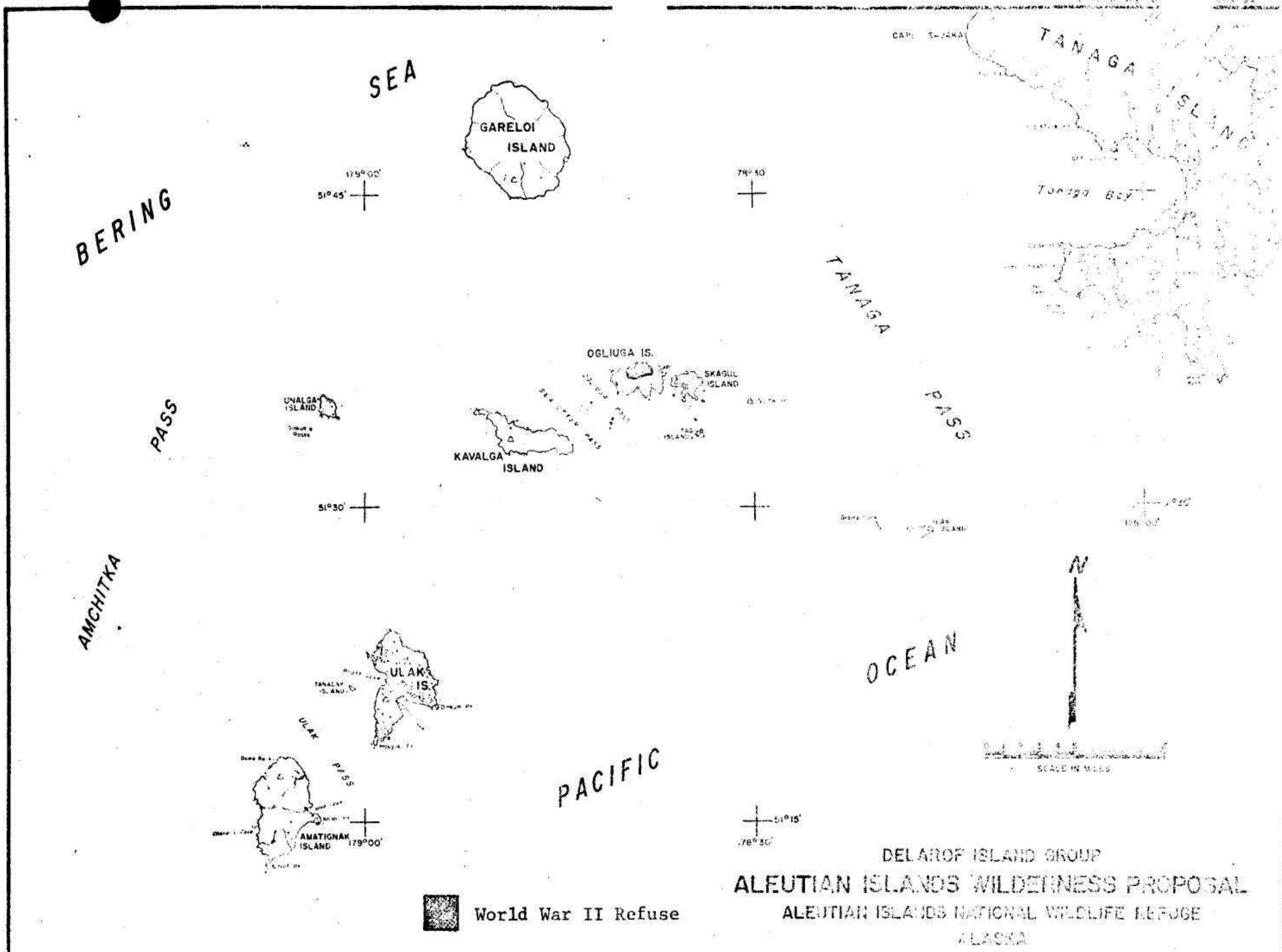


Figure 53. Areas of Military Refuse

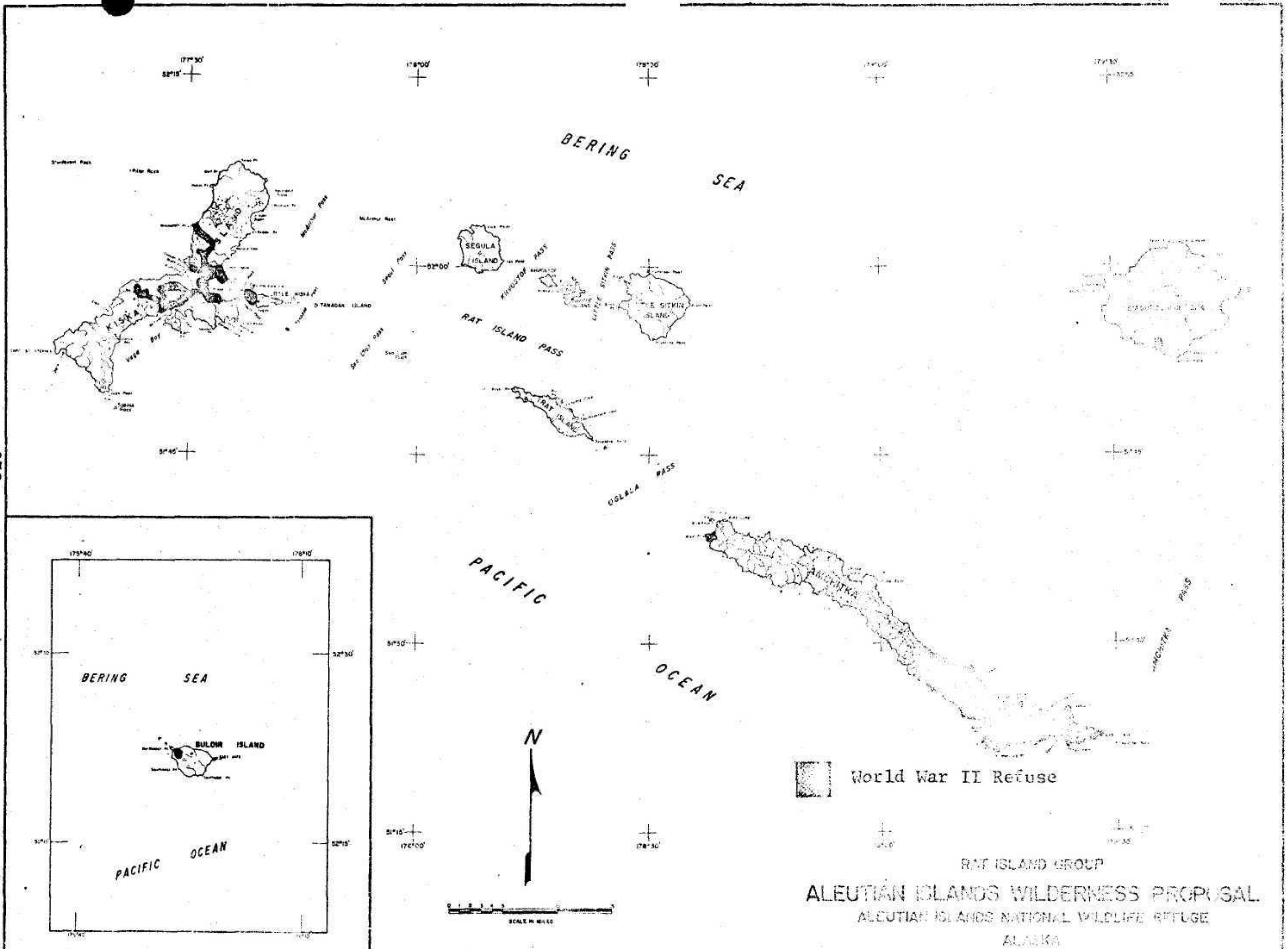


Figure 54. Areas of Military Refuse

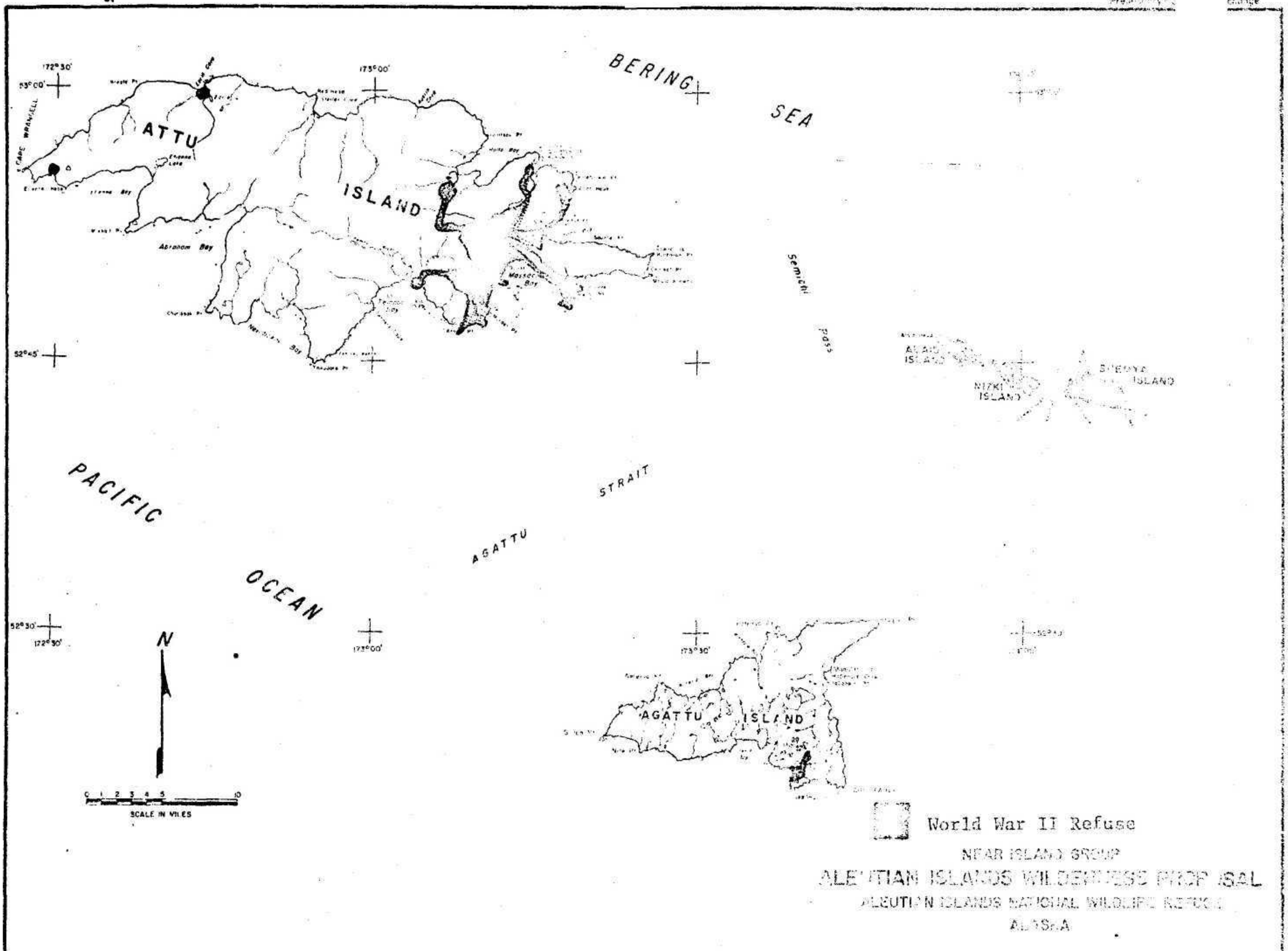


Figure 55. Areas of Military Refuse

Table 23. Areas of Military Refuse - Aleutian Islands Refuge

	ISLAND	AREA AFFECTED	AIRCRAFT RUNWAYS	DOCKS	LARGE BUILDINGS	QUONSET HUTS & OTHERS	OIL TANKS	RADIO ANTENNAS	55-CAL BARRELS	CONS EQUI
						TYPE OF REFUSE				
	Amak	1 acre				2				
	Caton	10 acres				6		5	X	
FOX	Unimak									
FOX	Scotch Cap	5 acres			1	X			X	
ANDREANOF	Atka	900 acres	1	1		X	X		X	X
ANDREANOF	Great Sitkin	700 acres			X	X	X		X	X
ANDREANOF	Adak	2000 acres		3	X	X			X	X
ANDREANOF	Tanaga	774 acres	1		X	X		X	X	X
ANDREANOF	Ogliuga	390 acres	1			X		X	X	X
RAT	Semisopochnoi	1 acre				X				
RAT	Amchitka									
RAT	SE end	20,900 acres	3	1	X	X	X	X	X	X
RAT	NW end	50 acres				X				
RAT	Kiska	1,940 acres	1	1	X	X	X		X	X
RAT	Little Kiska	35 acres				X			X	
RAT	Buldir	2 acres				X			X	
NEAR	Agattu	400 acres				X		X	X	
NEAR	Shemya	3,520 acres	2	1	X	X	X		X	X
NEAR	Attu	8,166 acres	4	3	X	X	X	X	X	X

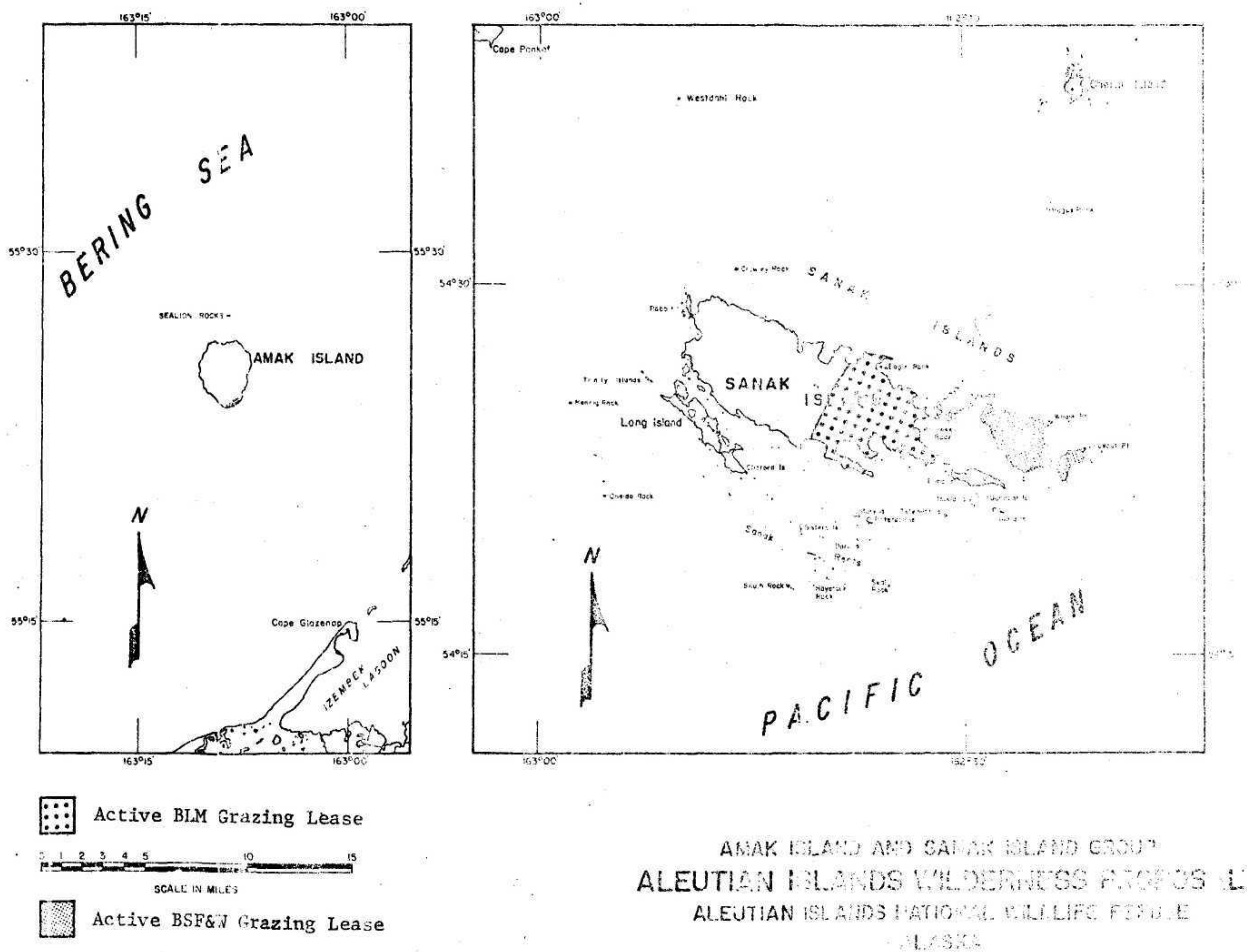
Several old plane and ship wrecks occur throughout the Chain. To remove these would be extremely difficult and very expensive. Time and the elements will ultimately eliminate these blights upon the land.

The Bureau has recorded 956 acres and 7.5 stream miles of the most obvious environmental disturbance by recent Atomic Energy Commission activities on Amchitka Island. This includes off-road vehicular damage to the terrain, damage to kitchen-middens, road improvements, gravel and rock quarries, oil spills, sump spills, and facilities construction. Current roll-up operations by AEC involve removal of trash and facilities, burial of sumps and settling basins, and restoration of the island to as natural a condition as possible. Several structures will remain on Amchitka after 1973. Following is an approximate list; three living quarters (barracks), two large warehouses, small metal warehouses, dry storage building, north and south hangars, airport terminal, pumphouse, generator buildings, and the bunker at the northwest camp. The sewage lagoon below the main camp will be left as will the airstrip and dock facilities. Instrumentation installed on the adjacent Rat, Semisopochnoi, and Amatignak Islands for monitoring the nuclear detonations is to be removed and the sites there also returned to as natural conditions as possible. These stipulations were agreed to by AEC when they obtained permission to install their instruments on the islands adjacent to Amchitka.

With the exception of government installations on Attu, Shemya, Amchitka, and Adak, fewer than 600 people live on or near the refuge. Because of the extreme isolation and inaccessibility of most of the chain, and persistent inclement weather, public use is of minor consequence. All islands except for Attu, Shemya, Amchitka, Adak, and Atka are infrequently visited. The major exception to this is at the Adak Naval Station where government personnel and their families, totaling about 5,000, reside. A self-guiding auto tour is presently planned for Adak. This would be located on existing roads within the Naval Station withdrawal. The present level of recreational use in the chain is expected to increase slowly but not to any significant level. No additional recreational development is planned and most use will continue to be that associated with the present use pattern.

Scientific studies within the refuge will be encouraged. Kenyon (1966) best summarized the value of the Aleutian Islands for scientific investigations as follows: "Murie (1959) considered the islands of the Aleutian

> National Wildlife Refuge '... one of North America's most significant biogeographic regions'. The special scientific value of the unique fauna and flora of oceanic islands is demonstrated through the works of Charles Darwin, Alfred Russel Wallace, Ernst Mayr, David Lack, and many others. Studies, based on the biota of oceanic islands, have revolutionized scientific thinking. Knowledge gained from them has deeply affected human lives. Scientists have yet touched little more than the surface of the scientific knowledge obtainable from the unique genetic biological material endemic to oceanic islands. Only in the undisturbed ecological situations that exist in isolation can unique island fauna survive. Already much of the valuable biological material of islands is extinct. For example, 'more than 90 percent of all bird species that have become extinct in historical times are island species,' (Mayr, 1954. p. 173)."



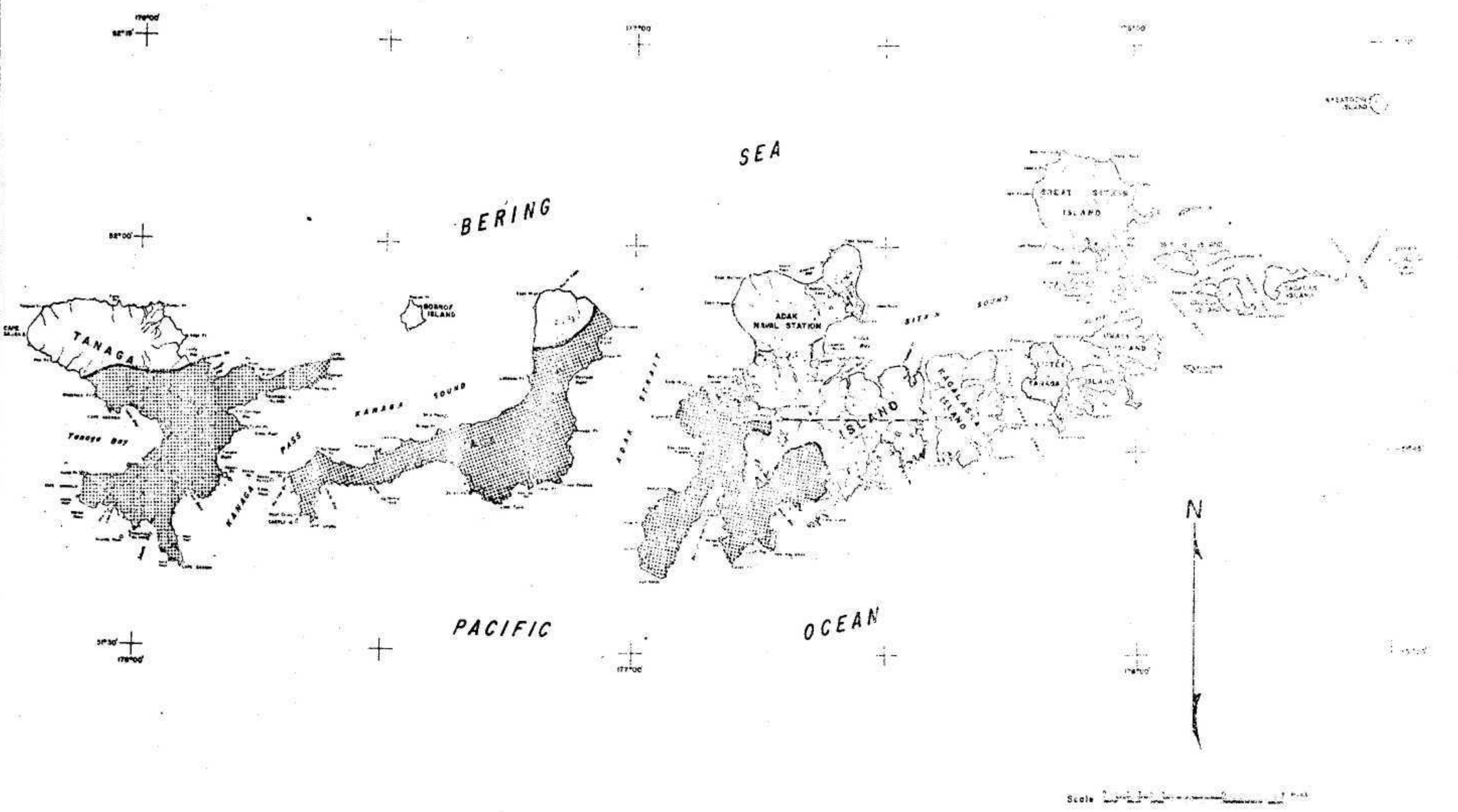
AMAK ISLAND AND SANAK ISLAND GROUP

ALEUTIAN ISLANDS WILDERNESS PROPOSAL

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

ALASKA

Figure 56. Caton Island Grazing Lease



Suitable for Grazing

WESTERN ANDREANOF ISLAND GROUP
ALEUTIAN ISLANDS WILDERNESS PROPOSAL
ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA

Figure 57. Lands Suitable for Grazing

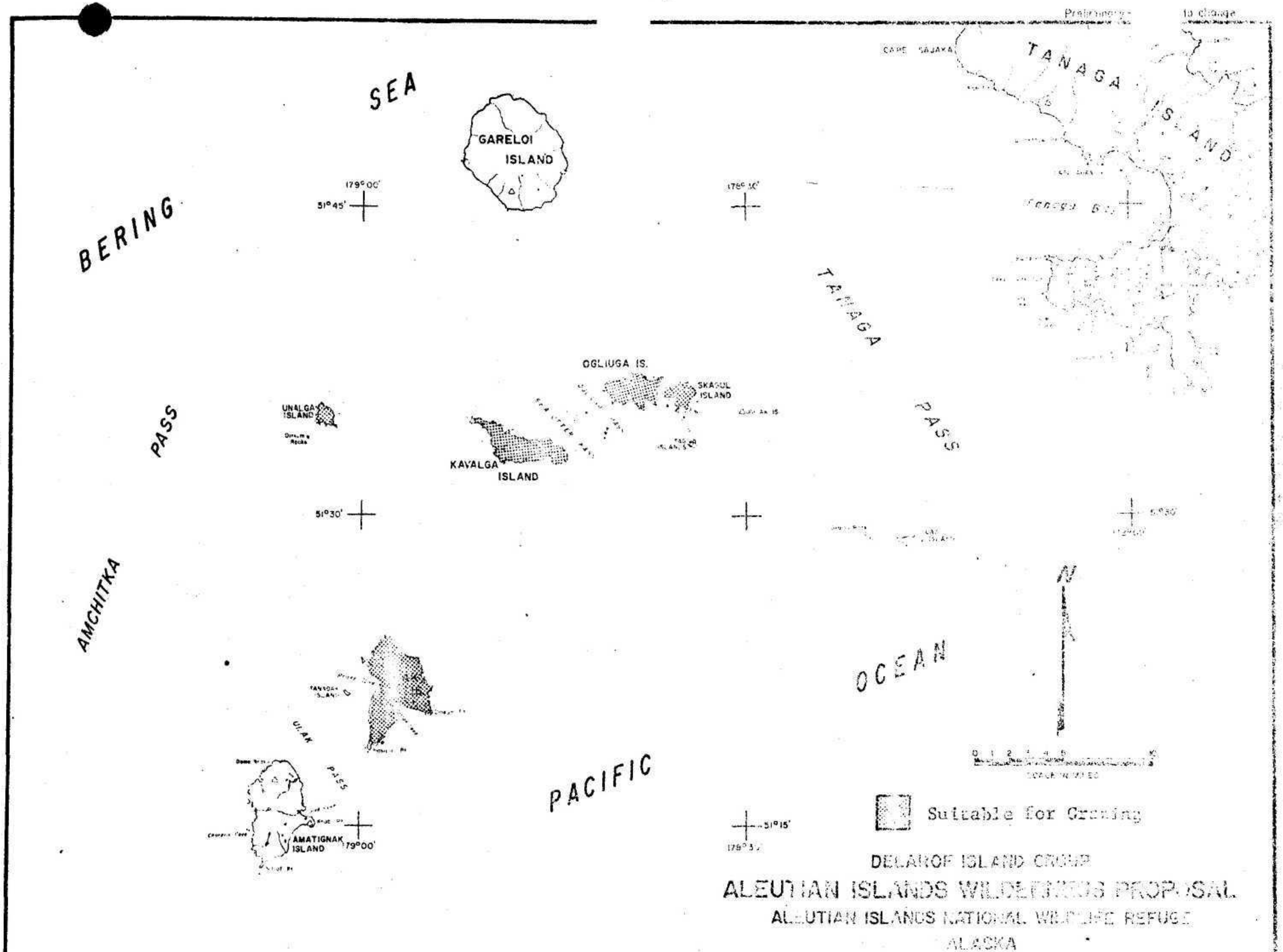


Figure 58. Lands Suitable for Grazing

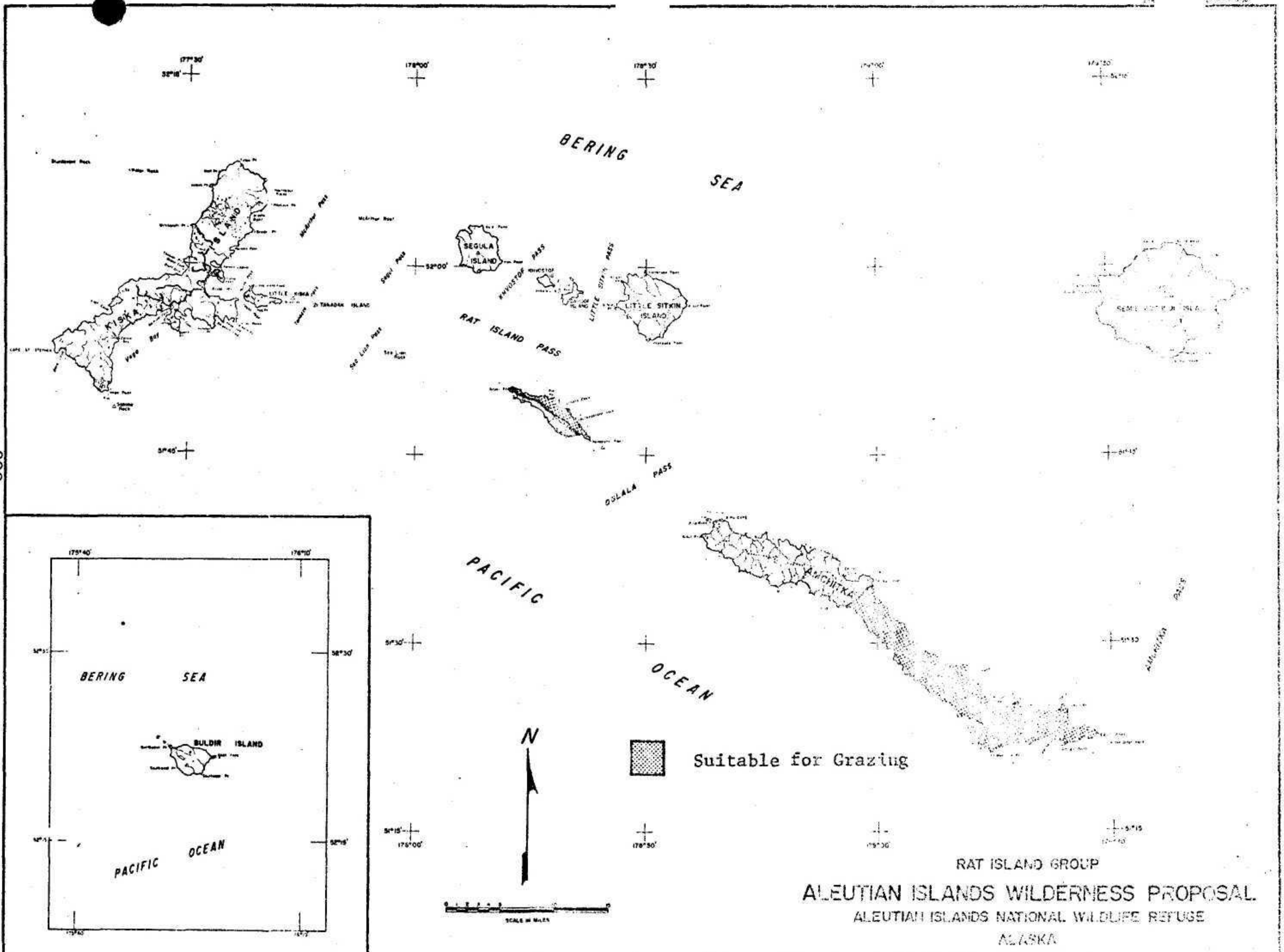


Figure 59. Lands Suitable for Grazing

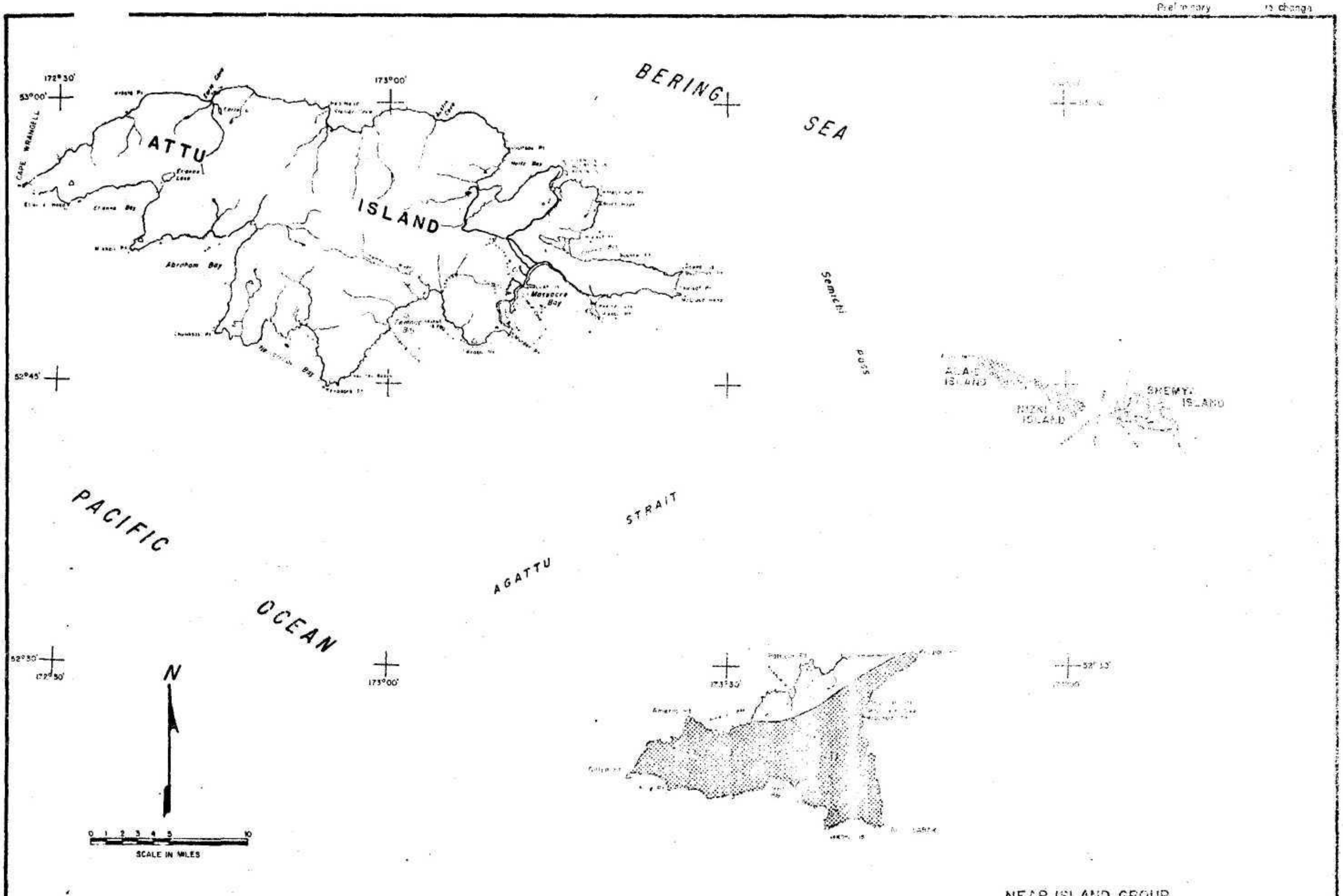


Figure 60. Lands Suitable for Grazing

Livestock grazing is permitted only on Caton Island in the Sanak Island Group (Figure 56). The leasee, Chris Gunderson, presently grazes 60 to 70 cattle on the entire island. The Bureau policy is to authorized grazing only where it may contribute to or is related to the administration of the area (Title 50, Code of Federal Regulations 29.1). Economic use shall not be authorized when the activity is incompatible with the purpose (s) for which the refuge was established. Section 29.3 of 50 CFR states that uses of wildlife refuges which make no contribution to the primary objective for the area, or are in no way related to the objectives of the National Wildlife Refuge System are classed as non-program uses. Permission for such uses will be granted only when compatible with the major purposes for which the area was established. There are no plans to terminate the grazing permit on Caton Island. The two major factors that normally determine the suitability of an area for grazing are the vegetation and availability of relatively flat areas. Areas constituting about 285,696 acres on 13 islands, or about 10.5 per cent of all refuge lands in the Aleutians, have potential for livestock grazing (Table 24 and Figures 57-60). Combining Unmak and Unalaska Islands, we estimate a maximum carrying capacity for this 285,696 acres of about 3,600 cattle or 18,000 sheep. Any grazing operation would require considerable support facilities such as large vessels for transportation of personnel, animals and supplies, docks, living quarters, barns, corrals, fences, slaughter facilities, etc. The capital investment would be considerable, especially in light of the widespread extent of the operation and the great distance to markets, whether in North America or Japan (Burton, 1971). The expense of such an operation requires large-scale production and it is doubtful that the limited carrying capacity of the area would enable such an operation to be economically feasible unless heavily subsidized. The Bureau of Reclamation (1967) concluded that even a large-scale livestock operation for an area as large as the Kenai-Kodiak-Aleutian Islands would not be profitable.

Table 24. Areas Within the Aleutian Islands Refuge Suitable for Grazing (see Figures 57-60).

Island	Acres
Adak Island (southwest corner)	53,000
Kanaga Island (southern portion)	63,000
Tanaga Island (southern portion)	70,000
Skagul Island	9,956
Ogliuga Island	2,389
Kavalga Island	3,618
Unalga Island	512
Alak Island	7,646
Amchitka Island (southeastern portion)	36,000
Rat Island (northwest portion)	3,400
Alaid Island	1,468
Nizki Island	1,707
Agattu Island	42,000
TOTAL	285,696A

Occasionally various private parties indicate an interest in starting a grazing operation in the Aleutians, especially on Kanaga and Tanaga Islands. In 1966, the Alaska State Legislature in a Joint Resolution (HJR4) urged the Secretary of the Interior to authorize grazing on lands within the Aleutian Islands National Wildlife Refuge west of Umnak Island. The resolution stated that grazing will aid in controlling foxes which cause large-scale destruction of wildlife including waterfowl, and will greatly enhance development of the livestock industry in that region.

Past experience has not indicated that grazing is beneficial or even necessarily compatible with refuge objectives. In fact, indications show a negative aspect. The assertion that grazing controls the number of foxes is in error. When the Bureau maintained a predator and rodent control agent in Alaska, one of his duties was to control foxes on the Umnak grazing leases. It was determined that the existence of livestock actually contributes to the development of an abnormally high fox population, since the high average winter stock loss provides an abundant food supply. In addition, permits were issued in the past to destroy limited numbers of bald and golden eagles. Reports reaching enforcement agents indicate that this practice continues even though no killing permits are presently issued. The Aleutian Islands constitute one of the remaining strongholds of the bald eagle. Since it is a national policy to protect this bird, it would not be logical to permit a land use practice on the refuge that could contribute to the destruction of our national bird.

The impact of grazing upon the vegetative cover is also an important consideration. Extensive acreages of peat underlie the vegetative cover, expecially in the less mountainous areas such as are located on Agattu, Amchitka, Kanaga and Tanaga. These areas are considered to be highly susceptible to extensive damage by trampling, and all are target islands for the reintroduction of the rare and endangered Aleutian Canada goose.

Because of the obvious potential conflicts with refuge objectives, grazing is discouraged as a land use where it is not now permitted.

Prospecting for metalliferous mineral deposits or locating or filing mining claims on National Wildlife Refuges is prohibited if the refuge has been withdrawn from appropriation under the mining laws (Title 50, CFR 26.29). Mining and mineral leasing is prohibited and mining cannot be permitted without a clause in the establishing order stating such. However, the refuge can be opened to mineral leasing under the provisions of 43 CFR 3103.2 - 3120.3-3 which requires a joint review by the Bureau of Sport Fisheries and Wildlife and the Bureau of Land Management to determine if part or the whole refuge can be opened to mineral leasing without conflict with primary objectives. The Aleutian Islands Refuge has not been opened nor are there any plans to open it to mineral leasing.

Existing and Planned Developments

Refuge management objectives are to preserve the existing wilderness-wildlife environment. No refuge development is comtemplated since construction of permanent facilities would tend to destroy those natural conditions which management is attempting to maintain.

The refuge headquarters is presently being established at the Adak Naval Station. A fish ladder is tentatively planned by the Adak Naval Station in cooperation with the Alaska Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife. This would be located at Lake Andrews, within the naval withdrawal, and would permit fish movement between the lake and the Bering Sea, enabling the development of anadronmous fish runs.

Existing structures on the refuge other than at government sites or Atka village are of three types; (1) cabins previously used for hunting, trapping, and fishing purposes, (2) Cabins on Adak used for recreational purposes, and (3) abandoned World War II facilities with their associated refuse (Table 23).

Several cabins remain from the fox farm era. These are wood frame structures in various stages of disrepair. Many have completely disintegrated while a few are still usable. For all intents and purposes they are no longer used and haven't been since the 1950's, and are expected to disappear with time.

Six cabins are presently located and used on Adak Island, south of the Naval Base withdrawal (Figure 61). To obtain sufficient harvest of the Adak caribou herd it was felt that shelters for hunters were required in accordance with the refuge objective to raise to optimum level the kinds, range, amount and quality of wildlife-and-wildlands orientated retreation. The cabins are of sheet metal and wood frame construction that would be easy to dismantle should the need arise. Access to the cabins and hunting areas is either by horseback, or by boats traveling the island's periphery.

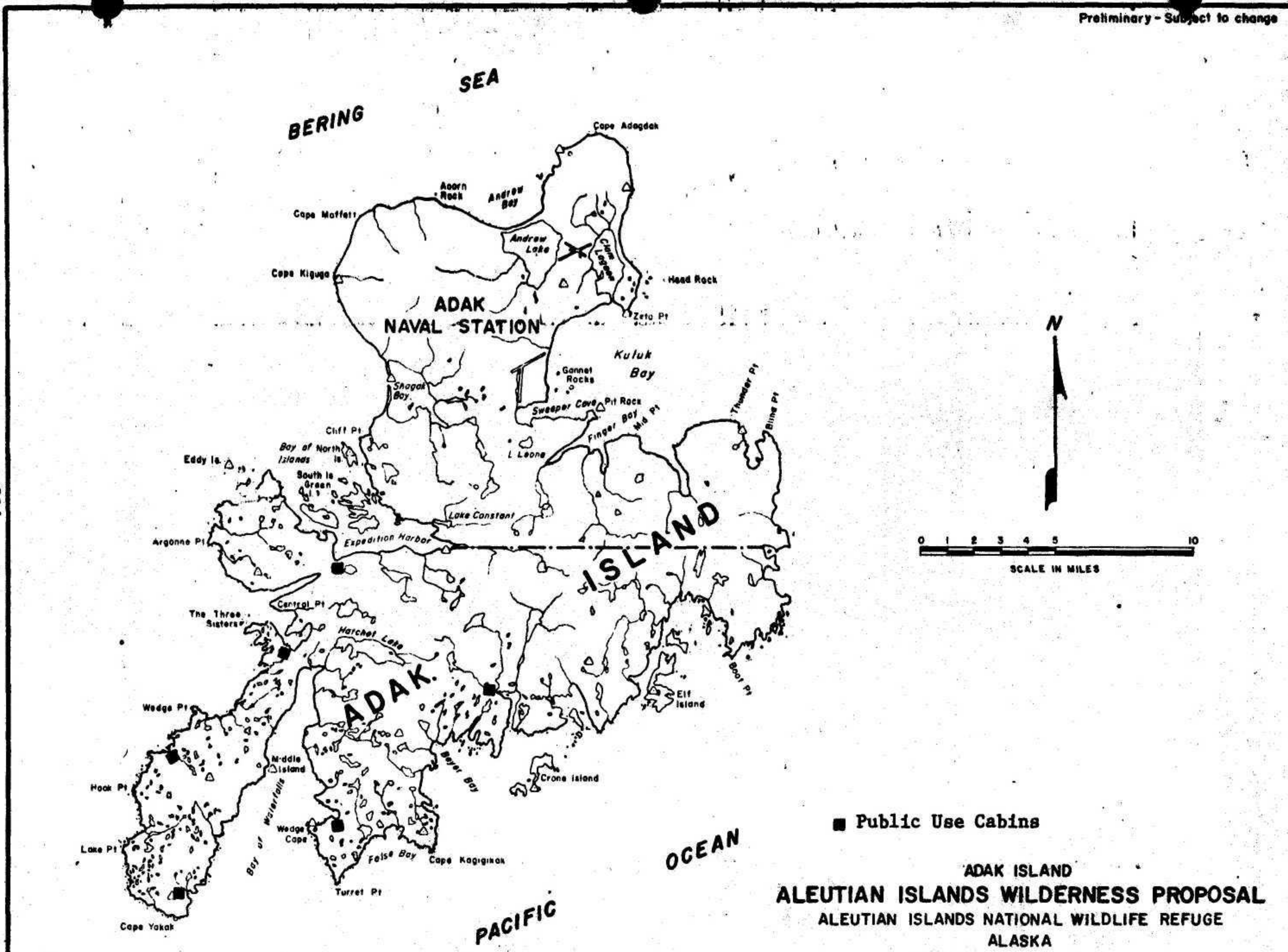


Figure 61. Public Use Cabins - Adak Island

294a

In a letter dated March 27, 1972 to Alaska Area Director Gordon W. Watson, the Commander-in-Chief, Pacific designated those lands which the military wished withheld from possible wilderness designation for defense purposes. This included all lands presently withdrawn and used for military and navigation-aid purposes, along with three parcels of land on Amchitka Island. The latter are located on those lands presently used by the Atomic Energy Commission. The military's use of these Amchitka lands is expected to conflict with refuge management objectives much as the Atomic Energy Commission's use has in the recent past.

Use of other remaining refuge lands is provided for by Executive Order 1733 as follows: "The establishment of this reservation shall not interfere with the use of the islands for lighthouse, military, or naval purposes..." An opinion by Associate Solicitor C. Brewster Chapman, Jr., (memorandum dated October 6, 1969, to Director, Bureau of Sport Fisheries and Wildlife, Washington D.C.) indicated that the Executive Order provision created a "use permit" in a broad fashion and that no formal use permit is therefore needed. Chapman further judged that 50 CFR 26.1 and 50 CFR 25.4 prescribes consultation and agreement with any Federal agency and the Bureau before the permitted use is begun.

Currently there is no understanding between the Bureau and any Federal agency concerning their needs on the Aleutians except for those areas now used by agreement. To provide for any use of the refuge under the establishing order provision, an understanding with other land-using agencies where such use is determined compatible with refuge objectives should be entered into. This understanding would establish agency intent and prescribe procedures as to how the conflicts could be resolved or minimized. It is suggested that the memoranda of understanding, discussed in the Land Status Chapter, be used as a guide in arriving at such agreements.

A fish processing plant is tentatively planned for Finger Bay on Adak Naval Station by Mr. Gene Norman, an employee of the Station. This plant would utilize the existing dock and road system, and not be expected to conflict with refuge management objectives. There are no known plans for future development of fish processing sites within the refuge boundary.

The Alaska Department of Highways does not envision a need for highway development in the Aleutians except for Unimak Island which is not involved in this study. And the Alaska Power Administration has not identified any hydrosites on the islands.

CHAPTER IX

SOCIO-ECONOMIC CONSIDERATIONS

The Federal Field Committee for Development Planning in Alaska (1971) in their publication, Economic Outlook for Alaska, states initially that, "Alaska really is unique in so many ways that it must be viewed differently than - though not separately from - the other 49 states." This is especially true of the Aleutian Islands. One can go even further and make the statement that, "The Aleutian Islands really are unique in so many ways that they must be viewed differently than - though not separately from - the remainder of Alaska."

This area is one of climatic extremes, high seismologic activity, and great inaccessibility. These factors severely limit man's activities there. The region's current economy and human population distribution is based primarily upon Governmental and the seafood industry activities. Governmental activities are concentrated in the central and western Aleutians, and the seafood industry in the eastern Aleutians. Native employment and income is mostly from the seafood industry.

Population, Employment and Income

Population: The population of the Aleutian Islands in 1970 totaled 5,772 people (Table 25a and Figure 62). Of this total, nearly 90 percent is concentrated at the military bases of Adak and Shemya. The remaining 10 per cent, or 575 people, are scattered among the six villages of the Chain and at Cape Sarichef and Attu.

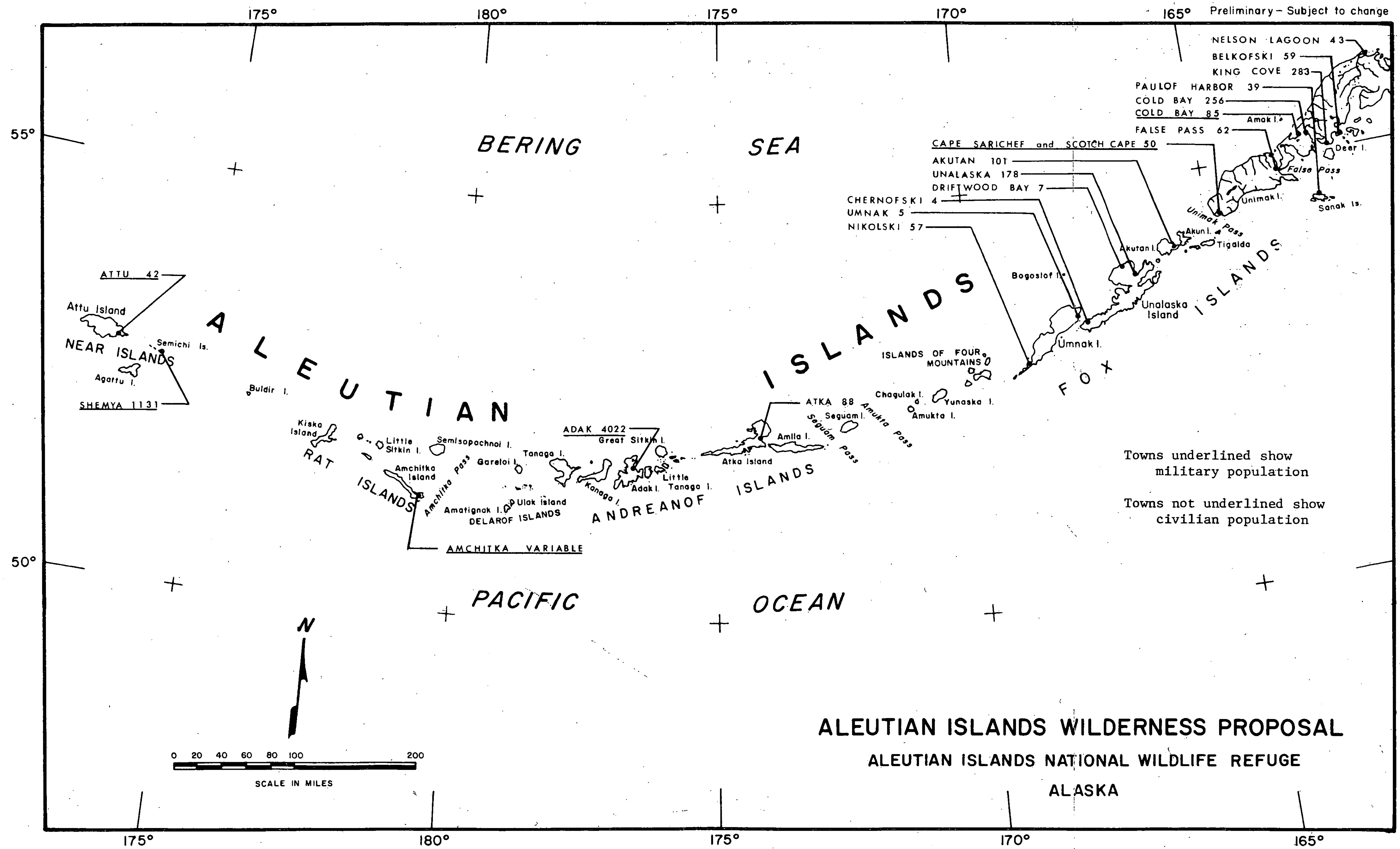


Figure 62. Population of the Aleutian Islands and Western Alaska Peninsula

Population of the surrounding area (Aleut Region) which extends eastward along the Alaska Peninsula to Chignik and includes the Shumagin and Pribilof Islands is an additional 2,285 people, for a total of 8,035 in the entire region (Table 25a). As of November 2, 1972, Native enrollment for this area totaled 2,271. Taking the Region as a whole, the military bases of Adak and Shemya account for over 64 per cent of the population. State population levels increased 32.8 percent from 1960 to 1970 with the greatest increase in the urban areas (Table 25). The Aleut Region experienced a gain of about 17% over the same period. This was mostly from Governmental activities at Shemya and Adak.

The Aleutians are of high strategic importance militarily, for they extend like a series of stepping stones toward the Russian coast on the Kamchatka Peninsula. During the 1950's and 1960's the Cold War resulted in a build-up of military strength in the Aleutians. Presently there are two major military installations located in the Chain at the Adak Naval Station on Adak Island, and the Shemya Air Force Station on Shemya Island. Both are considered critical to the balance of power in the North Pacific. A third military installation is located on Attu, but is quite small and the U.S. Coast Guard in the Department of Transportation maintains navigation-aid stations at Cape Sarichef, Adak, Attu, and on St. Paul in the Pribilof Islands.

Fluctuations in the military population are extremely difficult to predict, and are dependent upon the world situation and the closely related national security status of the United States. For the present, it appears safe to

Table 25a. Human Population of the Aleut Region and Aleutian Islands*

	1940	1960	1970	% change 1960-1970	Native enrollment as of 11/2/72
Aleutian Islands					
Military Bases					
Attu			42		
Shemya			1131		
Amchitka			variable		
Adak			4022		
Cape Sarichef			50		
Villages					
Adak					2
Attu**	44				6
Atka		119	88	-26.1	133
Nikolski		92	57	-38.0	96
Biorka					1
Unalaska City***		218	178	-18.3	212
Akutan		107	101	-5.6	112
False Pass		41	62	+51.2	62
Paulof Harbor		77	39	-49.4	14
Unimak					4
subtotals			5770		642
Alaska Peninsula					
King Cove		290	283	-2.4	328
Belkofski		57	59	+3.5	32
Cold Bay		86	256	+197.7	4
Nelson Lagoon			43		57
Chignik		99	83	-16.2	
Chignik Lake		107	117	+9.3	
Ivanof Bay			48		
Perryville		111	94	-15.3	
Shumagan Islands					
Sand Point City***			360		430
Unga					31
Squaw Harbor			65		11
Pribilof Islands					
St. George			163		185
St. Paul		378	450	+19.0	525
Other			264		
Mary Havai					5
Dutch Harbor					8
Chernofski					1
Simeonof Island					1
Dolgoi Island					1
Pavlof Bay					1
Shumagin Islands					1
At large					8
subtotals			2285		1629
GRAND TOTAL			8055		2271

*Data for 1960 and 1970 from U.S. Bureau of Census (U.S. Dept. of Comm., 1971)
**Attu residents interned in Japan for duration of W.W. II. U.S. govt. did not allow resettlement after W.W.II. Attuans settled at Atka & Nikolski.
***Sand Point & Unalaska cities incorporated since 1960.

Table 25. Alaska's Population Growth, Selected Years, 1840-1970.*

Year	Natives	Other Civilians	Military Personnel	Total
1840	40,076	700	0	40,776
1880	32,996	430	0	33,426
1890	25,354	4,298	0	29,652
1900	29,542	30,450	0	59,992
1910	25,331	36,400	0	61,731
1920	26,558	28,228	250	55,036
1930	29,983	29,045	50	59,279
1940	32,458	39,566	500	72,524
1950	33,863	74,373	2,407	128,643
1960	43,081	150,394	32,692	226,167
1966	57,000	187,600	33,200	271,500
1968	55,350	196,530	33,000	284,880
1970	--	--	--	302,173

*Sources: Census of Population, 1960, Vol. 1, Part 3, U. S. Bureau of Census; Census of Population, 1970, Vol. 1, Part 1, U. S. Bureau of Census; Alaska Department of Labor.

Table 26. Percentage Change in Population from 1897 to 1970 in Atka, Akutan, Nikolski, and Unalaska[1] (Jones, 1970)

	Atka		Akutan		Nikolski		Unalaska	
Year	Pop.	% + or -	Pop.	% + or -	Pop.	% + or -	Pop.	% + or -
1897	128		59		98		246	
1920	56	56% -	66	12% +	83	15% -	299	21% +
1930	103	84% +	71	8% +	109	31% +	226	24% -
1940[2]	81	21% -	74	4% +	92	16% -	174	23% -
1950	85	5% +	86	16% +	64	30% -	173	0
1960	119	40% +	107	24% +	92	44% +	218	23% +
1970	76	36% -	90	16% -	62	33% -	190[3]	13% -

[1]To insure comparability of data throughout the paper, we have used household census data for the years 1897, 1940, and 1970 in this table. For the remaining years, we have used U. S. Bureau of the Census data.

[2]Bureau of Indian Affairs data for Atka were secured in 1944.

[3]This figure reflects only the Native population and whites married to Natives. There are an additional 90 white residents in Unalaska. Until the 1960's, the white population in Unalaska was insignificant. There are only a few white residents in the other three villages.

assume that the installations at Attu, Shemya, Adak and Unimak will continue to be functional much as in the past. Captain Thummel, Commanding Officer at the Adak Naval Station (1972, Personal Communications) stated that the Adak operational plans call for an increase of only 125 people over the next five years, and that there are no plans beyond that.

Although Atomic Energy Commission activities on Amchitka are ending in 1973, future use of that island is in all probability dependent upon the national security status of the United States and the nuclear weapon deterrent capability deemed necessary to insure an adequate national defense. Population fluctuations of a short-term nature are to be expected with these activities. During the last bomb detonation, the number of people on the island varied from fewer than 100 to slightly more than 1,000.

Prediction of future population changes in the remainder of the Chain is as difficult as it is for the military installations. Jones (1970) closely examined past and present Native population structures of Atka, Akutan, Nikolski, and Unalaska villages (Table 26). She found that data since 1897 reveals fluctuating patterns that may have opposite trends each decade. These fluctuations are considered to be due in part to the health of the local economy and the effects of attendance at outside high schools:

> "Population changes appear to be clearly related to the state of the local economy. In all villages except Akutan, the decline in sea otter hunting at the end of the nineteenth century was accompanied by a corresponding decline in population. The economic situation in Akutan differed from that in other villages in that sea otter hunting was quickly replaced with the establishment of a cod station in 1904 and a whaling station in 1912. Conversely, at the height of fox hunting in the Aleutians in the 1920's, each of the villages except Unalaska experienced a population increase. The population decline in Unalaska in that period probably reflects the lack of access to

> favorable fox hunting grounds. At present. the two villages that virtually lack employment opportunities, Atka and Nikolski, have the highest rates of population decline.
>
> "The growing prevalance of attendance at outside high schools also appears to influence population changes in the Aleutians. Until the 1960's, high school attendance was desultory, but, during the 1960's is became widespread. A large proportion of high school students, especially those who graduate, do not return to the villages. Some who do return are dissatisfied with the low level of community services and facilities and ultimately emigrate. Additional factors, about which data are lacking, may also influence population changes in the villages, but the economic and educational factors appear clearly important."

In spite of the emigrations of the young adults the villages are surviving. Dr. Jones attributes this to reductions in infant and child mortality and emphasis on large families by those remaining in the villages.

Employment and income: In terms of employment and income accruing to the permanent residents of the Chain, the seafood ind:stry and a small part of government activities have the greatest economic impact.

Government employment is mostly with the Departments of Defense and Transportation, and the Atomic Energy Commission. The activities of these three agencies represent large capital investments and sizable payrolls, but have little economic impact on the remaining population of the Chain. The three major installations at Shemya, Amchitka, and Adak are within the Refuge and are quite remote from the other communities of the Chain. Relatively few civilians are employed on these installations and those that are generally come from the "South 48" or Anchorage. Nearly all supplies are brought in by air from Anchorage or by sea from outside the state.

The only significant impact upon the local area economy is from the king crab processors at Adak. The seafood industry in the remainder of the Chain is either based in, or operates from, the established communities of Unalaska (Dutch Harbor), Akutan and False Pass. Rodgers (1970) states that in 1967 the Aleutian area became the number-one king crab processor in the state, edging out Kodiak. The rapid growth in the Unalaska area found five crab-processing plants in 1967 compared to one in 1964. In 1972 four shore-based processors were located at Unalaska. The development of crab fishing and processing in the Aleutians over the past 15 years has increased local/employment and significantly extended the working season. Fishermen and cannery workers are now employed 60 to 10 months instead of 2 to 4 as when formerly dependent only on salmon fishing.

Crab, shrimp, and salmon are all processed at Unalaska. During the crab season, a floating processor anchors in Akutan Bay, thereby providing employment for the Akutan villagers. False Pass processes only salmon and thereby provides only short-term employment. At King Cove, both salmon and crab processing employ over 220 people annually (Alaska State Housing Authority, 1968).

Other economic activities having impact upon the area are construction, transportation, and service employment (Table 27). Construction is closely tied to the military and the Atomic Energy Commission, and employees are either from the Anchorage area or from stateside. Employment in transportation declined substantially in the region from 1961 to 1966, or from 126 to 55 employees (Rodgers, 1970). This decrease was due to more personnel

Table 27. 1970 Workforce Summary - Aleutian Islands Labor Area

	Jan.	Feb.	Mar.	Apr.	May	June
TOTAL CIVILIAN WORKFORCE	1,936	1,895	1,706	1,612	1,888	1,968
TOTAL UNEMPLOYMENT	157	193	220	159	265	197
Per Cent of Workforce	8.1	10.2	12.9	9.9	14.0	10.0
TOTAL EMPLOYMENT	1,779	1,702	1,486	1,453	1,623	1,771
Nonagric'l. Wage & Salary Employment	1,640	1,569	1,368	1,336	1,492	1,631
Mining	*	*	*	*	*	*
Contract Construction	114	132	153	180	183	149
Manufacturing	553	466	252	226	331	488
Transp. - Comm. & Pub. Utilities	72	66	53	34	33	36
Trade	130	129	129	128	141	146
Finance - Insur. & Real Estate	*	*	*	*	*	*
Services	125	117	122	113	117	119
Miscellaneous	*	*	*	*	*	*
Government	625	638	639	644	674	667
Federal	459	462	464	461	483	490
State & Local	166	176	175	183	191	177

Table 27 (cont.) 1970 Workforce Summary - Aleutian Islands Labor Area

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
TOTAL CIVILIAN WORKFORCE	2,541	2,597	2,071	1,936	2,048	1,999	2,016
TOTAL UNEMPLOYMENT	117	92	73	50	125	83	144
Per Cent of Workforce	4.6	3.5	3.5	2.6	6.1	4.2	7.1
TOTAL EMPLOYMENT	2,424	2,505	1,998	1,886	1,923	1,916	1,872
Nonagric'l. Wage & Salary Employment	2,227	2,286	1,842	1,736	1,764	1,761	1,721
Mining	*	*	*	*	*	*	*
Contract Construction	204	192	294	266	240	230	195
Manufacturing	820	919	428	371	420	440	476
Transp. - Comm. & Pub. Utilities	39	40	40	42	40	43	45
Trade	145	136	131	132	134	147	136
Finance - Insur. & Real Estate	*	*	*	*	*	*	*
Services	146	172	169	175	180	165	143
Miscellaneous	*	*	*	*	*	*	*
Government	838	791	739	701	705	689	696
Federal	686	656	579	542	531	521	528
State & Local	152	135	160	159	174	168	168

being stationed in Anchorage rather than to a decline in the level of transportation services. The employment level has remained relatively stable since 1966.

Services employment is limited in the area outside of the military bases. Virtually no professional employment services such as doctors, dentists, lawyers are available. Most service employment is gained from grocery stores, bars, and movie theaters.

A summary of per capita wage and salary income of residents within the Aleutian Islands labor market area found that in non-military-activities population of 8,057 - 94% of which is Native - per capita income was \$2,480. This compares to \$4,513 for Alaska as a whole and \$3,680 for the United States (Federal Field Committee, 1971). Over 47 per cent of the work force in 1970 was employed by the government, compared to 36 per cent for the state as a whole. Median family income was \$8,553, compared to \$12,443 for the state (Table 28). Fifteen per cent of the work force was unemployed and 8 per cent received incomes that were below the poverty level (Bureau of Census, 1971).

Arnold in Alaska Natives and the Land (Federal Field Committee, 1968) gives an excellent summary of the Aleuts' present-day situation.

> "Of all our aboriginal Alaska Native populations, perhaps the Aleuts more than any other group, have been most greatly affected by extra-cultural and economic influences. Conquered, enslaved, and subjected to disease and family disruption, wholesale population transfer and major governmental withdrawal of their former territories, they now number about 10% of their former number and this percentage too must be considered of mixed blood.

Table 28. Social and Economic Characteristics-
Aleutian Islands, 1960-1970

SOCIAL CHARACTERISTICS	Aleutian Islands Census Division 1960	Aleutian Islands Census Division 1970	State 1970
Population	6,011	8,057	300,382
Percent rural non-farm	99.5%	98.5%	49.8%
Percent rural farm	.5%	1.5%	1.4%
Percent residing in state of birth	38.4%	26.8%	31.7%
Persons 25 Years & Over			
Median school years completed	11.4	12.3	12.4
Persons 14-17 Years			
Per cent in school	68.4%	91.6%	91.0%
ECONOMIC CHARACTERISTICS			
Nonworker-Worker Ratio	.75	.68	1.28
Percent in Labor Force			
Female	30.6%	31.1%	46.2%
Male, 18-24 years	96.4%	96.4%	88.2%
lian Labor Force-Percent Unemployed	7.1%	15.0%	9.2%
Families			
Median income (dollars)	5,703	8,553	12,443
Percent with income$15,000 or more	N/A	13.1%	37.8%

Source: Bureau of Census, General Social & Economic Characteristics 1960 & 1970.

"The way of life of the Aleut today bears little resemblance to that of his aboriginal ancestors. Continued 'foreign' occupation of the region since early Russian days, together with the technological advances of the 20th century, have brought great change, but the change effected has been superficial -- in boats and ships, in housing, in fishing gear, in clothing and in greater dependence upon purchasable foodstuffs -- the basic reliance of the Aleut upon the marine environment for his life support remains.

"Today not nearly as many of the Aleutian Islands are occupied as were prior to the time of the Russian contact, and the people have been reduced in numbers, but those Aleuts that remain in the islands, those on Kodiak Island, or the Alaska mainland coast, possess the seaman's skills of generations. It is this mariner's skill and knowledge of the sea that provides them self-employed livelihood in a local commercial fishery or as a wage-earner in the Kodiak-Bristol Bay or Aleutian fishery, or with the Pribilof sealery.

"The sea also still provides a primary food preference source for these people -- fish, marine mammals, shellfish, even seal oil, when available, are dietary mainstays which supplement, in a most important way, their wage-earner purchases at the store."

In most villages Natives hold few full-time jobs. Typically they are in positions such as postmaster and school maintenanceman. There are a few operators of small stores in some villages. In most villages, however, there are no full-time jobs available. In a transportation hub such as Cold Bay (which is outside the refuge on the Alaska Peninsula), the number of full-time job opportunities is greater, although no Native village per se exists there. Cold Bay consists primarily of transitory personnel working for either federal and state government or the airline industry. Government agencies employing Natives at Cold Bay are the U.S. Weather Bureau, Federal Aviation Agency, State of Alaska Division of Aviation. Reeve Aleutian Airways employs Natives in Cold Bay and various other villages as well as freight handlers, refuelers, and station agents. Only a very few Natives are employed seasonally as ranch hands on the Umnak ranches.

Living costs

Another significant characteristic of the Alaskan economy is its structure of high prices and costs (Alaska Dept. of Natural Resources). The primary causes of this situation according to the late Leo M. Loll of the University of Alaska (1967) are severe climatic conditions and Alaska's distance from traditional markets and sources of supply. Table 29 gives indices based upon 1967 data on the costs of goods and services in four Alaska cities as compared with Seattle.

Table 29. Cost Index of Goods and Services, 1967.

City	Cost Index (Cost in Seattle = 100)
Anchorage	121
Fairbanks	132
Juneau	127
Ketchikan	118

Source:

U.S. Dept. of Labor, Bureau of Labor Statistics Alaska's economy base can be divided into two distinctly different types, i.e., a money economy where the dollars earned are used to purchase necessary goods and services - similar to the economy in the south 48-and an economy of subsistence nature where money is of little use and the primary work effort is related to the procurement of food; e.g. hunting of meat in the form of birds, sea mammals or land mammals, fishing and gathering of plant foods and berries. This subsistence economy is pretty much confined to the small villages of the Aleutians where there is a lack of seafood or governmental economic base. In the Aleutians and Southeastern Alaska, gathering activities for subsistence use are far less important, generally speaking, than they are in the north and west sections of the state, but, again, among villages and among families, there are variations (Federal Field Committee, 1968).

Fisheries

The principal fishery products of the Alaska Peninsula-Aleutian Islands region are salmon, halibut and king crab (Tables 30,31,32, and 34). Of lesser importance are dungeness and tanner crab (Tables 30 and 33). With the exception of Adak, the seafood processing is based in, or operates out of, Unalaska, Akutan, False Pass, King Cove, Sand Point and Squaw Harbor (Table 35). Of these, only Adak and False Pass are within the Refuge with Unalaska, King Cove and Sand Point plants the major processing sites.

The Adak site is presently utilized by floating processors rather than shore-based operations. In 1973 however, the U.S. Navy leased 10 acres at Finger Bay to a private individual for the purpose of a seafood-processing plant. Most of these operations are run by firms outside Alaska. Although there is considerable employment of local labor, most workers are brought in from other Alaskan locations, from out of Alaska, and even from as far away as the Philippines.

Residents of Aleutian villages rely more upon the fisheries than on any other resource for income and employment. Processing plants in Unalaska have employed up to 60% of the Aleut work force (Jones, 1969). Snodgrass (1970) considers fishing a prime segment of the state's economic base upon which other industries are built, and states, "Where fishing production suddenly decreased, Alaskans would undergo a sharp decline in economic activity and probably be forced to rely upon huge federal handouts to keep their standard of living from plunging drastically." This is especially true as regards villages in the Aleutian Islands, where fish are for all purposes the only goods produced locally and sold outside the village. This provides the sole means by which most villages produce goods to purchase needed products and services. Abrahamson (1968) feels that a great potential for additional jobs and income for the Aleut people exists in the harvest and processing of seafood resources that occur in the adjacent Bering Sea and North Pacific Ocean. Although limited by present financing, more interest in these resources is developing. Of immediate interest is king crab, tanner crab, and halibut. Future diversification with other available seafood resources is being investigated. The Russian and Japanese fleets have shown that large quantities of king and tanner crab, shrimp, flounder, cod, halibut, pollock, sablefish, rockfish and herring exist in waters of the region.

Abrahamson (1968) feels that two areas offer the best possibilities for further development of seafood processing sites. These are at Unalaska Island and Cold Bay on the western tip of the Alaska Peninsula. Both are adjacent to but outside the refuge. Unalaska Harbor offers a well-protected harbor, water-freight service to Seattle, air service to Anchorage, and an incorporated town providing services required for family living. The main advantage of Cold Bay as a processing site is that airfreight service exists direct to the "Lower 48" and monthly water freight service to Seattle. Disadvantages are great, however, as there is no protected bay or harbor for fishing boats, no easily accessible route between the Bering Sea and Pacific

Ocean, and the cost of shipping seafood by airfreight is prohibitive except possibly for king crab and shrimp.

Tussing (1972) discusses the fisheries other than the traditional crab, shrimp, halibut and salmon fisheries.

> "In addition to the resources which are presently exploited domestically, large stocks of low-value fish, both pelagic and bottom-dwelling, exist in the Gulf of Alaska and the Bering Sea. Some of these stocks are heavily fished by foreign vessels, but so far have been of almost no commercial interest to American fishermen based in Alaska. This situation is largely the result of cost factors that will probably not change soon. Industrial fisheries, whether engaged in reduction to fish meal or in producing blocks of whitefish for human consumption, must process vast quantities of low-value raw material on board or in nearby ports. Such an operation is highly sensitive to the cost of capital, labor, fuel and other materials. Alaska's relative position in respect to all of these costs may improve somewhat over the next decade. An extension of U.S. territorial waters of fisheries jurisdiction may relieve the pressure from foreign fleets but it is very improbable that Alaska will rapidly become the base of major industrial fisheries."

Tussing further states that expansion of the fishing industry in the foreseeable future will most likely proceed as it has in the recent past; that is, the further exploitation of those stocks which now bring high prices and for which demand increases as people's incomes increase. These resources are salmon, king crab, and halibut. He feels that there is little room for further expansion with these species. Other species presently utilized and for which there will be further exploitation are dungeness and tanner crab and also scallops. Other high-value species which are not exploited are clams and sablefish. The fish farming potential for the Aleutian area is unexplored but can be assumed to be limited because of the low number of freshwater lakes and shallow lagoons.

Table 30. 1969-1971 Domestic Catch and Value of Fisheries, Aleutian Islands Area*

Year	Salmon		Other Fish		Shellfish		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1969	894,816	$95,168	1,861	$435	25,566,831	$6,761,648	26,463,508	$6,857,251
1970	2,715,125	325,238	--	--	23,323,144	5,597,298	26,038,269	5,923,536
1971	128,603	15,655	1,464	220	37,092,501	9,642,581	37,222,568	9,658,456

* Alaska Department of Fish and Game, 1972.

Table 31. American Commercial Catch of Salmon, in number of fish for the Aleutian Islands*

Species	Sockeye	Pink	Chum	Coho	Chinook	All Species
1951	11,717	17,974	94,515	393	3	124,602
1952	42,829	31,751	25,732	9	211	100,532
1953	24,491	62,618	2,305	--	55	89,469
1954	20,721	566,457	1,608	840	9	589,635
1955	28,383	31,078	3,777	101	--	63,344
1956	147,069	7,707	893	4,422	13	160,104
1957	27,296	485	13,876	88	2,301	44,046
1958	344	613,225	277	14	2	613,862
1959	6,096	11,961	79	--	--	18,136
1960	7,649	444,897	299	3	--	452,848
1961	2,661	93,958	219	3	--	96,841
1962	5,473	2,001,731	1,151	99	12	2,008,466
1963	4,509	90,367	250	--	4	95,130
1964	248	194,138	2,314	4	1	196,705
1965	No data	No data	No data	No data	No data	No data
1966	999	63,483	703	14	1	65,200
1967	1,186	26,126	74	--	16	27,402
1968	3,032	894,157	792	112	37	898,130
1969	1,892	242,150	1,549	35	2	245,628
1970	1,629	670,991	3,348	134	6	676,109
1971	333	45,114	58	2	--	45,507

* Alaska Fish and Game Department. Commercial Fishery Statistics. 1951-1971; Kasashara (1963).

Table 32. Peninsula-Aleutian Islands King Crab Catches (in millions of pounds), Average Weights, and Number of Vessels, 1960-1971*

	SOUTH PENINSULA			UNALASKA			ADAK			BERING SEA			TOTAL		
Year	Catch	Ave. Wt.	# Vsl	Catch	Ave. Wt.	# Vsl	Catch	Ave. Wt.	# Vsl	Catch	Ave. Wt.	# Vsl	Catch	Ave. Wt.	# Vsl
1960	6.70	9.9								0.22	7.3		6.92	9.9	
1961	3.90	9.3		0.36	8.7		3.15	8.5					7.41	9.0	25
1962	2.27	7.9		1.91	8.6		4.83	8.8					9.01	8.5	
1963	6.54	6.7		2.14	8.1		14.44	8.1		1.07	7.7		24.[illegible]	7.7	
1964	14.35	7.5		13.58	8.1		19.65	8.0	14	0.64	8.7		48.22	7.9	47
1965	14.71	8.1	35	13.76	7.9	15	20.81	7.9	17	1.14	7.0		50.42	7.9	67
1966	22.57	9.0	37	31.44	9.1	22	8.68	8.7	11	1.05	7.5		63.74	9.0	70
1967	17.25	8.9	39	28.57	9.6	22	12.54	7.8	21	3.09	7.8		61.45	8.9	82
1968	10.94	8.6	34	14.01	7.3	26	19.17	6.9	28	8.96	6.8		53.08	7.3	88
1969	4.34	7.8	44	7.20	7.5	35	18.04	6.5	47	10.35	5.9		39.92	6.6	126
1970	3.51			10.90			12.42			8.58			35.41		
1971	4.21			10.86			25.83			13.09			53.99		

*Data from ADF&G Statistical Reports, 1971.

Table 33. 1967-1971 Peninsula-Aleutian Islands Dungeness Crab-Tanner Crab Catches (in thousands of pounds)*

Year	South Peninsula	Unalaska	Adak	Bering Sea	Total
Dungeness Crab					
1967	--	--	--	--	--
1968	953.4	--	--	--	953.4
1969	750.7	263.4	13.0	352.7	1379.8
1970	5.4	2.0	--	709.9	717.3
1971	5.9	5.9	--	10.3	22.1
Tanner Crab					
1967	3.1	--	--	--	3.1
1968	110.6	12.8	--	21.9	145.3
1969	606.3	21.0	2.2	1033.2	1662.7
1970	2093.6	--	--	1464.4	3558.0
1971	2140.8	--	--	166.0	2306.8

*Alaska Department of Fish and Game, 1971.

Table 34. Halibut Catches in Millions of Pounds for the Major Producing Areas in the Aleutian Islands (INPFC, 1972).

Year	3B	3C	4A*	Area 4B*	4C*	4D*	Total
1966	3.1	0.05	0.2	0.2	0.3	0.4	4.25
1967	2.2	0.01	1.3	0.01	0.4	0.6	4.52
1968	3.7	--	0.5	--	0.4	0.4	5.00
1969	4.1	0.05	0.2	0.3	0.2	0.5	5.35
1970	3.5	0.08	0.3	0.2	0.4	0.3	4.78
1971	2.9	--	0.5	0.2	--	0.2	3.80

*Canada and United States only

Foreign fisheries: Initial foreign fishing activity off the Alaska coast dates to Japan's initiating the eastern Bering Sea king crab fishery in 1930. Further expansion of the eastern Bering Sea fishery resources occurred in 1933 when a groundfish fishery was initiated. Expansion of the Japanese fishery exploitation was halted by 1941 due to the Japanese Imperial Navy's requisitioning most fishery vessels for military purposes.

It was not until 1952 that Japanese fishing activities off Alaska's coast resumed. In that year, they began salmon fishing along the western Aleutian Islands, and by 1953 had resumed their pre-war fishery activities in the eastern Bering Sea. In 1959 the fleets of the Union of Soviet Socialist Republic began fishing flounder and king crab in the eastern Bering Sea. The Soviets also commenced whaling along the Aleutian Islands about this time.

During the early 1960's, both the Japanese and the Soviets accelerated their exploitation of the fishery resources off Alaska, working new grounds and taking additional species. By the close of 1966, fisheries of these two nations engulfed nearly all the 550,000 square nautical miles of the Continental Shelf off Alaska. Their fleets ranged from Dixon Entrance in the south and east, to beyond Attu Island in the west, and into the Arctic Ocean in the north. Then in 1966, another Asian nation, South Korea, made preparations to enter the fisheries off Alaska.

Japanese and Soviet fisheries in the North Pacific Ocean have been important factors in the rising status of the fishing industries of those nations. Massive Japanese and Soviet fleets with some of the world's most modern fishing and associated vessels operate year-round off Alaska and annually catch over 3 billion pounds of fish, shellfish, and whales.

Government and Services

The military indicates that no expansion in this sector can be expected within the immediate future (five years) (Christensen, 1972, and Thummel, 1972, personnel comm.). Future military activities are dependent upon the nation's defense requirements which are naturally subject to change with the world situation. Construction projects are scheduled for both Adak and Shemya, but will have little economic impact on the Aleutian Island area since most of the manpower and materials utilized will be from the Anchorage area or from out of the state.

As discussed previously in Chapter V the Bureau of Sport Fisheries and Wildlife has requested of the Atomic Energy Commission their intentions regarding future land-use in the Aleutians. A reply is yet to be forthcoming. Again, the assumption is that the Amchitka activities will cease by 1974 and any resumption will be in accord with the nation's defense requirements. This project to date has had little impact upon the economy of the Aleutian area.

No change in the U.S. Coast Guard navigational-aid stations or functions is expected which will affect the area's economy, one way or another. Those lands specified by CINCPAC are considered sufficient for the needs of military, naval, and lighthouse purposes in the Aleutians (Christensen, 1972).

State of Alaska involvement in the Aleutians, as well as involvement by local government, is entirely within the established communities of Adak, Atka, Nikolski, Unalaska, Akutan, and False Pass. Impact upon the area's economy by State government will be primarily dependent upon the intensity of its activities which will in turn be dependent upon the needs and desires of the communities and the budget it has to work with. Any expansion of the communities will in all probability be due to increased activity of the seafood industry.

Service employment has a minor economic impact at present. The area will continue to be dependent for professional services on Anchorage and Kodiak due to the relatively low population level and improved air travel. Lodging facilities are generally provided by the military, or canneries in the villages. Trade employment has been experiencing limited growth with the growth of the seafood industry. This dependence will continue in the future.

Wildlife

Use of the islands' wildlife resources for sustenance and economic use is relatively low compared to much of Alaska. Waterfowl, seals and sea lions are commonly utilized for food, with the seal hides manufactured into clothing and souvenir items. Reindeer are hunted on Atka and Umnak with only a few hundred harvested each year. Both herds number between 2,500 and 4,000 and could easily sustain a heavier harvest. Occasional fox trapping occurs but is quite limited. Once common, fox farming terminated in the late 1940's because of low fur prices. Prices have not substantially increased since that time to make fox trapping financially feasible.

Minerals - Oil and Gas

No mineral survey per se has been accomplished on the Aleutian Islands and little is known of the region's potential. Discovery of gold, zinc, copper, and sulfur on Unalaska and Sedanka have not led to commercial exploitation.

The assumption is made that the deposits are not large enough to make their development financially feasible at this time. Although Drews et al. (1961) considered the Unalaska copper as low grade, they recommend field surveys to determine the extent and commercial viability of potential deposits.

The only known mineral deposit within the boundaries of the Aleutian Islands National Wildlife Refuge of commercial potential is the sulfur deposit on Little Sitkin Island. There has been no development of this resource; however, smaller but more accessible sulfur deposits exist on Akun and Unalaska, but no recent development has occurred other than assessment work. The Akun deposit was mined in 1919-20, but was subsequently abandoned. Development of the Little Sitkin deposits would be severely hindered by the great shipping distances to world markets, absence of a suitable harbor, very rugged terrain between the coast and crater deposits, and the extreme climatic conditions found in the area (Snyder, 1959). However, Snyder goes on to say that similar volcanic deposits in the Andes were commercially utilized in 1954 despite rigorous climatic and altitude conditions.

A combination of roads and an aerial tramway would probably be required to utilize this deposit. Anchorages are of a marginal nature and exposed to the weather. Construction of roads in this mountainous area would permanently alter natural landscape features. Other factors affecting the development of this deposit are lack of local labor and absence of scheduled transportation.

The sulfur market depends on both domestic and foreign production. Since 1916 the United States has led the world in the production of sulfur, mostly from the "salt domes" of the Gulf Coast states of Louisiana and Texas.

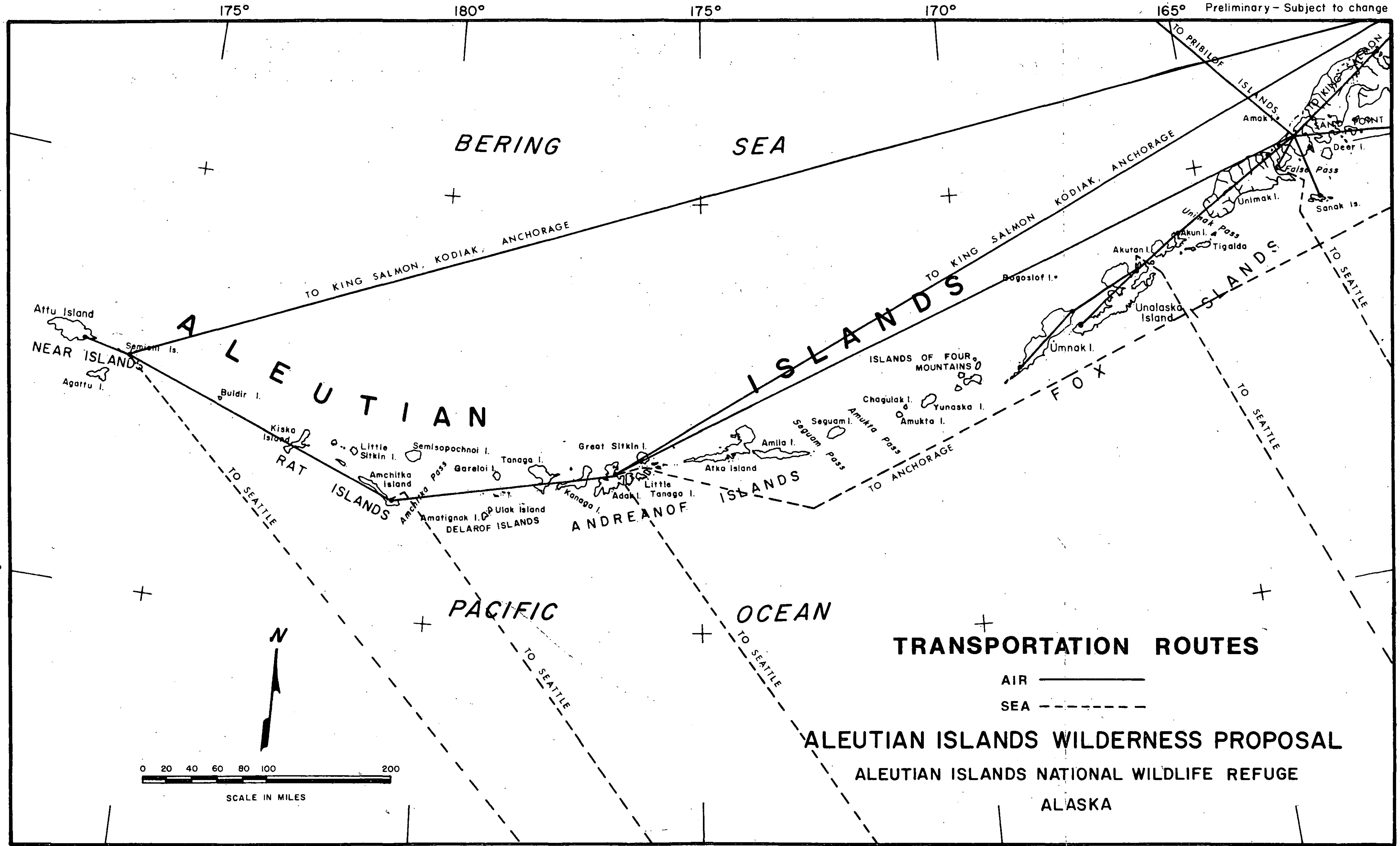


Figure 63. Transportation Routes

Mexico is the second largest producer. Current industrial demand for sulfur is great, and when present supplies cannot meet the demand, pressure to develop the Alaskan sulfur resources can be expected.

As discussed in Resources, Chapter VI, oil and gas potential for the Aleutian Islands are unknown. Continued exploration in the eastern Aleutians indicates that this area may have potential, but the U.S. Geological Survey classified the entire Aleutian Islands area as within a Volcanic Province and outside the petroleum provinces of Alaska.

Although geothermal resources exist, the potential is unknown. It is doubtful whether the resource in this area is hot enough to generate electricity, but it does have potential for domestic uses such as space heating and cooking. Development of this resource will be based upon its competitiveness with other available energy sources.

Agriculture

The Soil Conservation Service of the U.S. Department of Agriculture, Palmer, Alaska, 1968, gives some values for agricultural production in the Aleutians in 1966. In that region, the 1966 crops were valued at $1,000 compared to $0 in 1956. These crops included oats, barley, other grains, and vegetables. Hay and silage worth $1,000 were produced in 1966 and $0 in 1956. Animal products, excluding horses, goats, dairies, reindeer and fur, totaled $165,000 in 1966 and $55,000 in 1956. In the same report, the SCS considers the Aleutian Region as having 20,000 acres of suitable cropland and 40,000 acres of marginal croplands, marginal because excessively steep, shallow or wet. They recorded 50 acres cultivated during 1965. Other than loc·l gardens, the cultivated areas are in support of the grazing operations on Unalaska and Umnak.

Grazing use of the Aleutian Islands first occurred about 150 years ago, when Russian fur traders introduced sheep to the islands for the purpose of providing meat. Relatively few animals were stocked and these were used only for the immediate purpose of food supply. Sheep ranching, per se, was started in 1918 when Dr. Andrew C. Smith of Portland, Oregon, and William MacIntosh of Bend, Oregon, shipped 500 ewes to Dutch Harbor. Over half these animals were lost in the hard winter of 1918-19. In 1919, the remaining ewes, along with their lambs, were divided with half going to Chernofski on Unalaska and half to the Nikolski area on Umnak. Shortly there after Smith and MacIntosh separated their operations into the Western Pacific Livestock Company on Unalaska and the Aleutian Livestock Company on Umnak.

Both companies continued to ship in sheep from the "South 48", but range disputes and resultant lawsuits put both companies into serious financial trouble with both going into receivership. Mr. Carlyle C. Eubank became receiver for both companies about 1932, and orientated them both to strictly sheep ranching. Both ranches prospered under his management. In 1936, Mr. Roy Bishop purchased the Western Pacific Livestock Company, and in 1949 Mr. Art Harris bought the Aleutian Livestock Company putting both in Alaskan ownership for the first time. In 1956, a Texas company leased land and established a ranch on the north end of Umnak at Fort Glenn.

During the mid-60's, the Bishop ranch on Chernofski was sold to Mr. Milt Holmes, who now operates it basically as a sheep ranch. In 1971, both ranches on Umnak were sold to New York interests represented by Mr. Perry Osburn. This organization is changing the sheep and wool operation to a cattle operation and has invested a reported $200,000 in improvements, including a slaughterhouse. The owner's objective is to attain maximum sustained production of livestock for marketing. The aforementioned ranches are three of the largest livestock operations in Alaska.

The only grazing effort west of Umnak occurred around 1930, when Mr. Harold E. Bowman of the Kanaga Ranching Company introduced Karakul sheep to Kanaga Island. These sheep did not survive, and it is thought that the climate was too harsh.

Other Aleutian Islands where grazing presently occurs are Akutan and Caton and Sanak Islands (Table 36). Livestock were introduced to these islands after 1945. The Akutan permittee, Mr. Charles Brown, indicates that he plans to sell his grazing lease because of severe sheep losses. He reports a stock change from 16 head of cattle, 2 horses and 406 sheep in 1965 to 30 head of cattle, two horses and no sheep in 1972.

Caton Island, the only island within the Aleutian Islands National Wildlife Refuge on which grazing is presently permitted, is leased to Chris Gunderson under BSF&W special-use permit #32942 (Table 36). The lease covers all of Caton Island, or approximately 4,000 acres, and was issued on January 1, 1969. The lease will expire on December 31, 1973. The annual rental on this lease is $150, and the maximum stocking rate in animal-units is

Table 36. Grazing Permits in the Aleutian, Shumagin, and Sanak Islands

Permittee or Lessee & #	Map Ref #	Location	Approx. Acreage	Term of Lease Issued	Term of Lease Expires	Annual Rental on Lse	Auth'ized Animal Units	Livestock on Lease 1/1/72 Cattle	Sheep	Horses	Revenue from Lease	Agency Admin. Lease	In AI NWR
Aleutian Livestock Corp. A 030488	6	Umnak I. E 2/3	255,360	5/10/70	12/31/75	$1,500	Max: 2500	175	8,205	18	for 1968 Beef $1,827.90 Mutton 1,120.00 Wool 43,474.18 Misc. 1,028.75 $47,450.83	BLM	NO
Aleutian Livestock Corp. A 030544	7	Umnak I. W 1/3	115,497	1/1/71	12/31/73	$1,200	Max: 2000	235	3,813	37	unknown	BLM	NO
Brown, Charles A 062012	3	Akutan I E 1/2	41,500	1/1/65	12/31/84	$ 60	Max: 100 Min: 60	30	--	2	1965-1971 none	BLM	NO
Choate Livestock & Trading Company A 057947	4	Unalaska E 1/2	60,000	1/1/62	12/31/81	$ 120	Max: 200 Min: 120	59	5	6	1971 Cattle $1575 1970 " 700 1968 " 500 1966 " 640 1969,67,65,64 0	BLM	NO
Gunderson, Chris SUP # 32942	1	Caton I. (all)	4,000	1/1/69	12/31/73	$ 150	Max: 100	no report (1962 had 44 cattle)			unknown	BSF&W	YES
Gunderson, Chris A 059782	2	Sanak I. E 1/3	10,100	1/1/63	12/31/82	$ 150	Max: 250 Min: 150	182	--	--	one report-$750 year unknown	BLM	NO
Holmes, Milton, & Beverly A 060872	5	Unalaska W 1/2	151,915	1/1/64	12/31/83	$1,200	Max: 2000 Min: 1200	200	6,000	110	none	BLM	NO
Osterback, Alvin A 050739	--	Wosnesenski I.	7,500	1/1/60	12/31/79	$ 45	Max: 75	69	--	1	none	BLM	NO
Woodworth, H. J. A 053[illegible]2	--	Simeonof I.	10,850	1/1/61	12/31/80	$ 165	Max: 275	256	--	4	none	BLM	NO*
Wright, Donald C. A 061517	--	Chernabura I.	7,248	1/1/64	12/31/83	$ 120	Max: 200	92 (est)	--	--	none lease unmanaged	BLM	NO

*lease located in Simenonof National Wildlife Refuge

100 with one animal-unit equivalent to one cow or five sheep. Approximately 60-70 head of cattle now utilize the island and are essentially wild and unmanaged. Gunderson is attempting to sell his cattle on both Caton and Sanak Islands, the latter of which he leases from the Bureau of Land Management.

Combined state and federal leases on grazing lands in Alaska amount to 1.468 million acres. Of the 87 leases, 14 containing a million acres are between Cook Inlet and the eastern Aleutian Islands, accounting for 22,000 sheep and 5,000 beef cattle. Another 1,172 mixed cattle, 500 horses and a few individuals of minor species make personal or year-long use of the balance of the leases. Some 1,700 additional horses and 2,800 cattle make seasonal use of privately-owned lands (Snodgrass and Sanders, 1972).

There are presently 9 grazing leases issued by the Bureau of Land Management in the Bristol Bay resource area (Aleutian, Sanak, and Shumagin Islands), in addition to one special-use permit issued by the Bureau of Sport Fisheries and Wildlife (Table 36). The BLM grazing leases are on Umnak, Akutan, Unalaska, Sanak, Wosnesenski, Simeonof, and Chernabura Islands, none of which are part of the Aleutian Islands National Wildlife Refuge. The Bureau's special-use permit for grazing on refuge lands covers only Caton Island.

One consideration that needs to be recognized is that increased demand for mutton, beef, and possibly reindeer in Japan may create a great deal of pressure to enlarge the livestock industry in the Aleutian Islands. Tussing (1968) summarizes this as, "Import needs are expected approximately to double between 1965 and 1970, to double again by 1975, and by 1980 to stand at about six times the 1966 figure. (Imports of beef were about 13 thousand tons and those of mutton were about 93 thousand tons in 1966...) Production in Australia and New Zealand is not expected to be able to supply this need, and Japanese meat packers are looking to other areas, Mexico, Brazil, and even Alaska, for meat sources to be developed in the next few years."

Previous discussion has indicated that such large-scale operations as would be needed to fulfill such demands would probably not be feasible in the Aleutian Islands.

Transportation

Transportation to and within the Aleutian Islands is by air and sea (Figure 63). Short road systems are located on Attu, Shemya, Amchitka, Adak, Umnak, Unalaska and Unimak Islands.

High costs of transportation among other reasons severely limit any commercial developments in the Chain.

Air-Transportation- Commercial air carriers provide access to all military sites and villages, except for Atka. Major runways are located at Attu, Shemya, Amchitka, Adak, Nikolski, Fort Glenn, Umnak, Dutch Harbor, Cape Sarichef, Scotch Cap, and False Pass. Amphibious operations service Chernofski, Akutan, Pavlof Harbor, and frequently False Pass, when adverse winds prohibit the use of the runway. Atka possesses a runway that was used into the early 1950's, but was abandoned when runway conditions prevented safe landing operations. This runway still exists and could be renovated given moderate construction monies.

The great expense of air transportation in the Aleutians precludes all but essential travel and shipment of goods. The following table summarizes current (as of March 1, 1973) passenger and freight rates from Anchorage to various points in the Chain.

From Anchorage to	Round trip fare (includes tax)	Freight*
False Pass	$265	$0.35/lb
Unalaska	286	0.30/lb
Adak	329	0.35/lb
Shemya	443	0.40/lb
Attu	460	0.40/lb

*This is for general commodities. There is an additional 5% tax for freight charges.

Water Transportation - All military sites and villages are serviced by water-borne transportation, which is almost entirely for shipment of goods and supplies. Little passenger traffic occurs, except where provided by fishing boats. Atka village depends entirely upon water transportation and is only serviced monthly by a Navy tug from Adak Naval Station.

Steamship freight haulers service Adak, Unalaska, Akutan, and False Pass. Contract shipments are made to Attu, Shemya, Amchitka, and Adak. Shipment of goods and materials into the Chain is principally from the Seattle area, although a minor amount does come from Anchorage and Kodiak. Unalaska and Adak are serviced bi-monthly, and the remainder except for Attu, Shemya, and Amchitka, on a monthly basis. Attu and Shemya receive the major portion of their supplies once annually from the military-contracted "Cool Barge."

Expensive shipping costs preclude movement of all but the most essential goods and supplies. An example of commercial freight rates as of March 1, 1973, are given below.

Anchorage to	Household Goods	
Unalaska	$14.62/hundred wt.	
Adak	18.28/hundred wt.	
Seattle to	**Household Goods**	**Canned Goods**
Unalaska	$16.24/hundred wt.	$12.66/hundred wt.
Adak	20.30/hundred wt.	15.83/hundred wt.

Long-range plans for the Alaska Marine Highway include expansion to the Alaska Peninsula, Bristol Bay, and the Aleutian Islands. This is to be dependent upon an increased need of these areas for linkage with the highway system (Federal Field Comm., 1971). At what level of development this might occur has not been given, nor has an estimate in terms of time been made. In January 1973, the Alaska Transportation Commission had received an application for ferry service in the eastern Aleutians. Malcolm S. McDonald of Dutch Harbor proposed to transport people, baggage, and vehicles among the islands of Umnak, Unalaska, Amaknak, Akutan and Akun. As of February 1973, no decision had been made. However, since the ferry routing takes the ferry beyond the three-mile limit into international waters, the approval of the ferry system may have to come from the Federal Maritime Commission.

Land Transportation - Short road systems are located and used on Attu, Shemya, Amchitka, Adak, Umnak, Unalaska, and Unimak Islands. Of those islands within the refuge, no future need for expansion is foreseen or expected. Existing roads sufficiently service the various sites and no need for future roads are envisioned by the Alaska Department of Highway in the study area (letter of December 6, 1972 from Alaska Department of Highways Commissioner Campbell to Alaska Area Director Watson, BSF&W).

Communications and Power

Communications - The origin of present communications can be traced to the first military use of Alaska. Prior to this, high-frequency radio was the only means of communication out of the isolated Aleutian villages. With the arrival of the military, radio circuits and land lines were commonly used until the White Alice system was put into operation in March 1958. Prior to this, the Federal Aviation Agency had installed a VHF repeater system in the early fifties to provide better aviation communications. In January of 1971, the long-distance communications facilities previously owned and operated by the Alaska Communication System of the Department of Defense, were sold to the Radio Corporation of America. These sites are located at Cape Sarichef, Driftwood Bay, Nikolski, Adak, and Shemya.

Total communications are provided by a mixture of submarine cables, VHF/UHF, microwave, tropospheric scatter, and MF/HF radio circuits. AM radio at the military sites is provided by the Armed Forces Radio and Television Network. Otherwise there is no radio available except that received by high-powered sets.

Closed-circuit television is provided at Adak, Shemya, and from Shemya to Attu. The increasing use of satellites for the transmission of television may bring live television to the Native villages within the near future.

The White Alice sites provide telephone service for Attu, Shemya, Adak, Niksolski, Unalaska, and Cape Sarichef. Atka, Fort Glenn, Chernofski, Akutan, Palof Harbor and False Pass still rely on MF/HF (two-way) radio.

There are no newspapers published in the Chain except for local weekly or bimonthly papers. These usually are of one or two pages and concern only local affairs. The closest newspapers are in Kodiak and Anchorage.

Power - All power used in the Islands is produced locally by diesel or gasoline-driven generators. Fuel is brought in from out of state by barge or ship. There are no planned or potential hydropower sites in the Aleutian Islands (Federal Power Commission, 1969).

Recreation and Tourism

Past and present recreational use is almost entirely by those who live in the region. Their use is normally confined to the immediate surrounding area. Expenditures for needs related to recreation are made locally and are usually of a minor nature. Travel to and within the Chain and to the outside for recreation is generally prevented by the high cost of transportation. Tourism is also severely curtailed by the high cost of transportation. The need for security clearances on the military sites is also a limiting factor. Lodging facilities are lacking and in some instances non-existent.

Future recreational use and tourism is expected to remain at the present level. With improved access and cheaper transportation, both would be expected to increase, and would have an economic impact in the eastern Aleutians and might help to broaden and stabilize the economy in those areas. Because the mission of the various government agencies in the central and western Aleutians does not encompass this type of economic development however, no change is expected in these areas.

BIBLIOGRAPHY

HISTORY

Alaska Historical Research Project. Alaska History Documents. 15 vols. Typescript. (Translations from the records of the Russian American Company and other documents in the National Archives, Washington.)

Andreyev, A.I. 1944. Russian discoveries in the Pacific and in North America in the eighteenth and nineteenth centureies. Trans. by Carl Ginsburg for the American Council of Learned Societies. Edwards Bros., Ann Arbor, 214 pp. 1952

Applegate, Sam. "The Third or Unalaska District", in Robert P. Porter (ed.). Population and Resources of Alaska at the 11th Census, 1890. Washington: Government Printing Office, 1893.

Bancroft, H.H. 1886. The history of Alaska. A.L. Bancroft CO., San Francisco, 775 pp.

______________ . History of Alaska 1730-1885. New York: Antiquarian Press Ltd, 1886.

Bensin, Basil M. Russian Orthodox Greek Church in Alaska, 1794-1967. Sitka: Russian Orthodox Greek Church of North America, 1968.

Bergslund, Knut. "Aleut Dialects of Atka and Attu", Transactions of the American Philosophical Society, April 1959. Philadelphia: American Philosophical Society, 1959.

Berhk, Vasili. 1823. The chronological history of the discovery of the Aleutian Islands, or the exploits of the Russian merchants with the supplement of the historical data on the fur trade. (In Russian, trans. by Dimitri Krenov, W. P. A. Proj. 5668, Seattle) Typography of W. Grech, St. Petersburg, 169 pp.

Berkeland, Knute. The Whalers of Akutan: An Account of Modern Whaling in the Aleutian Islands. New Haven: Yale University Press, 1926.

Chevigny, Hector. Russian America. New York: Viking Press, 1965.

Chittendon, Hiram Martin. 1954. A history of the American fur trade of the far west. 2 vols. Academic Reprints, Stanford. 1029pp.

Conn, Stetson and Bryon Fairchild, The Framework of Hemisphere Defense, United States Army in World War II. Washington, D.C.: Office, Chief of Military History, Department of the Army, 1960.

Conn, Stetson, Rose C. Engleman and Bryon Fairchild, Guarding the United States and its Outposts, United States Army in World War II. Washington, D.C.: Office, Chief of Military History, Department of the Army, 1960.

Cook, James and James King, 1784. A voyage to the Pacific Ocean, undertaken by the command of His Majesty for making discoveries in the northern hemisphere, to determine the position and extent of the west side of North America; its distance from Asia; and the practicability of a northern passage to Europe, in the years 1776-1780. 3 vols. London. (Commonly called "Cooks third voyage").

Cox, D.C. and G. Pararas-Carayannis. 1969. Catalog of Tsunamis in Alaska. U.S. Dept. of Comm. Washington, D.C. 39p.

Coxe, W. 1780. Account of the Russian discoveries between Asia and America, to which are added, the conquest of Siberia, and the history of the transactions and commerce between Russian and China. London. 378pp.

Craven, W.F. and J.L. Cate, eds., Plans and Early Operations, January 1939-August 1942, The Army Air Forces in World War II, Vol IV. Chicago: University of Chicago Press, 1950.

Dall, W.H. Alaska and its Resources. Boston, 1870.

Dixon, G. 1789. A voyage round the world; but more particularly to the Northwest Coast of America; performed in 1785, 1786, 1787, and 1788, in the Kung George and Queen Charolotte, Captains Portlock and Dixon. London, 360p

Douglas, Sir James. Fur trade returns. Columbia District and New Caledonia 1825-185 Archives of British Columbia, Victoria. MS. 408.

Dufresne, F. 1946. Alaska's animals and fishes. Binfords and Mort, Portland, Oregon. 297pp.

Garfield, B. 1969. The Thousand-Mile War. Garden City, N.Y. Doubleday & Co., Inc. 351pp.

Geoghegan, R.H. The Aleut Language. Washington: U.S. Department of Interior, 1944.

Golder, F.A. 1922. Bering's voyages; an account of the efforts of the Russians to determine the relation of Asia to America. American Geog. Soc. N.Y., 2 vols. I. The log books and official reports of the first and second expeditions 1725-1730 and 1733-1742. 371pp. II. Steller's journal of the sea voyage from Kamchatka to America and return on the second expedition, 1741-1742. 291pp.

Gruening, E. The State of Alaska. NY: Random House, 1954.

Howay, F.W. 1930. A list of trading vessels in the maritimes fur trade, 1785-1794. Proc. and Trans. Royal Soc. Canada, Sect. 2, Series 3, 24: 111-134.

__________. 1931. A list of trading vessels in the maritimes fur trade, 1795-1804. Proc. and Trans. Royal Soc. Canada, Sect. 2, Series 3, 25: 117-149.

__________. 1932. A list of trading vessels in the martimes fur trade, 1805-1814. Proc. and Trans. Royal Soc. Canada, Sect. 2, Series 3, 26: 43-86.

_______. 1933. A list of trading vessels in the maritimes fur trade, 1815-1819. Proc. and Trans. Royal Soc. Canada, Sect. 2, Series 3, 27: 119-147.

_______. 1934. A list of trading vessels in the maritimes fur trade, 1820-1825. Proc. and Trans. Royal Soc. Canada, Sect. 2, Series 3, 28: 11-49.

Historical Section, 5th Infantry Division, The Fifth Infantry Division in the ETO, 1945. Atlanta, 1945.

Hrdlicka, A. The Aleutian and Commander Islands and their Inhabitants. Philadelphia: Wistar Institute, 1945.

Jochelson, W. History, Ethnology, and Anthropology of the Aleut. Oosterhoot N.B. -- The Netherlands: Anthropological Publications, 1933.

Karig, Capt. W. and Comm. E. Purdon, Battle Report, Pacific War, Middle Phase. N.Y. and Toronto: Rinehart and Co., Inc. 1947.

Khlebnikoff, Kiryll. 1835. Biography of Alexander Andreivitch Baranoff: Governor-General of the Russian Colonies in America. Navy Pr. Off., St. Petersburg. (In Russian, excerpts trans. by G. Guilsher.)

_______________. 1861. Notes of K. Khlebnikov about America. In Materials for the history of Russian settlements along the shores of the eastern ocean. Suppl. to Navy Coll. No. 3, Navy Typog., St. Petersburg. (In Russian, excerpts trans. by G. Guilsher).

Langsdorff, G.H. The Voyage to the Aleutian Islands and Northwest Coast of America, 1803-1807. London, 1814.

Laughlin, W.S. "A New View of the Aleutian Islands," Arctic, 4: 75-88, 1951.

__________. "Human Migration and Permanent Occupation in the Bering Sea Area", in David M. Hopkins (ed.). The Bering Land Bridge. Stanford: Stanford University Press, 1967, pp. 409-450.

__________. "The Aleut-Eskimo Community", Anthropological Papers of the University of Alaska, 1: 25-47, December, 1952.

Life and Work of Innocent the Archbishop of Kamchatka, the Kuriles and the Aleutian Islands and Later the Metropolitan of Moscow. San Francisco: Printed by Rev. Bishop Micholas, 1897.

Masterson, J.R. and Helen Brower. 1948. Bering's successors, 1745-1780: Contributions of Peter Simon Pallas to the history of Russian exploration toward Alaska. Univ. of Washington Press, Seattle, 96pp.

McCracken, H. 1957. Hunters of the stormy sea. Oldbourne, London. 312 pp.

Meares, John. 1791. Voyages made in the years 1788 and 1789 from China to the North West Coast of America. 2 vols., London.

Morgan, M.C., Bridge to Russia: Those Amazing Aleutians. N.Y.: E.P. Dutton & Co., 1947.

Morison, S.E., The Rising Sun in the Pacific, 1931-April 1942. History of United States Naval Operations in World War II, Vol. III, Boston: Little, Brown & Co., 1948.

__________. Coral Sea, Midway, and Submarine Actions, May 1942-August 1942. History of United States Naval Operations in World War II, Vol. IV. Boston: Little, Brown & Co., 1949.

__________. Aleutians, Gilberts and Marshalls, June 1942-April 1944, History of United States Naval Operations in World War II, Vol. VII. Boston: Little, Brown & Co., 1951.

Muir, J. Cruise of the Corwin. Boston and New York: Houghton Mifflin Co., 1917.

Okun, S.B. (Translated by Carl Ginsburg). The Russian-American Company. Cambridge: Harvard University Press, 1951.

Perouse, J.F.D. de la. 1799. A voyage round the world, performed in the years 1785, 1786, 1787, 1788, by the Boussale and Astrolabe, under the command of J.F.D. de la Perouse. 2 Vols., London.

Petroff, I. 1884. Alaska: its population, industries, and resources. Tenth Census of the United States, Vol. 8. 189pp.

__________. 1880. Population and Resources of Alaska. A report to the 46th Congress, 3d session, House of Representatives, Executive Document No. 40. Washington.

Ranson, M.A. and Eloise K. Engle. Sea of the Bear. Annapolis, Maryland: U.S. Naval Institute, 1964.

Smithsonian Institution, The Aleutian Islands, Their People and Natural History. Smithsonian Way Background Studies, Washington, D.C.: Smithsonian Institution 1945.

Stacey, Col. C.P., Six Years of War: The Army in Canada, Britain, and the Pacific, History of the Canadian Army in the Second World War, Vol. I. Ottawa: Minister of National Defense, 1955.

Tikhmenev, P.A. (Translated by Michael Dobrynin). Historical Review of the Origin of the Russian-American Company and its Activities up to the Present Time, Washington: WPA Project No. 65-1-08-62, Unit A-17, 1940.

Veniaminov, I. Notes on the Islands of the Unalaska Division. 3 Vol. St. Petersburg, 1840. Partial translations appear in Alex Hrdlicka, William Dall, Alaska and its Resources, and Richard Pierce, in Litt. An unpublished partial translation by Ivan Petroff is in Bancroft Library, University of California, Berkeley. And a translation and microfilm of Vol. II is in the Human Relations Area Files at Yale University.

Walker, E.P., Alaska, America's Continental Frontier Outpost. Washington, D.C.: Smithsonian Institution, 1943.

Winchell, Mary. Home by the Bering Sea. Caldwell, Idaho: Caxton Printers, 1950.

ANTHROPOLOGY

Aigner, J.S. 1966. Bone tools and Decorative Motifs from Chaluka, Umnak Island. Arctic Anthropology. 3(2): 57-83.

Bank, T.P. II. 1952. Botanical and Ethnobotanical Studies in the Aleutian Islands; Part I: Aleutian Vegetation and Aleut Culture. Papers of the Michigan Academy of Science, Arts, and Letters. 37: 13-30.

_________. 1953a. Ecology of Prehistoric Aleutian Village Sites. Ecology 34(2): 246-264.

_________. 1953b. Cultural Succession in the Aleutians. American Antiquity. 19(1): 40-49.

_________. 1954. Archaeology at Unalaska, Aleutians, During 1954. Mimeographed report. 15pp.

_________. 1963. The Past Ages of Unalaska. Explorers Journal. Sept. pp. 34-42.

_________. 1971. Aleutian-Bering Sea Institutes and Research Program. (Mimeo) 37pp.

n.d. Loose map sheets with marked sites: Uliaga, Kagamil, Near Islands, Kiska, Rat, Delarof Islands, & Atka.

Bergsland, K. 1959. Aleut Dialects of Atka and Attu. Transactions of the American Philosophical Society. 49(3).

Black, R.F. and W.S. Laughlin. 1964. Anagula: A Geologic Interpretation of the Oldest Archeologic Site in the Aleutians. Science. 143(3612): 1321-1322.

Campbell, J.M. 1964. Current Research: Arctic. American Antiquity. 29(4): 535-539.

Cook, J., Clerke, C. and Gore. 1818. A Voyage to the Pacific Ocean in the Years 1776-80. Vol. 2. Robert Sesilver, Philadelphia.

Cook, J.P., Dixon, E.J. and C.E. Holmes. 1972. Archaeological Report, Site 49 RAT 32, Amchitka Island, Alaska. U.S. Atomic Energy Commission, Nevada Operations Office. pp. 109.

Coxe, W. 1797. Account of the Russian Discoveries Between Asia and America. Augustus M. Kelley. New York (1970).

Dall, W.H. 1870. Alaska and Its Resources. Lee and Shepard. Boston.

_________. 1873. Notes on Pre-Historic Remains in the Aleutian Islands. Proceedings of the California Academy of Science. 4(5): 283-287.

_________. 1875. On Further Examinations of the Amaknak Cave, Captain's Bay, Unalaska. Proceedings of the California Academy of Science, Vol. 5. pp. 196-200.

_______. 1877. On Succession in the Shell-Heaps of the Aleutian Islands. In: Tribes of the Extreme Northwest; Contributions to North American Ethnology. Vol. 1; U.S. Geographical and Geological Survey of the Rocky Mountain Region, Government Printing Office. pp. 41-106.

_______. 1880. On the Remains of Later Prehistoric Man Obtained from Caves in the Catherina Archipelago, Alaska Territory and Especially from Caves of the Aleutian Islands. Smithsonian Contributions to Knowledge (1878). 22(318).

_______. 1884. On Masks, Labrets and Certain Aboriginal Customs with an Inquiry into the Bearing of the Geographical Distribution. Third Annual Report of the Bureau of American Ethnology. pp. 73-202.

Denniston, G. 1966. Cultural Change at Chaluka, Umnak Island: Stone Artifacts and Features. Arctic Anthropology. 3(2): 84-124.

Desautels, R.J., A.J. McCurdy, J.D. Flynn and R.R. Ellis. 1971. Archaeological Report, Amchitka Island, Alaska, 1969-70. U.S. Atomic Energy Commission, Division of Technical Information. 396pp.

Golder, F.A. 1922, Berings Voyages. American Geographical Society Research Series. 1(1).

Grayson, D.K. 1969. The Tigalda Site: An Eastern Aleutian Midden. Unpublished M.A. Thesis, University of Oregon. 137p.

Guggenheim, P. 1945. An Anthropological Campaign on Amchitka. Scientific Monthly. 61: 21-32.

Hrdlicka, A. 1939. Explorations in the Aleutian and the Commander Islands. Explorations and Field Work of the Smithsonian Institution in 1938. Pub. No. 3525. pp. 79-86.

_______. 1941. Explorations of Mummy Caves in the Aleutian Islands, Part I: Previous Knowledge of Such Caves. Scientific Monthly. 52:5-23.

_______. 1945. The Aleutian and Commander Islands and Their Inhabitants. Wistar Institute of Anatomy and Biology. Philadelphia.

Hurt, W.R., Jr. 1950. Artifacts from Shemya, Aleutian Islands. American Antiquity. 16(1): 68-69.

Jochelson, W. 1925. Archaeological Investigations in the Aleutian Islands. Carnegie Institution of Washington. Publication No. 367.

_______. 1933. History, Ethnology and Anthropology of the Aleut. Carnegie Institution of Washington Publication No. 432.

Jones, R.D., Jr. 1963. Buldir Island, Site of a Remnant Breeding Population of Aleutian Canada Geese. The Wildfowl Trust. pp. 80-84.

Kroeber, A.L. 1939. Cultural and Natural Areas of Native North America. University of California Publications in American Archaeology and Ethnology. Vol. 38.

Lantis, M. 1970. The Aleut Social System, 1750 to 1810, from Early Historic Sources. In: Ethnohistory in Southwestern Alaska and the Southern Yukon. ed. M. Lantis. The University Press of Kentucky, Lexington, pp. 139-295.

Laughlin, W.S. 1951. Notes on an Aleutian Core and Blade Industry. American Antiquity. 17(1): 52-55.

____________. 1952. The Aleut-Eskimo Community. Anthropology Papers of the University of Alaska. 1(1): 25-46.

____________. 1958. Neo-Aleut and Paleo-Aleut Prehistory. Proceedings of the 32nd International Congress of Americanists. Copenhagen (1956), pp. 516-30.

____________. 1962. Archaeological Investigations on Umnak Island, Aleutians. Arctic Anthropology. 1(1): 108-110.

____________. 1963. Eskimos and Aleuts: Their Origins and Evolution. Science Vol. 142, No. 3593. pp. 633-45.

____________. 1967. Human Migration and Permanent Occupation in the Bering Sea Area. In: The Bering Land Brdige (ed. D.M. Hopkins), Stanford University Press. pp. 40[illegible]-49.

Laughlin, W.S. and J.S. Aigner. 1966. Preliminary Analysis of the Anangula Unifacial Core and Blade Industry. Arctic Anthropology. 3(2): 41-56.

Laughlin, W.S. and G.H. Marsh. 1951. A New View of the History of the Aleutians. Arctic 4(2): 75-88.

____________. 1954. The Lamellar Flake Manufacturing Site on Anangula Island in the Aleutians. American Antiquity. 20(1): 27-39.

____________. 1956. Trends in Aleutian Chipped Stone Artifacts. Anthropological Papers of the University of Alaska. 5(1): 5-21.

Laughlin, W.S. and W.G. Reeder. 1962. Revision of Aleutian Prehistory. Science 137(3533): 856-857.

Lippold, L.K. 1966. Chaluka: The Economic Base. Arctic Anthropology. 3(2): 125-131.

McCartney, A.P. 1967. An Analysis of the Bone Industry from Amaknak Island, Alaska. Unpublished MA thesis, University of Wisconsin-Madison. pp. 540.

____________. 1969. Prehistoric Aleut Influences at Port Moller, Alaska. Anthropological Papers of the University of Alaska. 14(2): 1-16.

____________. 1970. "Pottery" in the Aleutian Islands. American Antiquity. 35(1): 105-108.

__________. 1971. A Proposed Western Aleutian Phase in the Near Islands, Alaska. Arctic Anthropology. 8(2): 92-142.

__________. 1973. An Archeological Site Survey and Inventory for the Aleutian Islands National Wildlife Refuge, Alaska, 1972. FWS File Report. 11-1-72. Anchorage. 46pp.

McCartney, A.P. and C.G. Turner II.1966a. Stratigraphy of the Anangula Unifacial Core and Blade Site. Arctic Anthropology. 3(2): 28-40.

__________. 1966b. Memorandum on the Anangula Core and Blade Complex. Mimeographed report. 26pp.

Mooney, J. 1928. The Aboriginal Population of America North of Mexico. Smithsonian Miscellaneous Collections. (Pub. No. 2955). 80(7).

Nelson, W.H. and F. Barnett. 1955. A Burial Cave on Kanaga Island, Aleutian Islands. American Antiquity. 20(4): 387-392.

Petroff, I. 1884. Report on the Population, Industries, and Resources of Alaska. Tenth Census (1880). Dept of Interior.

Pinart, A.L. 1872. Catalogue des Collections Rapportee de l'Amerique Russe par Alphonse Pinart, Exposeis dans le Musee d'Histoire Naturalle de Paris. Paris.

__________. 1885. LaCaverne d'Aknanh, Isle d'Ounga, par A.L. Pinart. Paris

Quimby, G.I. 1944. Aleutian Islanders (Eskimo of the North Pacific). Anthropology Leaflet. No. 35, Chicago Natural History Museum.

__________. 1945. Periods of Prehistoric Art in the Aleutian Islands. American Antiquity. 11(2): 76-79.

__________. 1946. Toggle Harpoon Heads from the Aleutian Islands. Fieldiana-Anthropology. 36(2): 15-23.

__________. 1948. Prehistoric Art of the Aleutian Islands. Fieldiana-Anthropology. 36(4): 77-92.

Sarichev, G. 1807. Account of a Voyage of Discovery to the North-East of Siberia, the Frozen Ocean, and the North-East Sea. Richard Phillips, London.

Spaulding, A.C. 1962. Archaeological Investigations on Agattu, Aleutian Islands. Anthropological Papers, The University of Michigan Museum of Anthropology. No. 18.

Turner, C.G. II. 1970. Archaeological Reconnaissance of Amchitka Island, Alaska. Arctic Anthropology. 7(2): 118-128.

__________. 1972. Preliminary Report of Archaeological Survey and Test Excavations in the Eastern Aleutian Islands, Alaska. Arctic Anthropology. 9(2): 32-35.

Turner, C.G. II and J.A. Turner 1972. Akun. Mimeographed report. 53 pp.

Veniaminof, I. 1840. Notes on the Islands of the Unalaska District. Human Relations Area File translation of Vol. 2 and part of Vol. 3; Russian-American Company, St. Petersburg.

Weyer, E.M. Jr. 1929. An Aleutian Burial. Anthropological Papers of the American Museum of Natural History. 31(3).

RESOURCES (other than Geology)

Alaska Department of Fish and Game. 1970. Aerial Count of Sea Otters-South Side of the Alaska Peninsula. File report. 30 pp.

Alaska Department of Fish and Game. 1973. Alaska's Wildlife and Habitat. Juneau, Alaska.114 pp.

American Fisheries Society. 1960. A List of Common and Scientific Names of Fishes from the United States and Canada. 2nd ed. American Fisheries Society Spec. Pub. No. 2. 102 pp.

Amundsen, C.C. 1972. Plant Ecology of Amchitka Island. Final Report. Battelle Institute, BMI-171-139. Columbus, Ohio. 27 pp.

Baker, R.C., F. Wilke, and C.H. Baltzo. 1963. The Northern Fur Seal. U.S. Fish and Wildlife Serv., Circ. 169. 22pp.

Belopol'skii, L.O. 1957. Ecology of Sea Colony Birds of the Barents Sea. Trans. of Russian Pub. U.S. Department of Commerce, Washington, D.C. 346 pp.

Buckley, J.L. 1958. The Pacific Walrus. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 41. 29 pp.

Burns, J.J. The Walrus in Alaska: its Ecology and Management. Alaska Department of Fish and Game. 47 pp.

Collins, H.B., Jr., A.H. Clark, and E.H. Walker. 1945. The Aleutian Islands: their People and Natural History. Smithsonian War Background Studies #21. Smithsonian Institution, Washington, D.C. 129pp.

Dodimead, A.J., F. Favorite, and T. Hirano. 1963. Salmon of the North Pacific Part II, Review of Oceanography of the Sub-arctic Pacific Region. International North Pacific Fisheries Commission Bulletin. #13. Vancouver, Canada. 195pp.

Dunn, J.R. 1969. Direction of Movement of Salmon in the North Pacific Ocean, Bering Sea and Gulf of Alaska as Indicated by Surface Gill-net Catches 1962-1965. International North Pacific Fisheries Commission Bulletin #26. Vancouver, Canada. pp. 27-56.

Federal Field Committee for Development Planning in Alaska. 1968. Alaska Natives and the Land. Anchorage, Alaska. 565 pp.

Feulner, A.J. 1972. Portion of Watershed Resources. Report to Alaska Land-Use Planning Commission. 44pp.

Fiscus, C.H. 1969. Steller Sea Lions at Ugamak Island, Aleutian Islands, Alaska, June 1969. File Report at Marine Mammal Bio. Lab., Sand Point, Washington. 53 pp.

Gard, L.M., G.E. Lewis, and F.C. Whitmore. 1972. Steller's Sea Cow in Pleistocene Interglacial Beach Deposits on Amchitka, Aleutian Islands. Geo. Soc. of Am. Bull. 83: 867-870.

Godfrey, H. 1965. Salmon of the North Pacific Ocean, Part IX. Coho Salmon in Offshore Waters. International North Pacific Fisheries Commission, Bulletin #16: 1-39.

Gulland, J.A. and A.R. Tussing. 1972. Fish Stocks and Fisheries of Alaska and the Northeast Pacific Ocean. from Alaska Fisheries Policy, University of Alaska, Institute of Social, Economic, and Government Research. pp. 75-116.

Hall, E.R. and K.R. Kelson. 1959. Order Pinnipedia. in The Mammals of North America, New York, Ronald Press. Vol. 2: 973-988, 1083.

Hanamura, N. 1966. Salmon of the North Pacific Ocean, Part III. A Review of the Life History of North Pacific Salmon. Sockeye Salmon in the Far East. International North Pacific Fisheries Commission Bulletin #18: 1-27.

Hartt, A.C. 1962. Movement of Salmon in the North Pacific Ocean and Bering Sea as Determined by Tagging, 1956-58. International North Pacific Fisheries Commission Bulletin #6: 157 pp.

_________. 1966. Migrations of Salmon in the North Pacific Ocean and Bering Sea as Determined by Seining and Tagging, 1959-1960. Inter-National North Pacific Fisheries Commission Bulletin #19. 141 pp.

Hulten, E. 1960. Flora of the Aleutian Islands. 2nd Ed. Weinsh. Bergstr. 418. pp.

_________. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press. 1008 pp.

Ingersoll, E. (ed.). 1914. Alaskan Bird-Life. Audubon Society, New York, 72 pp.

International North Pacific Fisheries Commission. 1966. Statistical Yearbook 1966. Vancouver. 87 pp.

____. 1972. Statistical Information on Halibut. Bull. 28: 20-25.

Jackson, R.C. 1963. Introduction. Salmon of the North Pacific Ocean, Part 1. International North Pacific Fisheries Bulletin #12: 1-5.

Johnson, R.C. 1964. Direction of Movement of Salmon in the North Pacific as Indicated by Surface Gillnet Catches, 1959-60. International North Pacific Fisheries Commission Bulletin #14: 33-48.

Kasahara, J. 1963. Salmon of the North Pacific Ocean, Part I. Catch Statistics for North Pacific Salmon. International North Pacific Fisheries Commission Bulletin #12: 7-82.

Kenyon, K.W. 1961. Birds of Amchitka Island, Alaska. Auk 78(3): 304-326.

__________. 1962. History of the Steller Sea Lion at the Pribilof Islands, Alaska. J. Mammal. 43(1): 68-75.

__________. 1966. Military Use of Island Refuges, Including Operation Long Shot: Sea Otter Surveys and Sea Otter Transportation Experiment, October-December 1965. BSF&W file report. 50 pp.

Kenyon, K.W. and J.G. King. 1965. Aerial Survey of Sea Otters, Other Marine Mammals and Birds, Alaska Peninsula and Aleutian Islands. 19 April to 9 May 1965. 61 pp. Mimeo reprint in FWS files, Anchorage.

Kenyon, K.W. and D.W. Rice. 1961. Abundance and Distribution of the Steller Sea Lion. J. Mammal. 42(2): 223-234.

Kenyon, K.W. and V.B. Scheffer. 1953. The Seals, Sea-Lions and Sea Otters of the Pacific Coast. U.S. Fish Wildl. Serv. Leaf. 344. 28 pp.

Kenyon, K.W. and D.L. Spencer. 1960. Sea Otter Population and Transplant Studies in Alaska, 1959. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 48 pp.

Kenyon, K.W. and F. Wilke. 1956. Sea Otter Studies in Alaska. Alaska Science Conf. , Juneau. 6 pp.

Lensink, C.J. 1960. Status and Distribution of Sea Otters in Alaska. J. Mammal. 41 (2): 172-182.

Lensink, C.J. 1962. The History and Status of Sea Otter and Alaska. Ph.D. thesis, Purdue University.

Manville, R.H. and S.P. Young. 1965. Distribution of Alaskan Mammals. U.S. Fish Wild. Serv. Circ. 211. 74 pp.

Manzer, J.I., T. Ishida, A. Peterson and M. Hanavan. 1965. Salmon of the North Pacific Ocean, Part IV. Offshore Distribution of Salmon. Inter-National North Pacific Fisheries Commission Bulletin #15. 452 pp.

Mason, J.E. 1965. Salmon of the North Pacific Ocean, Part IX. Chinook Salmon in Offshore Waters. International North Pacific Fisheries Commission Bulletin #16: 41-73.

Mayr, E. 1954. Change of a Genetic Environment and Evolution. in Evolution As a Process. ed. J. Huxley, A.C. Hardy, and E.B. Ford, George Allen & Unwin Ltd., London: 157-180.

Murie, O.J. 1959. Fauna of the Aleutian Islands and Alaska Peninsula. U.S. Fish Wildl. Serv., N. Amer. Fauna 61. 406 pp.

Murie, O.J. and V.B. Scheffer. 1959. Fauna of the Aleutian Islands and Alaska Peninsula [with appendix by V.B. Scheffer on] Invertebrates and Fishes Collected in the Aleutians, 1936-38.

Nishiwake, M. 1966. Distribution and Migration of the Larger Cetaceans in the North Pacific as Shown by Japanese Whaling Results. In Whales, Dolphins, and Porpoises. K.S. Norris (ed.). University of California Press, Berkeley: 171-191.

____________. 1967. Distribution and Migration of Marine Mammals in the North Pacific Area. Ocean Research Inst., University of Tokyo, Bull. #1. 62 pp.

Sanger, G.A. 1972a. Checklist of Bird Observations from the Eastern North Pacific Ocean, 1955-1967. Murrelet 53(2): 16-21.

____________. 1972b. The Recent Pelagic Status of the Short-Tailed Albatross (*Diomedea albatrus*).Biol. Cons. 4 (3): 189-193.

____________. 1972c. Preliminary Standing Stock and Biomass Estimates of Seabirds in the Subarctic Pacific Region. Biol. Oceanography of the Northern North Pacific Ocean. Tokyo. 589-612.

Scheffer, V.B. 1958. Seals, Sea Lions and Alruses: a Review of the Pinnipedia. Stanford University Press. 179 pp.

Scheffer, V.B. and D.W. Rice. 1963. A List of the Marine Mammals of the World. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. 431. 12 pp.

Schneider, K. 1969. Aerial Count of Sea Otters, Aleutian Islands, Alaska Peninsula and Shumagin Islands. File report. ADF&G. 22 pp.

Shacklette, H.T. 1966. The Aleutian Islands Oceanic Tundra. Address to Alpine Research Seminar, Boulder, CO. 12/9/66.

____________. et al. 1969. Vegetation of Amchitka Island, Aleutian Islands, Alaska. Geol. Surv. Prof. Paper 648. Washington D.C. 66 pp.

Slijper, E.J. 1958. Whales. Basic Books, Inc. New York. 475 pp.

Tatewaki, M. 1930-31. Notes on the Plants of the Western Aleutian Islands Collected in 1926. Trans. Sapporo Nat. Hist. Soc. 11: 152-156; 12: 200-209.

U.S. Fish and Wildlife Service. 1971. Unimak Wilderness Field Study Report. Anchorage. 61 pp.

U.S. Weather Bureau. 1965. Climatic Summary of the United States, Supplement for 1951 through 1960: Alaska. Climatography of the U.S., No. 86-43. 68 pp.

U.S. Weather Bureau and Navy Hydrographic Office. Current Maps.

Wilke, F. and K.W. Kenyon. 1954. Migration and Food of the Northern Fur Seal. Trans. 19th N. Amer. Wildl. Conf. 430-440.

Williamson, F.S.L. and W.B. Emison. 1969. Studies of the Avifauna on Amchitka Island, Alaska. Annual Progress Report, June 1968- July 1969. Battelle Rpt. BMI-171-125. 36 pp.

Yasso, W.E. 1965. Oceanography. Holt, Reinhart, Winston. New York. 176 pp.

GEOLOGY

Anderson, A.T., Jr. 1970. Nickel in Basaltic olivine and glass. EOS (Am. Geophys. Union Trans.). 51(4): 443-444.

Anderson, R.E. 1970. Tectonic overview of the Bering Sea - Aleutian Ridge region. AM. Assoc. Petro. Geologists Bull. 54(12): 2467.

Anderson [Andersen], S.T. and T.P. Bank. 1952. Pollen and radiocarbon studies of Aleutian soil profiles [Alaska]. Science. 116(3004): 84-86.

Atwood, W.W. 1911. Geology and mineral resources of parts of the Alaska Peninsula. U.S. Geological Survey Bull. 467. Acad. Sci. Jour. 2:85-86.

Bath, G.D., W.J. Carr, L.M. Gard Jr. & W.D. Quinlivan. 1972. Interpretation of an Aeromagnetic Survey of the Amchitka Islands area Alaska, Geological Survey, Professional Paper #707, U.S. Government Printing Office. 25 pp.

Becker, G.F. 1895. Distribution of Gold deposits in Alaska. Journ. Geol. 3:960-962.

Black, R.F. and W.S. Laughlin. 1964. Anangula - a geologic interpretation of the oldest archaeological site in the Aleutians. Science. 143(3612): 1321-1322.

Bodle, R.R. 1947. Note on the earthquake and seismic sea wave of April 1, 1946. Am. Geophys. Union Trans. 27(4): 464-465.

Bradley, C.C. 1948. Geologic notes on Adak Island and the Aleutian Chain, Alaska. Am. Journ. Sci. 246(4): 214-240.

Burk, C.A. 1966a. Geologic history of Alaska Peninsula. Am. Assoc. Petro. Geologists Bull. 50(3): 645.

________. 1966b. The Aleutian arc and Alaska Continental Margin, in Continental margins and islands arcs. Canada Geol. Surv. Paper 66-15, p. 206-214.

Byers, F.M. Jr., et al. 1947. Volcano investigations on Umnak Island [Aleutians] 1946. U.S. Geol Surv. , Alaskan Volcano Inv. Rept. 2, p. 19-53.

Byers, F.M. Jr. and W.W. Brannock. 1949. Volcanic activity on Umnak and Great Sitkin Islands. 1946048. Am. Beophys. Union Trans. 30(5): 719-734.

Byers, F.M. Jr. 1959. Geology of Umnak and Bogoslof Islands, Aleutian Islands, Alaska. U.S. Geol Surv. Bull. 1028-L, pp. 267-239.

____________. 1952. Orogenic significance of two volcanic sites at Umnak Island, Alaska. Geol. Soc. America Bull. 63(12): 1323.

__________. 1953. Silica-variation diagram, northeastern Umnak Island, Alaska. Geol. Soc. America Bull. 64(12): 1500.

__________. 1961. Petrology of three volcanic suites, Umnak and Bogoslof Islands, Aleutian Islands, Alaska. Geol. Soc. America Bull. 72(1):93-128.

Byers, F.M. Jr., and T.F.W. Barth. 1953. Volcanic activity on Akun and Akutan Islands [Aleutian Islands]. Pacific Sci. Cong. New Zealand, 1949.Proc. Wellington, v.2. p. 382-397.

Cameron, C.P., D.B. Stone. 1970a. Outline geology of the Aleutian Islands with paleomagnetic data from Shemya and Adak Islands. Univ. Geophys. Inst. [rept.] UAG R-213. 153 pp.

Capps, S.R. 1934. Notes on the geology of the Alaska Peninsula and Aleutian Islands. U.S. Geol. Survey Bull. 857-D. p. 141-153.

Carr, W.J. and W.D. Quinlivan. 1969. Progress report on the geology of Amchitka Island, Alaska. U.S. Geol. Survey Rept. USGS-474-44. 15 pp.

Carr, W.J., L.M. Gard, G.D. Bath, D.L. Healey. 1971. Earth-Science studies of a nuclear test area in the western Aleutian Islands, Alaska: an interim summary of results. Geol. Soc. America Bull. 82(3): 699-705.

Chiburis, E.F. 1971. Alocation study of Aleutian Islands explosions and earthquakes. EOS(Am. Geophys. Union Trans.). 52(4): 284.

Coats, R.R. 1962. Magma type and crustal structure in the Aleutian arc, in The crust of the Pacific Basin: Am. Geophys. Union Geophys. Mon. 6. p. 92-109.

__________. 1961. Magma type and crustal structure in the Aleutian arc. Pacific Sci. Cong. Abs. Symposium Papers. pp. 390.

__________. 1947a. Geology of northern Adak Island [Aleutians, Alaska]. U.S. Geol. Survey Alaskan Volcano Inv. Rept. No. 2. pp. 71-85.

__________. 1947b. Geology of northern Kanaga Island [Aleutians, Alaska]. U.S. Geol. Survey Alaskan Volcano Inv. Rept. No. 2. pp. 87-94.

__________. 1947c. Reconnaissance geology of some western Aleutian Islands [Alaska]. U.S. Geol. Survey Alaskan Volcano Inv. Rept. No. 2. pp. 95-105.

__________. 1956a. Geology of northern Adak Island, Alaska. U.S. Geol Surv. Bull. 1028-C. pp. 45-67.

__________. 1956b. Geology of northern Kanaga Island, Alaska. U.S. Geol. Surv. Bull. 1028-D. pp. 69-81.

__________. 1956c. Reconnaissance geology of some western Aleutian Islands, Alaska. U.S. Geol. Surv. Bull. 1028-E. pp. 831-100.

__________. 1953. Geology of Buldir Island, Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 989-A. pp. 1-26.

__________. 1959a. Geological reconnaissance of Gareloi Island, Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 1028-J. pp. 249-256.

__________. 1959b. Geological reconnaissance of Semisopochnoi Island, western Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 1028-O. pp. 477-519.

__________. 1952. Magmatic differentiation in Tertiary and Quarternary volcanic rocks from Adak and Kanaga Islands, Aleutian Islands, Alaska. Geol. Soc. Surv. Bull. 989-A. pp. 1-26.

__________. 1950. Volcanic activity in the Aleutian Arc. U.S. Geol. Survey Bull. 974-B. pp. 34-49.

Coats, R.R. , W.H. Nelson, R.Q. Lewis, and H.A. Powers. 1961. Geologic reconnaissance of Kiska Island, Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 1028-R. pp. 563-581.

Collier, A.J. 1905. Auriferous quartz veins on Unalaska Island [Alaska]. U.S. Geol. Survey Bull. 259. p. 102-103.

Cox, D.C. and G. Pararas-Carayannis. 1969. Catalog of Tsunamis in Alaska. U.S. Dept. of Comm. Washington. 39 pp.

Dall. W.H. 1868a. Explorations in Alaska. Boston Soc. Nat. History Proc. 12:143-145.

_________. 1868b. Explorations in Russian America. Am. Jour. Sci. 45:96-99.

_________. 1868a. Observations on the geology of Alaska. Am. Naturalist. 3:668.

________. 1869b. [Observations on Alaska]. California Acad. Sci. Proc. 4:30-37.

________. 1878a. Nuere Forschungen auf den Aleuten [Recent investigations in the Aleutians]. Deutsche Geographische Blatter. 2:38-43, 84-101.

_________. 1884. A new volcano island in Alaska. Science. 3:89-93.

_________. 1885. Further notes on Bogoslof Island. Science 5: 32-33.

_________. 1896. Report on coal and lignite of Alaska. U.S. Geol Surv. Ann. Rept. 17. pp. 763-875.

________. 1918. Reminiscences of Alaska volcanoes. Sci. Monthly. 7:80-90.

Dall. W.H. and Marcus Baker. 1879. Partial list of books, pamphlets, papers in serial journals and other publications on Alaska and adjacent regions. U.S. Coast and Geodetic Survey, Pacific Coast Pilot, Coast and Islands of Alaska (2nd Ser.), App. I., p. 225-374; preliminary note p. 165-166. [Contains 3,832 titles and subtitles in 11 languages; 895 titles and 1,486 subtitles are in English. Most are of historical rather than geological interest, but this list is the most complete of its kind.]

Davis, T.N. 1963. Seismic history of Alaska and the Aleutian Islands. Bol. Biblof. Geogisica y Occanografia Am. 3:1-16.

Dawson, G.M. 1894a. Geological notes on some of the coasts and islands of Bering Sea and vicinity. Geol. Soc. America Bull. 5:117-146; Am. Geologist. 13:137.

Diller, J.S. 1885a. Lava from the new volcano on Bogoslof Island. Science 5:66-67

________. 1884a. Report on atmospheric sand dust from Unalaska. Nature. 30:91-93.

________. 1884b. Volcanic sand which fell at Unalaska October 20, 1883, and some considerations concerning its composition. Science. 3(651-654).

________. 1885b. The volcanic sand which fell at Unalaska October 20, 1883, and some considerations concerning its composition. Phil. Soc. Washington Bull. 7:33-35.

Drewes, H., G.D. Fraser, G.L. Snyder, and H.F. Barnett, Jr. 1961. Geology of Unalaska Island and adjacanet insular shelf, Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 1028-S. pp. 583-676.

Eakins, G.R. 1970. Mineralization near Stepovak Bay, Alaska Peninsula, Alaska. Alaska Div. of Mines and Geology Spec. Rept. 4. 12 pp.

Engdahl, E.R. and A.C. Tarr. Seismicity of the Amchitka Island region. Geol. Soc. America Abs. 2(7): 547.

Everett, K.R. 1971. Composition and genesis of the organic soils of Amchitka Island, Aleutian Islands, Alaska. Arctic and Alpine Research. 3(1):1-16.

Finch, R.H. 1935. Akutan volcano. Zeitschr. Vulanologie, Band. 16, Heft 3, pp. 155-160.

________. 1934. Shishaldin volcano. 1933. Pacific Sci. Cong. Proc. 3:2369-76.

Forbes, R.B., D.K. Ray, R. Katsura, H. Matsumoto, J. Haramura, and M.J. Furst. 1969. The comparative chemical composition of continental vs.island arc andesites in Alaska. Oregon. Dept. of Geology and Mineral Ind. Bull. 65. pp. 111-120.

Fraser, G.D. and G.L. Snyder. 1959. Geology of southern Adak Island and Kagalaska Island, Alaska. U.S. Geol. Survey Bull. 1028-M. pp. 371-408.

Fraser, G.D. and H.F. Barnett, Jr. 1959. Geology of the Delarof and westernmost Andreanof Islands, Aleutian Islands, Alaska. U.S. Geol. Survey Bull. 1028-I. pp. 211-248.

Freiday, D. 1945. The Aleutians, island necklace of the north. Nat. Hist. 44(10): 444-445.

Gard, L.M., B.J. Szabo. 1971. Age of the Pleistocene deposits at South Bight, Amchitka Island, Alaska. Geol. Soc. America ABS. 3(7):577.

Gates, O., H.A. Powers, R.E. Wilcox. 1971. Geology of the Near Islands, Alaska. U.S. Geol. Survey Bull. 1028-U. 822 pp.

Gates, O., G.D. Fraser, and G.L. Snyder. 1954. Preliminary report on the geology of the Aleutian Islands. Science. 119(3092): 446-447.

Gates, O., W,M, Gibson. 1956. Interpretation of the configuration of the Aleutian Ridge [Alaska]. Geol. Soc. America Bull. 67(2):127-146.

Gibson, W.M. and H. Nichols. 1953. Configuration of the Aleutian Ridge, Rat Islands-Semisopochnoi Island to west of Buldir Island. Geol. Soc. America Bull. 64(10):1173-1187.

Godwin, L.H., L.B. Haigler, R.L. Rioux, D.E. White, L.J.P. Muffler, and R.G. Wayland. 1971. Classification of Public Lands Valuable for Geothermal Steam and Associated Geothermal Resources. U.S. Geo. Surv. Circ. 647. Wash. 18 pp.

Hansen,W.R., E.B. Eckel, W.E.Schaem, R.E. Lyle, W. George, and Genie Chance. 1966. The Alaska Earthquake, March 27, 1964. Field Investigations and Reconstruction Effort. Geol. Surv. Prof. Paper 541. 111 pp.

Hopkins, D.M. (editor) 1967. The Bering land bridge. Stanford Univ. Press. 495 pp

Itsikson, M.I., V.J. Berger. 1971. Comparative analysis of metallogeny of eastern-Asiatic and Alaska-Canadian links of northern part of Pacific ring. Am. Assoc. Petroleum Geologists Bull. 55(1):68.

Jordan, D.S. and G.A. Clark. 1906. The Bogoslofs. Pop. Sci. Monthly. 69:481-489.

Judson, S.S. Jr. 1946. Late-glacial and post-glacial chronology on Adak Island, [Aleutian Islands, Alaska]. Journ. Geology. 54(6):376=385.

Kelleher, J.A. 1970. Space-time seismicity of the Alaska-Aleutian seismic zone. Jour. Geophys. Research. 75(29): 5745-5756.

Koning, L.P.G. 1952. Earthquakes in relation to their geographical distribution, depth, and magnitude-[Pt.] 5, Central America and the Caribbean area; [Pt.] 6 , the southern Antilles; [Pt.]7, Pacific Coast of N. America and Aleutian arc. K. Nederlandse Akad. Wetensch. Proc. 55:272-283,292.

Lattman, L.H. and A.V. Segovia. 1961. Analysis of fracture trace pattern of Adak and Kagalaska Islands, Alaska. Am. Assoc. Petroleum Geologists Bull. 45(2):249-251.

Lawton, N.O. 1909. Makushin sulphur deposits, Unalaska (Alaska). Mining Sci. Press. 98:259-260.

Lukens, R.R. 1936. Bogoslof volcano [Alaska]. Mil. Engineer. 28(159): 205-206.

Maddren, A.G. 1919. Sulphur on Unalaska and Akun Islands and near Stepovak Bay, Alaska. U.S. Geol. Survey Bull. 692-E. pp. 283-298.

Menard, H.W. 1971. The Deep-Ocean Floor. Oceanography. Sci. Am. Reprints. pp. 161-170.

Merriam, C.H. 1902a. Bogoslof, our newest volcano (Alaska). Harriman Alaska Expedition. 2:291-336.

_________. 1902b. Bogoslof volcanoes. Smithsonian Inst. Ann. Rept. 1901. pp. 367-375.

Merrill, G.P. 1884. Hornblende and adesite from the New Bogoslof volcano. Science. 4:524.

_________. 1885. On hornblende adesites from the new volcano on Bogoslof Island in Bering Sea. U.S. Natl. Museum Proc. 8:31-33.

Moore, J.C. 1971a. Late Mesozoic continental margin; southern Alaska-Bering Sea shelf. EOS(Am. Geophys. Union Trans.). 52(4): 259.

_________. 1971b. Structural evolution of the Cretaceous pre-Aleutian trench, Alaska. Geol. Soc. America Abs. 3(7):650-651.

Morris, R.H. 1970. A Preliminary Study of Relict Marine Terraces of the Western Aleutian Islands, Alaska. U.S. Geol. Surv. Rept. USGS-472-62. 20 pp.

_________. 1971. Marine Terraces of the Western Aleutian Islands. U.S. Geo. Surv. Rept. USGS-474-139. 23 pp.

Murdock, J.N. 1969a. Crust-mantle system in the central Aleutian region; a hypothesis. Seismol. Soc. America Bull. 59(4): 1543-1558.

_________. 1969b. Short-term seismic activity in the central Aleutian region. Seismol. Soc. America Bull. 59(2):789-797.

Murphy, L.M. and E.B. Roberts. 1951. Modern Seismology in Alaska. 2nd Alaskan Sci. Conf. Proc. pp. 261-263.

Murray, H.W. 1945. Profiles of the Aleutian Trench. Geol. Soc. America. 56(7):757-781.

Nelson, W.H. 1959. Geology of Segula, Davidof, and Khvostof Islands, Alaska. U.S. Geol. Survey Bull. 1028-K. pp. 257-266.

Nybakken, B.H., W.G. Reeder. 1965. A soil sequence from southwestern Umnak Island, Alaska. Northwest Sci. 38(3):104-117.

Perry, R.B., H. Nochols. 1965. Bathymetry of Adak canyon, Aleutian arc, Alaska. Geol. Soc. America Bull. 76(3): 365-370.

____________________. 1966. Geomorphology of Amlia basin, Aleutian arc, Alaska. Geog. Rev. 56(4):570-576.

Peter, G., D. Elvers, and M. Yellin. 1964. Geological structure of the Aleutian Trench SW of Kodiak Island. Am. Geophys. Union Trans. 45(1):35.

Petroff, I. 1884. Alaska: Its Population, Industries, and Resources. V. 8. 189 pp.

Plafker, G. 1967. Possible evidence for downward-directed mantle convection beneath the eastern end of the Aleutian arc. Am. Geophys. Union Trans. 48(1):218.

Powers, H.A. 1958. Landscapes of Alaska. Univ. of Cal. Press, Berkeley. pp. 61-7!

__________. 1961. The emerged shoreline at 2-3 meters in the Aleutian Islands, in Pacific island terraces - Eustatic? Zeitschr. Geomorphologie, Supplementband 3 pp. 36-38.

Powers, H.A., R.R. Coats, and W.H. Nelson. 1960. Geology and submarine physiography of Amchitka Island, Alaska. U.S. Geol. Surv. Bull. 1028-P, pp. 521-554.

Powers, Sidney. 1916a. Recent changes in Bogoslof Volcano. Geol. Rev. 2:218-221.

__________. 1916b. Volcanic domes in the Pacific. Am. Journ. Sci. 42:261-274.

Ransom, J.E. 1946. The Bogoslof Islands, Alaska. Mineralogist. 14(3): 118-121.

Robinson, G.D. 1947a. Objectives, methods, and progress of Alaskan [Aleutian Islands] volcano investigations of the United States Geological Survey. U.S. Geol. Surv., Alaskan Volcano Inv. Rept., No. 2, pp. 1-5.

__________. 1947b. The 1945 eruption in Tulik [Okmok] Caldera, Umnak Island, Alaska. Washington Acad. Sci. Jour. 37(10):368-369.

__________. 1948. Exploring Aleutian volcanoes [Alaska]. Natl. Geog. Mag. 94(4): 509-528.

Scientific American. 1971 . Oceanography, Readings from Scientific American. Freeman and Co., San. Fran. 417 pp.

Shacklette, H.T., Meyer Rubin. 1969. Radiocarbon dating of ash deposits on Amchitka Island, Alaska. U.S. Geol. Survey Prof. Paper 650-B. pp. B81-B83.

Shacklette, H.T., others. 1969. Vegetation of Amchitka Island, Aleutian Islands, Alaska. U.S. Geol. Survey Prof. Paper 648. 66 pp.

Shacklette, H.T. 1967. Copper mosses as indicators of metal concentrations. U.S. Geol. Survey Bull. 1198-G. pp. G1-G18.

Shārp, R.P. 1946. Note on the geology of Agattu, an Aleutian Island [Alaska]. Journ. Geology. 54(3): 193-199.

Shor, G.G. Jr. 1959. Reconnaissance seismic-refraction studies of the Aleutian Ridge [Alaska] and the Bering Sea. Geol. Soc. Amer. Bull. 70(12):1748-1749.

__________. 1964. Structure of the Bering Sea and the Aleutian Ridge. Marin Geology. 1(3):213-219.

__________. 1965. Structure of the Aleutian ridge, Aleutian trench, and Bering Sea. Am. Geophys. Union Trans. 46(1):106.

__________. 1966. Continental margins and island arcs of western North America. Canada Geol. Survey Paper 66-15. pp. 216-221.

Simons, F.S. and D.E. Mathewson. 1947. Geology of Great Sitkin Island [Aleutians, Alaska]. U.S. Geol. Surv., Alaskan Volcano Inv. Rept., No. 2, pp. 55-69.

__________. 1955. Geology of Great Sitkin Island Alaska. U.S. Geol. Survey Bull. 1028-B. pp. 21-43.

Snyder, G.L. 1957. Ocean floor structures, northeastern Rat Islands, Alaska. U.S. Geol. Survey Bull. 1028-G. pp. 161-167.

__________. 1959. Geology of Little Sitkin Island, Alaska. U.S. Geol. Survey Bull. 1028-H. pp. 169-210.

Snyder, G.L. and G.D. Fraser. 1963. Pillowed lavas-[Pt.1]. Intrusive layered laval pods and pillowed lavas, Unalaska Island, Alaska. U.S. Geol. Survey Prof. Paper 454-B. pp. B1-B23.

Spence, W.J., E.R. Engdahl. 1970. Relocation of large earthquakes in the Amchitka Island region. EOS(Am Geophys. Union Trans.). 51(11):778.

Stauder, W., and A. Udias. 1963a. S-wave studies of Aleutian Island earthquakes. Geol. Soc. America Spec. Paper 73:67.

__________. 1963b. S-wave studies of earthquakes of north Pacific - Pt. 2. Aleutian Islands. Seismol. Soc. America Bull. 53(1):59-77.

Stauder, W. 1968. Tensional character of earthquake foci beneath the Aleutian trench with relation to sea-floor spreading. Jour. Geophys. Research. 73(24): 7693-7701.

Stone, R.W. 1905. Coal resources of southwestern Alaska. U.S. Geol. Survey Bull. 259. pp. 151-171.

Taggart, J.,.D. Rocher, 1965. Recent seismicity in the Aleutian Islands. Am. Geophys. Union Trans. 46:(1)151.

U.S. Geological Survey. 1971. Geologic and Hydrologic Effects of the Milrow Event, Amchitka Island, Aleutian Islands, Alaska. U.S.G.S.-474-71. 76 pp.

Waldron, H.H. 1951. Geologic reconnaissance of Frosty-Peak volcano and vicinity, Alaska. U.S. Geol. Survey Bull. 1028-T. pp. 677-708.

Waring, G.A. (Revised by R.R. Blankenship and R. Bentall) 1965. Thermal Springs of the United States and Other Countries of the World - A Summary. Geol. Surv. Prof. Paper 492. pp. 51-53.

Webber, B.S., J.M. Moss and F.A. Rutledge. 1946. Exploration of Sedanka zinc district, Sedanka ISland, Alaska. U.S. Bur. of Mines Rept. 3967.

Weyl, P.K. 1970. Oceanography, An Introduction to the Marine Environment. Wiley & Sons, Inc. New York. 535 pp.

Yasso, W.E. 1965. Oceanography. Holt, Rinehart, and Winston, Inc. New York. 176 pp.

SOCIO-ECONOMIC

Alaska Department of Natural Resources. 1967. 1967 Alaska Agricultural Statistics. Juneau, Alaska.

Alaska State Housing Authority. May 1968. King Cove, Alaska. Comprehensive Development Plan. Juneau, Alaska. 66 pp.

Bureau of Census. 1971. General Population Characteristics. Department of Commerce. Alaska 3-205-207.

Bureau of Census. 1971. 1970 Census of Population. General Social and Economic Characteristics. Department of Commerce, Washington, D.C. p. 3-86-37.

Bureau of Reclamation. 1967. Livestock Industry in Alaska: Possibility of an Integrated Livestock Industry on Kenai Peninsula, Kodiak, And Adjoining Islands. Juneau, Alaska.

Burton, W. 1971. Alaska's Agriculture. Institute of Social, Economic, and Government Research. University of Alaska, College, Alaska. 259 pp.

Federal Field Committee for Development Planning in Alaska. 1968a. A Subregion Economic Analysis of Alaska. 385 pp.

__________. 1968b. Alaska Natives and the Land. Anchorage, Alaska.

__________. 1971. Economic Outlook for Alaska. Anchorage, Alaska. 392 pp.

Federal Power Commission. 1969. Alaska Power Survey. Washington D.C. 108 pp.

Foote, D.C., V. Fischer, and G.W. Rodgers. 1968. St. Paul Community Study. Fairbanks, University of Alaska, Institute for Social, Economic and Government Research.

Jones, D.M. 1969. A Study of Social and Economic Problems in Unalaska, an Aleut Village. Ph. D. Thesis, University of California, Berkeley. 242 pp.

__________. 1970. Changes in Population Structure in the Aleutian Islands. University of Alaska, Institute of Social, Economic and Government Research. Research Note A-2. 9 pp.

Loll, L.M. 1967. A Study of Technical and Economic Problems - State of Alaska. University of Alaska, Institute of Social, Economic, and Government Research.

Munger, J.A. 1972. A Regional Overview of Socio-Economic Conditions in Alaska. Report to the Alaska Land-Use Planning Commission. 59 pp.

Patterson, A. 1972. The Native Subsistence Values and Their Relationship to (d)(1)-(d)(2) Land Classifications. Report to the Alaska Land-Use Planning Commission. 110 pp.

Rodgers, G.W. The Future of Alaska: Economic Consequences of Statehood. John Hopkins Press, Baltimore.

__________. 1967. Alaska Regional Population and Employment. University of Alaska. Institute of Social, Economic and Government Research. 97 pp.

__________. 1971. Alaska Native Population Trends and Vital Statistics, 1950-1985. University of Alaska. Institute for Social, Economic, and Government Research. Research Note. 19 pp.

Rodgers, G.W. and R.A. Cooley. 1963. Alaska's Population and Economy, Regional Growth, Development and Future Outlook.

Snodgrass, R., 1970. Alaska Statistical Review, 1970. Department of Economic Development. State of Alaska.

Snodgrass, R. and H D. Sanders. 1972. Agricultural Resources in Withdrawals under Section 17 (d)(1) and (d)(2) of the Alaska Native Claims Settlement Act. Report to the Alaska Land-Use Planning Commission.

State of Alaska. Alaska Outdoor Recreation Plan. Vols. 1-4. Department of Natural Resources, Juneau, Alaska.

Tussing, A.R. 1968. Alaska-Japan Economic Relations. University of Alaska, Institute of Social, Economic and Government Research. 468 pp.

__________. 1972. Introduction: Economics and Policy of Alaskan Fisheries and the Alaska Fisheries Policy. University of Alaska, Institute of Social, Economic and Government Research. pp. 1-11.

Tussing, A.R., T.A. Morehouse, and J.D. Babb, Jr., editors. 1972. Alaska Fisheries Policy. University of Alaska, Institute of Social, Economic, and Government Research. 470 pp.