A BIOLOGICAL SURVEY OF NUNIVAK ISLAND JUNE 1985

by

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Key Words

fauna	Nunivak Island
flora	Reindeer
habitat types	weather
Musk Ox	Yukon Delta NWR

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SUMMARY

In 1985 the Yukon Delta National Wildlife Refuge initated a general biological survey of the flora and fauna on the refuge. Nunivak Island, one of three study areas, was surveyed by a three person crew. To gather this information, various habitats were sampled for birds, fish, mammals, vegetation, and weather. This report contains data collected during June 5 -30, 1985.

Nunivak Island lies in the Bering Sea, 32 km off the west coast of Alaska, adjacent to the Yukon-Kuskokwin Delta. In 1980, Nunivak Island was incorporated into the Yukon Delta National Wildlife Refuge, the largest in the United States.

Topography varies from sand beaches and dunes in the east to rocky shores on the north and sheer vertical cliffs along the west. Elevations range from sea level to 500m at Roberts Mountain. 'Mekoryuk, the only inhabited village on the island, contains about 250 people. The southern half of the island is a designated Wilderness Area.

Work completed during June concentrated in the Cape Mendenhall area on the south east side of the island. A total of 594 birds, comprising 25 species, were recorded on six bird transects. Waterfowl and shorebirds were predominant.

Eight habitat types were identified: Dry Crowberry Tundra, Alpine Crowberry Tundra, Barren Boulder Fields; Dune Complexes, Tidal Pools/Backshores, Grass-Sedge Hummocks, Sedge Meadow Tundra, and Riparian Tundra. These habitats are all characterized by low growth form plants. However, the Riparian Tundra does contain 2m willows, the tallest trees on the island.

Snap trapping yielded only one small mammal, a brown lemming, during 750 trap nights. Small mammal populations appear very low in 1985. Approximately 15-20 musk ox and 35-50 reindeer were observed, some animals daily.

A gill net was set in Duchikthluk Bay on five occassions. Total catch for all five sets was 37 fish of five species: chum salmon, dolly varden, pacific herring, starry flounder, and staghorn sculpin.

Spring breakup occured later than normal this year, delaying the start of field work. Average high temperature was 8.6C and the average low was 1.3C. Wind on the island is continual, averaging 15.1 km/hr. Total rainfall was 11.3 mm, occurring on seven days. The last snowfall was on 12 June, 1985.

ACKNOWLEDGEMENTS

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I. Introduction.

A. Introduction.

During the summer of 1985, the Yukon Delta National Wildlife Refuge (YDNWR) embarked on a general biological inventory of the refuge. This report describes the inventory techniques used, and results from Nunivak Island. Critiques by other researchers, comments and recomendations of field crews, and quality of data collected will be used to evaluate this years efforts. This evaluation will help modify the techniques for future inventories. It is the foundation of knowledge on which the YDNWR can build from future inventories and surveys.

The YDNWR, largest in the United States, encompasses 26 million acres of various habitats and associated wildlife species. The general inventory for 1985 concentrated on three study areas: Nunivak Island; the Andreafsky River basin; and three tributaries of the Kuskokwim River - Eek, Kwethluk, and Kisaralik Rivers. The Nunivak crew consisted of Dean Cramer, bio-tech USFWS, along with Karen Bolovan (Botanist) and Mary Ade, Student Conservation Association (SCA) volunteers.

Breakup and snowmelt in 1985 were later than usual. The Nunivak field crew did not reach the island until early June. Due to a shortened field season, and small crew size, the information to be collected was prioritized for birds and vegetation. Mammal trapping, fish seining, and other related projects were done on a time available basis. Techniques employed were quick and relatively simple to maximize data collection and minimize effort.

Previous work on the island focused on seabird nesting colonies, Musk-Ox and Reindeer surveys. Information on other flora and fauna, as to distribution and abundance, is limited. This survey was intiated to gather baseline data on floral and faunal identification, distribution and abundance. This information will be useful in making resource management decisions and as an index to monitor changes in abundance or distribution due to environmental or man-made impacts (ie. oil exploration, grazing, hunting, fishing, etc.).

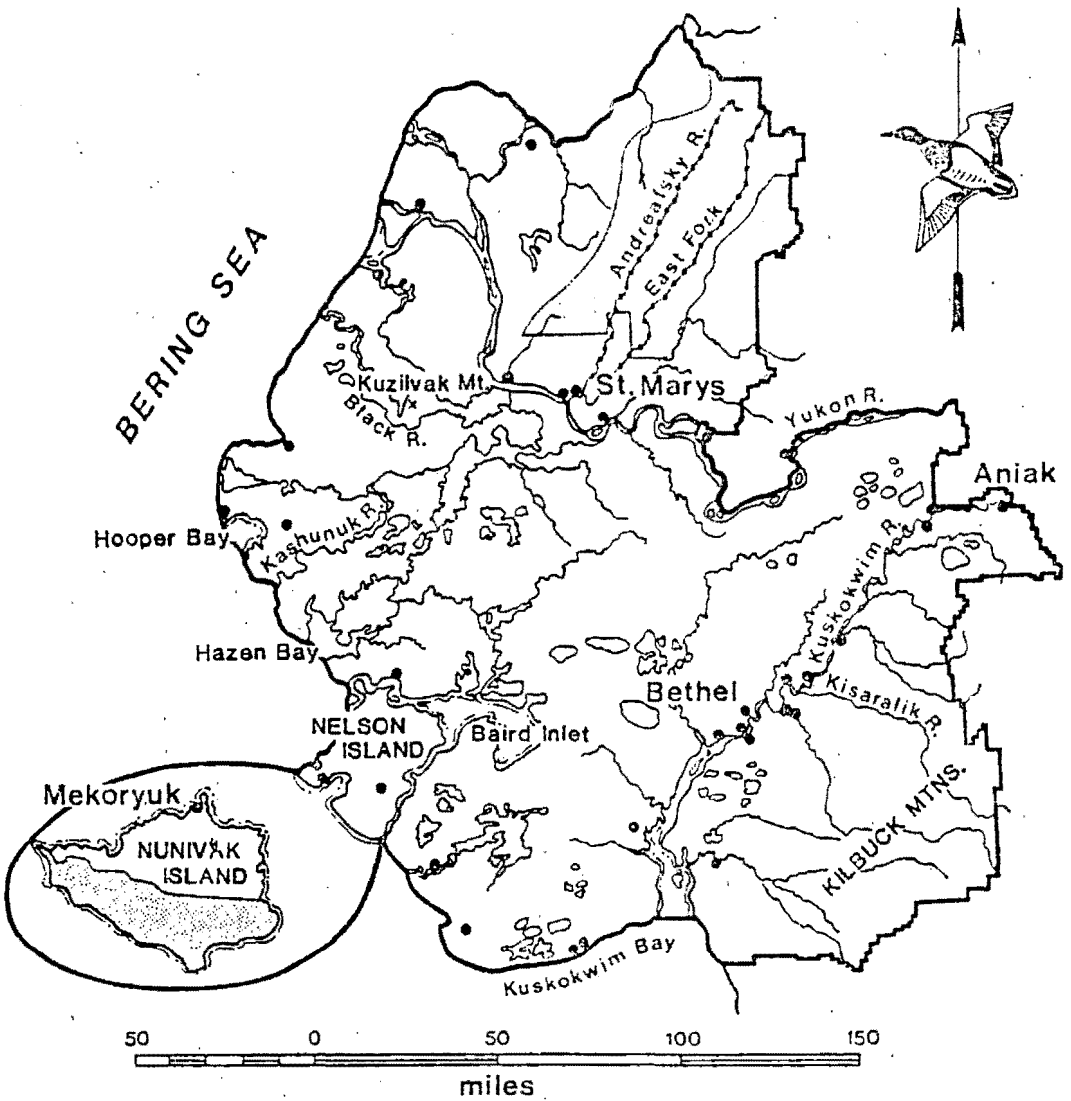
The crew examined various habitats on the island and recorded results from various sampling methods for vegetation, birds, mammals, and fish. This report is a summary of the information collected during June 5 - 30, 1985.

B. Study Area.

Nunivak Island lies in the Bering Sea 32/km (20/mi.) off the western coast of Alaska, adjacent to the Yukon Kuskokwim Delta (Figure 1). It was established as a National Wildlife Refuge in 1929 by President Herbert Hoover (Annon., 1972). In 1980, along with Clarence Rhodes NWR and Hazen Bay NWR, Nunivak NWR was incorporated into the Yukon Delta National Wildlife Refuge, the largest refuge in the United States.

The main island is 112/km (70/mi.) long by 80/km (50/mi.) wide totaling about 462,000 hectares (1.1 million acres). The refuge also includes 50 small offshore islands and submerged lands for a total of 1.5 million hectares (3.6 million acres).

YUKON DELTA
NATIONAL WILDLIFE REFUGE



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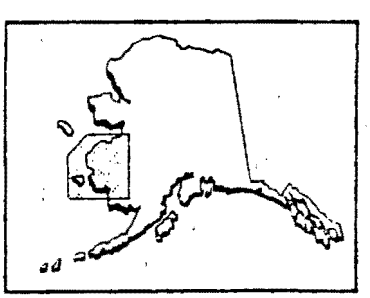

The coastline varies from sandy beaches with large dunes in the east and south, rocky shores along the north, and sheer vertical cliffs up to 136m (450ft) along the west. Inland is a broad upland plateau ranging 150-250m (500-800ft) above sea level dotted with low mountains, volcanic craters and broad lava flows. Roberts Mountain is the highest point on the island, reaching over 500m (1675ft) (Figure 2).

Tundra covers the majority of this treeless island. The tallest vegetation consists of 2m (6ft) willows lining some of the larger rivers. About 40 rivers and streams drain the uplands into the Bering Sea. Many of these rivers have created marshes inland and large shallow bays and lagoons along the coast.

The one permanent settlement is the village of Mekoryuk on the north-east shore, inhabited by about 250 people. Small seasonal fish camps are dotted all around the island and are used during spawning runs of several fish species.

The entire island is roadless except for a few dirt streets in Mekoryuk. The southern half of the island is a wilderness area (Figure 1).

II. Methods.

A. Birds.

Bird census transects are 100m wide and 1800m long. Each plot was traversed by the three person crew, spaced approximately 25m apart. Presence and productivity all birds and nests were recorded (Appendix E-1). The middle observer recorded all observations and kept the crew on course with a compass. String run through a belt chain helped to measure distance traveled and location of birds along the transect. Birds were identified with the aid of 10x binoculars and field guides. Only birds in front of the observers and within the 100 meter boundaries were counted. Counts are restricted to observations no more than 30 meters ahead of the observers to avoid double counts. Transects were intended to be run perpendicular to rivers, one on each side, at approximately 30m (100ft) elevation intervals from the headwaters to the mouth. Eight o'clock was the intended time for doing transects to observe birds when they are most active. For the purpose of this survey it was assumed that the extended daylight hours of Alaskan summers did not affect bird activities.

Due to logistical problems we deviated from the intended methods. The rivers on the island are too shallow to be navigable with the boats we were using. Transects were started at various points on the coast and run inland. In some cases the transects were on a north-south line, however some were done on different compass headings to sample a particular type of habitat (ie. marshy waterfowl nesting areas behind and parallel to the dunes on the coast).

Transects were also conducted at varying times during the day due to weather and travel restraints caused by tide schedules. Early morning ground fog, very common on the island, also delayed starting times on occasion.

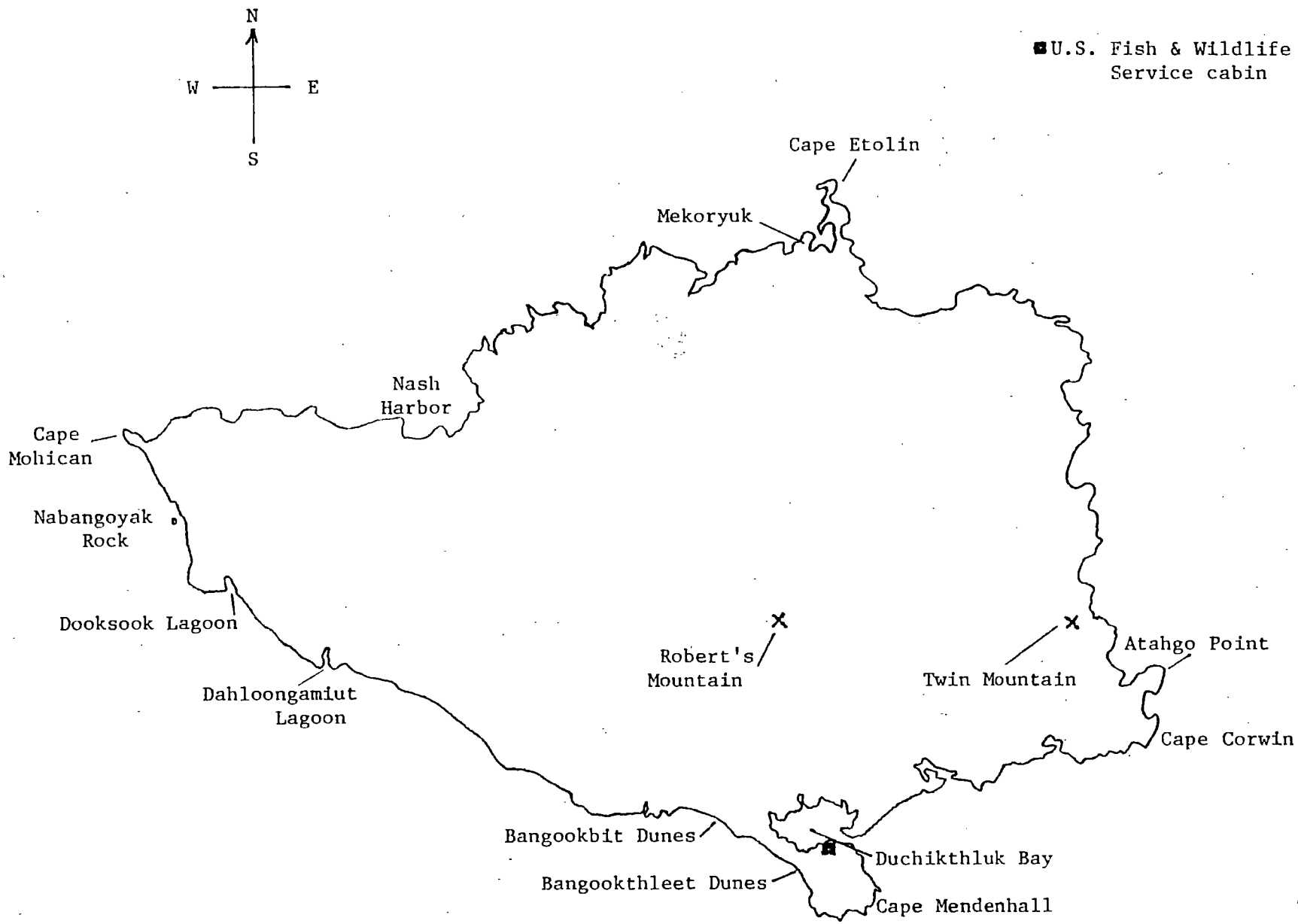

Figure 2. Nunivak Island

B. Vegetation.

While the bird census was being conducted, vegetation changes were noted on the Bird Transect data form (Appendix E-1) to determine habitat types and percentage of area for each of the types. .The field crews selected sample plots along the belt transects used for the bird surveys. The sample plots within each habitat type were selected based on the uniformity of the habitat and the homogeneity of plant cover within each plot. Braun-Blanquet's Releve analysis (Mueller-Dombois, Ellenberg, 1974) was the method applied for collecting vegetation data (Appendix E-2). Dominant and associated species were recorded along with physical aspects of the area, including slope, elevation, moisture, and animal disturbance. The vegetation was classified on the basis of a modified Vierick system (Vierick, et al, 1982). The number of releve plots on each transect varied depending on the number of habitat types along that transect.

C. Mammals.

Mammal sample plots were located within various habitat types. Each plot contained 50 museum special snap traps in a 5 X 10 trap grid with 10 meter spacing between traps. One grid was placed near the river (or sea) to sample species related to riparian habitat, and a second grid was placed approximately 500 meters from the riparian area to sample species related to upland habitats. Traps were set for several consecutive nights in each location. Trap location, length and weight were recorded for captures (Appendix E-3). Specimens were saved to be prepared in museum style mount for the refuge collection.

Reindeer and musk-ox sightings were recorded in an effort to identify spring-summer use areas and population sizes in certain areas. Fecal pellets were collected from both species for a range study conducted by the Soil Conservation Service.

D. Fish.

Fish samples were taken in cooperation with Alaska Fish and Game Department. A variable mesh monofilimant gill net was set to obtain samples. The net consisted of five mesh sizes, 0.5 - 2.5 in, each section 10 ft. long and four ft. deep. The amount of time for each set varied.

A species of special interest is the arctic grayling. Reports exist for the presence of this species on the island, however exact distribution is not known. Nunivak is believed to contain the only island population of this species in Alaska.

E. Weather.

Atmospheric conditions were monitored and recorded daily. These measurements included high and low temperatures, relative humidity, daily precipitation, wind speed and direction, and high and low tide times. Other conditions, such as fog, rain and snow were also noted.

III. Results.

A. Birds.

Six transects were completed on the southeast side of the island, near Cape Mendenhall (Appendix F1, F2, G). Time required for completing a transect averaged 90 minutes (SD=30). A total of 594 birds comprising 25 species was recorded (Table 1). The average number of birds per transect was 99 (SD=57.1) comprising an average of 10 species (SD=1.8).

Western sandpiper was the predominant species on all transects and in all habitat types. Four western sandpiper nests were located, three contained four eggs and one contained two. Hatching for this species was first observed on 16 June. Other shorebirds observed included pectoral and rock sandpipers, dunlin, phalaropes, turnstones and plovers.

Common waterfowl observed included tundra swans, emperor geese, brant, eiders and sandhill cranes. Two pintail nests were found; one with nine eggs and the other with seven. One sandhill crane nest contained two eggs.

Only four passerine species were found: lapland longspur, savannah sarrow, redpoll (probably common), and snow bunting. No nests were found. Passerine numbers increased with distance from coast.

B. Vegetation.

Eight distinct habitat types were classified (based on moisture, dominant species, plant growth form and physiognomy) from analysis of the releve data. The types include: 1) dry crowberry tundra, 2) alpine crowberry tundra, 3) barren boulder fields, 4) dune complexes, 5) tidal pools/backshores, 6) grass-sedge hummocks, 7) sedge-meadow tundra, and 8) riparian tundra. These are all characterized by low growth form plants, typically less than 0.5m tall. The riparian tundra type, found along some rivers, contained the tallest vegetation on the island, 2m tall willows. The sedge meadow tundra is the most common type on the island and was found along all transects. Plant specimens were collected whenever possible, to add to the refuge herbarium collection and to confirm identification.

C. Mammals.

The attempt to secure small mammals by snap trapping indicated a low population. A total of 750 trap nights at four different locations yielded only one brown lemming (Lemmus trimucronatus). This animal was caught on the night of 15 June in a marshy area about 200 meters east of the cabin.

Approximately 15-20 musk ox and 35-50 reindeer were observed daily on Cape Mendenhall (Figure 2). These population estimates are for animals on the Cape Mendenhall area only. Conversations with Richard Davis and Tony Amos, USFWS employees living in Mekoryuk, indicate a total island population of about 550 musk ox and 5000 reindeer.

Table 1. Species and numbers of birds observed by transect.

Species	Transect Number					
	1	2	3	4	5	6
Arctic loon	0	0	2	1	1	2
Sandhill crane	0	0	2	0	0	1
Tundra swan	2	0	0	0	0	0
Emperor goose	3	0	0	0	0	6
Brant	0	0	1	0	0	0
Green-winged teal	2	0	0	0	0	0
American wigeon	0	0	0	0	2	0
Northern pintail	2	1	0	3	5	11
Greater scaup	0	0	0	0	2	0
King eider	0	0	0	0	9	4
Oldsquaw	2	0	2	0	2	6
Semipalmated plover	0	0	1	0	0	0
Black-bellied plover	0	1	0	0	0	0
Lesser golden plover	5	2	0	2	0	0
Red-necked phalarope	6	0	14	1	0	13
Black turnstone	1	0	0	1	0	0
Dunlin	10	0	0	8	0	13
Western sandpiper	80	15	43	79	10	107
Pectoral sandpiper	0	1	0	0	0	0
Long-tailed jaegar	0	0	0	0	4	0
Arctic tern	0	0	0	0	0	6
Willow ptarmigan	0	1	0	1	0	0
Savannah sparrow	0	0	5	3	2	1
Lapland longspur	14	11	18	13	9	18
Snow bunting	0	0	0	1	0	0
Total Individuals	127	32	88	113	46	188
Total Species	11	7	9	11	10	12
Time Required (min.)	90	96	108	90	138	60

Total individuals on all transects = 594

Total species on all transects = 25

Average number of individuals per transect = 99.0 (SD = 57.1)

Average number of species per transect = 10.0 (SD = 1.8)

Average time required per transect = 90 minutes

D. Fish.

The gill net was set in Duchikthluk Bay on five occasions. The length of time for each set varied from two to eight hours, but all catches were small in number (Table 2). Total catch for all five sets included one chum salmon (Oncorhynchos keta), two dolly varden (Salvelinus malma), twenty pacific herring (Clupea harengus), two starry flounder (Platichtys stellatus), and twelve pacific staghorn sculpin (Leptocottus armatus). arctic grayling (Thymallus arcticus) were not caught or observed during June surveys.

On 24 June, king salmon (Oncorhynchus tshawytscha) were observed starting their spawning run into the bays.

Subsistence fishermen, from Mekoryuk, were catching pacific cod (Gadus macrocephalus), saffron cod (Eleginus gracillis), and halibut (Hippoglossus stenolepis) with hand lines, chum salmon in gill nets, and bering cisco (Coregonus laurettae) in dip nets.

E. Weather.

The Nunivak crew arrived in Mekoryuk on 5 June, however icebergs were still present in the Mekoryuk River on 9 June, delaying the start of field work until 10 June. The average high temperature for June was 8.6C (47.5F), the average low was 1.3C (34.3F). The wind was constantly blowing with an average speed of 15km/hr (9.4mph). Rain occured on seven days for a total of 11.3mm (.45in). The last snowfall occured on 12 June with no measurable accumulation (Table 3.)

IV. Discussion.

A. Birds.

The number of species (25) was low compared with transects completed on the mainland this year(pers. comm. Mike Brown). This is probably due to low habitat diversity on the island. The absence of large trees and shrubs restricts the types of birds to ground nesters and marsh nesters. Average density however was higher (550 birds/km^2) than on the mainland.

Many areas of the island contain networks of bogs and marshes that appear to be good waterfowl habitat. Aside from the waterfowl observed on the bird transects, numerous others (Appendix A) were on areas adjacent to the transects. Sandhill cranes were seen in pairs in most survey areas. Northern pintails and oldsquaws were also very abundant. Flocks of brant were observed flying over Duchikthluk Bay, with 100- 300 birds per flock, but were never seen in pairs or on nests. These appear to be non-breeders congregating together. Canada geese flew over periodically, however none were seen on the ground during census transects.

An unusual observation involved king eiders. On three separate occasions, two breeding pairs were sharing one nest. They appeared to be sharing nesting duties.

Table 2. Fish captures with gill net in Duchikthluk Bay.

Species	Set Number				
	1	2	3	4	5
Chum salmon	1	0	0	0	0
Dolly varden	1	0	0	0	1
Herring	0	20	0	0	0
Starry flounder	0	2	0	0	0
Pacific sculpin	0	1	0	5	6
Total Individuals	2	23	0	5	7
Time Set (min.)	150	270	108	450	198

Total Individuals, all sets = 37

Total Species, all sets = 5

Average Number of Individuals per set = 7.4 (SD=9.1)

Average time per set = 234 minutes.

Table 3. Daily weather data recorded at Cape Mendenhall.

Date	High Temp (C)	Low Temp (C)	Wind Speed (km/hr.)	Wind Direct.	Precip-itation (mm.)	Barometric Pressure (cm. Hg)
6/11	9.0	n/a	12.8	SW	0	75.45
6/12	3.5	0.0	9.6	NW	0	75.30
6/13	3.5	-1.0	27.2	W	0	75.38
6/14	1.8	-1.0	6.4	NW	0	75.55
6/15	7.2	-0.5	n/a	n/a	0	75.80
6/16	8.0	3.5	19.2	E	T	76.20
6/17	9.5	1.1	11.2	NE	0	76.10
6/18	9.0	-1.0	8.0	NE	T	75.50
6/19	10.1	n/a	12.8	E	2	75.40
6/20	12.2	4.5	n/a	n/a	T	75.69
6/21	12.8	0.5	11.2	SW	3	76.30
6/22	11.6	3.5	19.2	E	3	76.40
6/23	13.5	3.5	14.4	E	3	76.18
6/24	n/a	2.2	28.8	W	0	76.50

Average High Temp	8.6	Average Precipitation	0.8
Average Low Temp	1.3	Total Precipitation	11.3
Average Wind Speed	15.1		
Average Pressure	75.84		

T= Trace of Precipitation = less than 1 mm.
n/a= not available

Seabirds were noticed congregating on some of the small offshore islands. Reaching these islands with the Zodiac was not attempted due to rough water and rocky shores. Species observed included black-legged kittywakes, various gull species, arctic and aleutian terns, tufted puffins, pelagic cormorants, and Cassin's auklets.

B. Vegetation.

Most of the vegetation was in early growth stages on the island. This was due to the late summer and generally colder climate on the island compared to the mainland. Plant species already up and growing in the Bethel area had not even started yet on Nunivak. It appears that green-up of similar species are two to three weeks behind the mainland. This made initial identification difficult.

The harsh climate, especially the perpetual winds, limited the plant types to low growth forms. Following is a general description of the major habitat types found on Nunivak Island:

1) DRY CROWBERRY TUNDRA. Common on higher, well drained areas and at the base of buttes. It is dominated by Empetrum nigrum, fruiticose lichens, Vaccinium vitis-idaea, and Ledum decumbens . Other associated species are Pedicularis verticillata, Rubus chamaemorous, Carex bigelowii, Betula nana, and Sedum rosea. These areas are dwarf shrub tundra with an occassional shrub willow and are typically very dry.

2) ALPINE CROWBERRY TUNDRA. Occurs on higher inland elevations, the summits of buttes, and volcanic peaks. These areas are quite xeric and often have frost boil activity with up to 30% bare ground. Slopes can be extreme (up to 40%). Cold winds and rocky substrates make growth conditions difficult. Dominant species are Empetrum nigrum, Loiseluria procumbens, Arctostaphylos alpina and fruiticose lichens. Associated species include Diapensia lapponica, Dryas octapetala, Salix polaris, Lloydia serotina, Phyllodoce coerulea, Minuartia arctica, and Carex bigelowii.

3) BARREN BOULDER FIELD. Occurs on top of buttes and on top of slopes parallel to river banks. Some sites were virtually 90% rock, with only crustose lichens growing on the rocks. Dominant species are Loiseleuria procumbens and Empetrum nigrum. Associated species included Minuartia arctica, Lloydia serotina, Carex bigelowii, Ledum decumbens, Sedum rosea, and various fruiticose lichens. Conditions were extremely dry, open and exposed to the wind.

4) DUNE COMPLEXES. The large active dune systems harbor only a few plant species adapted to the shifting, well drained sands. Dominant species are Elymus aranarius, Lathyrus maritimus, Honkenya peploides and Stellaria humifusa. Behind the active dune systems, another, more sheltered series of plants include Oxytropis nigrescens, Minuartia arctica, Empetrum nigrum, Arnica lessingi, Potentilla uniflora and Arctostaphylos alpina.

5) TIDAL POOLS/BACKSHORES. These areas, located behind the dunes, serve as nesting grounds for large numbers of waterfowl and shorebirds. The sites are composed of numerous small, shallow ponds, interspersed with ridges of dry tundra. The ponds are filled with rich algal blooms and surrounded by Hippuris vulgaris, Ranunculus pallasii, Caltha palustris, Juncus sp., and Carex lyngbaei. The tundra ridges appear to be colonized dunes, dominated by Empetrum nigrum, Elymus arenarius, Potentilla uniflora, and fruiticose lichens.

6) GRASS - SEDGE HUMMOCKS. Occurs commonly along tundra drainages and rivers. These meter high hummocks are composed of Calamagrostis canadensis and various sedges. Associated species, growing between the hummocks, include Angelica lucida, Sedum rosea, Spiraea beauverdiana, Claytonia sarmentosa and Salix pulchra, which has large spreading branches between hummocks. The tops of the hummocks are quite dry, and between them the moisture ranges from damp soil to standing or flowing water. These hummocks are very difficult to traverse on foot for long distances.

7). SEDGE MEADOW TUNDRA. This is the most common vegetation type on Nunivak Island. This tundra type typically has a thick, continuous sphagnum moss layer that maintains a very wet condition. Dominant species are Eriophrum angustifolium, Eriophrum russeolum, and Carex aquatilis. Associated species include Pedicularis parviflora, Saxifraga hieraciflora, Salix fuscescens, Rubus chamaemorus, Petasites frigidus, Cardamine pratensis, and Sedum rosea. On higher areas these sites are moist, but lower areas are poorly drained, with standing water usually present

8) RIPARIAN TUNDRA. These areas along the rivers host the greatest plant species diversity. The riverbanks consist of lush graminoid growth including Calamagrostis canadensis, and several Carex sp. Other associated species include Saxifraga punctata, Valeriana capitata, Tridentalis europaea, Parnassia kotzebueii, Cerastium beerugianum, Claytonia sarmentosa, Sedum rosea, Caltha palustris, and Rumex arcticus. Various wet mosses occur on these riverbanks, below the herbaceous layer.

An interesting find was Sedum rosea with yellow flowers, located near the cabin on Cape Mendenhall. Hulten lists this yellow flower variety as occurring only on Alaska's Seward Peninsula (Hulten,1968).

C. Mammals.

The small mammal trapping only yielded one animal. I believe this was due mainly to three factors: low point of cyclic populations, late summer causing a delayed breeding season (no juveniles), and high fox numbers.

From conversations with people in Mekoryuk it appears that small mammals were in a high cycle two years ago, and this year and last year not many have been observed. Since small mammals have cyclic populations with resulting crashes, they may currently be recovering from a decline in numbers and current populations may be very small.

Arctic fox and red fox both inhabit the island. Along with numerous observations of both species, scats were very abundant on every bird transect. This would indicate high numbers of foxes, and predation on small mammals may be keeping their populations at small numbers. On the mainland red fox typically inhabit the interior areas and arctic fox inhabit the coastline. This pattern is reversed on Nunivak with red fox on the coastal areas and arctic fox on the interior areas.

Initial identification of the one small mammal trapped is of a brown lemming (Lemmus trimucronatus harroldi). This sub-species is a distinct race found only on Nunivak Island. The skin was prepared in a museum style mount and the skull saved for positive identification.

D. Fish.

The gill net was only set in Duchikthluk Bay and not in any of the rivers due to travel restrictions. Rough seas and wind made the net difficult to use. People from Mekoryuk began arriving at Cape Mendenhall on 16 June for subsistence fishing. In an effort not to interfere with them, we discontinued setting the gill net.

E. Weather.

Weather conditions affect both travel and working time on the island. Each area of the island is quite different and independent of other areas due to a varying maritime influence surrounding the island. Generally north and west winds bring colder Arctic Ocean temperatures, while south and east winds bring warmer Pacific Ocean and mainland temperatures. The winds also greatly affect tide movements and heights, varying with location on the island.

During the work in Duchikthluk Bay, a north or west wind did not affect the tide heights, while a west wind caused very low tides and delayed high tide, and an east wind caused very high tides.

Temperatures were fairly mild during June (Table 4) with daytime highs averaging 8.6C (47.5F), and nighttime lows averaging 1.3C (34.3F). Rain occured on seven days for a total of 11.3mm June is typically the driest month on the island with July and August more stormy.

The weather also changed, sometimes dramatically, during the course of a day. Preparation for all types of weather is necessary when starting out for a days work. Wet weather gear should be with crews at all times.

Work planned for the Mount Roberts area was cancelled due to the weather. This area has a longer winter and a later summer than the coastal areas of the island. Snow buildup here is deeper and therefore slower to melt. As of 18 June, Karon Lake, at the southern edge of Mt. Roberts contained too much ice to land a float plane. As of 25 June, Mt. Roberts still had considerable amounts of snow remaining, visible from the southside cabin at Cape Mendenhall. The last snowfall at the southside cabin occurred on 12 June but no accumulation occurred.

The erratic weather patterns affected both travel and working conditions. Travel by Zodiac was often delayed, and sometimes cancelled due to rough seas caused by strong winds, ice, or drastic tidal flucuations. This further shortened an already short field season.

F. Equipment.

Different types of boats are needed. The Boston Whaler, already at Mekoryuk, seems to be the wrong boat for these waters in all respects. It does not handle rough water well, rides very rough - which is detrimental to both passengers and equipment - and is not fuel efficient. Similar size boats in Mekoryuk use approximately 28 gallons of gasoline for a trip to Cape Mendenhall, while the Whaler uses 40 gallons for the same distance. All of the other privately owned boats in Mekoryuk are of a V-hull or semi-V design, so this appears to be the preferred design of the people familiar with these waters.

The 17 foot Zodiac is also the wrong choice for work on and around the island. This boat is designed for 12 people or a lot of gear, and with only a three person crew it is not suitable for use in these seas on most days. Without the weight, and in rough seas (most days) the Zodiac bounces across the waves and is very unstable. For work in the bays and rivers it is too large, due to very shallow water. None of the rivers or streams are navigable with the Zodiac or the Boston Whaler and even during high tides most of the bays are shallow, with only narrow meandering channels. Much of our time traveling through the bays was spent pulling the boat off sand bars and mud flats.

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APPENDIX A

Bird Species List
(Armstrong, 1980; Robbins,1984)

Common Name	Scientific Name
Yellow-billed loon	Gava adamsii
Common loon	G. immer
Arctic loon	G. arctica
Pelagic cormorant	Phalacrocorax pelagicus
Tundra swan	Cygnus colombianus
Brant	Branta bernicla
Emperor goose	Chen canagica
Northern pintail	Anas acuta
American wigeon	Anas americana
Green-winged teal	Anas creca
Greater scaup	Aythya marila
Common goldeneye	Bucephala clangula
Harlequin duck	Histrionicus histrionicus
Common eider	Somateria mollissina
King eider	S. spectabilis
Spectacled eider	S. fischeri
Oldsquaw	Clangula hyemalis
Black scoter	Melanitta nigra
White-winged scoter	M. fusca
Red-breasted merganser	Mergus serrator
Willow ptarmigan	Lagopus lagopus
Sandhill crane	Grus canadensis
Lesser golden plover	Pluvialis dominica
Black-bellied plover	P. squatarola
Semipalmated plover	Charadrius semipalmatus
Red phalarope	Phalaropus fulicarius
Red-necked phalarope	P. lobatus
Common snipe	Gallinago gallinago
Ruddy turnstone	Arenaria interpres
Black turnstone	A. melanocephala
Rock sandpiper	Calidris ptilocnemis
Pectoral sandpiper	C. melanotos
Dunlin	C. alpina
Western sandpiper	C. mauri
Parasitic jaegar	Stercorarius parisiticus
Long-tailed jaegar	S. longicaudus
Glaucous gull	Larus hyperboreus
Glaucous-winged gull	L. glaucescens

Appendix A. Bird Species (cont.).

Common Name	Scientific Name
Mew gull	*L. canus*
Black-legged kittywake	*Rissa tridactyla*
Arctic tern	*Sterna paradisaea*
Aleutian tern	*S. aleutica*
Common murre	*Uria aalge*
Pigeon guillemot	*Cepphlus columbia*
Horned puffin	*Fratercula corniculata*
Tufted puffin	*F. cirrhata*
Cassin's auklet	*Ptychoramphus aleuticus*
Savannah sparrow	*Passerculus sandwichensis*
Lapland longspur	*Calcarius lapponicus*
Snow bunting	*Plectrophenax nivalis*

APPENDIX B

Fish Species List
(Morrow, 1980)

Common Name	Scientific Name
Pacific herring	*Culpes harengus*
Bering cisco	*Coregonus laurettae*
Chum salmon	*Onorhynchus keta*
King salmon	*O. tshawytscha*
Arctic char	*Salvelinus alpinus*
Dolly varden	*S. malma*
Arctic grayling	*Thymallus arcticus*
Saffron cod	*Eleginus gracilis*
Pacific cod	*Gadus macrocephalus*
Ninespine stickleback	*Pungitus pungitus*
Pacific staghorn sculpin	*Leptocottus armatus*
Arctic flounder	*Liopsetta gracilis*
Starry flounder	*Platichtys stellatus*
Halibut	*Hippoglosus stenolepis*

APPENDIX C

Mammal Species List
(Hall and Kelson, 1959; Burt and Grossenheider, 1976)

Common Name	Scientific Name
Arctic shrew	*Sorex arcticus*
Mink	*Mustela vison*
Arctic fox	*Alopex lagopus*
Red fox	*Vulpes fulva*
Walrus	*Odobenus rosmarus*
California sea lion	*Zalophus californianus*
Harbor seal	*Phoca vitulina*
Northern fur seal	*Callorhinus ursinus*
Musk ox	*Ovibos moschatus*
Reindeer	*Rangifer tarandus*
Brown lemming	*Lemmus trimucronatus*
Beluga whale	*Delphinapterus leucas*
Pilot whale	*Globicephala melaena*
Gray whale	*Eschrichtius glaucus*

APPENDIX D

Plant Species List
(Hulten, 1968)

Lycopodiaceae (Club Moss Family)
- *Lycopodium alpinium*
- *L. annotinium*
- *L. selago*

Aspidiaceae (Shield Fern Family)
- *Dyopteris dilatata*
- *Polystrichum sp.*

Juncaginaceae (Arrow Grass Family)
- *Triglochin sp.*

Poaceae (Grass Family)
- *Calamagrostis canadensis*
- *Elymus arenarius*
- *Eriophrum angustifolium*
- *E russeolum*
- *Hierochloe pauciflora*

Cyperaceae (Sedge Family)
- *Carex aquatilis*
- *C. bigelowii*
- *C. gmelini*
- *C. lyngbyaes*
- *C. rariflora*
- *Eriophrum vaginatum*

Juncaceae (Rush Family)
- *Juncus sp.*

Liliaceae (Lily Family)
- *Lloydia serotina*

Salicaceae (Willow Family)
- *Salix arctica*
- *S. fuscescens*
- *S. ovalifolia*
- *S. polaris ssp. pseudopolaris*
- *S. pulchra*
- *S. reticulata*

Betulaceae (Birch Family)
- *Betula nana*

Polygonaceae (Buckwheat Family)
- *Rumex arcticus*

Appendix D. Plant Species (cont.)

Portulacaceae (Purslane Family)
Claytonia sarmentosa

Caryophyllaceae (Pink Family)
Honckenya peploides
Minuartia arctica
Stellaria humifusa

Ranunculaceae (Crowfoot Family)
Anemone narcissiflora
A. richardsonii
Caltha palustris
Ranunuclus pallasii

Fumariaceae (Earth Smoke Family)
Corydalis pauciflora

Cruciferae (Mustard Family)
Cardamine pratensis
Cochlearia officinalis

Crassularaceae (Stone Crop Family)
Sedum rosea

Rosaceae (Rose Family)
Dryas octopetala
Potentilla palustris
P. villosa
Rubus chamaemorus
Sanguisorba stipulata
Spiraea beauverdiana

Leguminoseae (Pea Family)
Lathyrus maritimus
Oxytropis nigrescens

Violaceae (Violet Family)
Viola epipsila

Haloragaceae (Water Milfoil Family)
Hippuris vulgaris

Umbelliferae (Parsley Family)
Angelica lucida

Cornaceae (Dogwood Family)
Cornus suecica

Pyrolaceae (Wintergreen Family)
Pyrola sp.

Appendix D. Plant Species (cont.).

Empetraceae (Crowberry Family)
- *Empetrum nigrum*

Ericaceae (Heath Family)
- *Arctostaphylos alpina*
- *Ledum decumbens*
- *Loiselueria procumbens*
- *Phyllodoce coerulea*
- *Vaccinium vitis-idaea*

Diapensiaceae (Diapensia Family)
- *Diapensia lapponica*

Primulaceae (Primrose Family)
- *Primula borealis*
- *P. tschuktschorum* var. *arctica*

Polemoniaceae (Polemonium Family)
- *Polemonium acutiflorum*

Scrophulariaceae (Figwort Family)
- *Pedicularis langsdorffii* ssp. *langsdorffii*
- *P. oederi*
- *P. verticillata*

Valerinaceae (Valerin Family)
- *Valeriana capitata*

Campanulaceae (Bluebell Family)
- *Campanula lasiocarpa*

Asteraceae (Composite Family)
- *Antennaria monocephala*
- *Arnica lessingii*
- *Artemisia frigidus*
- *Petasites frigidus*

Appendix E-1

Bird Transect data form

BIRD TRANSECT DATA

1. Study Area Code
2. Transect Number
3. Date
4. Azimuth
5. End Time
6. Wind Speed
7. Wind Direction
8. % Cloud Cover
9. Temperature
10. Observers ________

Bird #	Species	# of Bird	Sex	Age	Behavior

5904
5740
5576
5412
5248
5084
4920
4756
4592
4428
4264
4100
3936
3772
3608
3444
3280
3116
2952

BIRD TRANSECT DATA

1. Study Area Code
2. Transect Number
3. Date
4. Azimuth
5. Begin Time
6. Wind Speed
7. Wind Direction
8. % Cloud Cover
9. Temperature
10. Observers ______

Bird #	Species	# of Bird	Sex	Age	Behavior

2452
2788
2624
2460
2296
2132
1968
1804
1640
1476
1312
1148
984
820
656
492
328
164
0

GENERAL INSTRUCTIONS for BIRD FORM

ITEM

1. Study Area Code - two digit code numbered sequentially (ie. Nunivak 01, Andreafsky 02, Eek 03, etc.)
2. Transect Number - two digits representing consecutive transects (ie. first transect on Nunivak is 01)
3. Date - enter year, month, day (ie. June 7,1986 = 860607)
4. Azimuth - three digit compass bearing, direction the transect is run
5. Begin Time - enter time based on 24 hour clock
6. Wind Speed - entered in miles per hour
7. Wind Direction - two alpha character codes (ie. northeast = NE)
8. Percent Cloud Cover - two digits. If 100% then use 99.
9. Temperature - enter in Fahrenheit
10. Observers - last name of all observers, no initials.

As birds are observed they must be listed in the table. Bird number is a sequential numbering system given to individuals or groups as they are observed. Bird number is also drawn on the transect diagram on the right side of the form where the bird or birds were observed.

When walking the transect differences in habitat should be noted on the transect diagram. This is to aid the association of birds to vegetation types.

When observers reach the end of a transect any changes in weather should be noted on page 2 of the form and the End Time recorded.

Appendix E-2

Vegetation Plot data form

VEGETATION PLOT DATA

5-85

1. Site No. [ ][ ]-[ ][ ]-[ ][ ] 2. Date [ ][ ]/[ ][ ]/[ ][ ] 3. Observer _____

4. Twn [ ][ ][ ] 5. Rng [ ][ ][ ] 6. Sec [ ][ ] 7. Qtr [ ][ ] 8. Quad Name _____

9. Aspect [ ][ ] 10. Slope [ ][ ] 11. Elevation [ ][ ][ ][ ] 12. Photos [ ][ ]-[ ][ ]-[ ][ ]

13. Plot size: 1 10 100 [ ][ ]-[ ][ ]-[ ][ ] [ ][ ]-[ ][ ]-[ ][ ]

14. General Site Description:

Stratification	
15. tree	[ ][ ][ ]
16. tall shrub	[ ][ ][ ]
17. low shrub	[ ][ ][ ]
18. dwarf shrub	[ ][ ][ ]
19. herbaceous	[ ][ ][ ]
20. moss	[ ][ ][ ]
21. lichen (fruticose)	[ ][ ][ ]
22. lichen (crustose)	[ ][ ][ ]

Dominant Species	Cover Class
23	
24	
25	

Associated Species	Cover Class
26	
27	
28	
29	
30	

Associated Species	Cover Class
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	

Site Moisture

1.0 - extremely xeric sites - almost no moisture; no plant growth

2.0 - very xeric sites - very small amount of moisture; dry sand dunes

3.0 - xeric sites - small amount of moisture; stabilized sand dunes, dry ridge tops

4.0 - subxeric - noticeable amount of moisture; well-drained slopes, ridges

5.0 - subxeric to mesic sites - very noticeable amount of moisture; flat, gently sloping surfaces

6.0 - mesic sites - moderate amount of moisture; flat shallow depressions

7.0 - mesic to subhygric sites - considerable amount of moisture; depressions

8.0 - subhygric sites - very considerable amount of moisture; saturated but with <3% standing water <10 cm deep

9.0 - hygric sites - large amount of moisture; up to 100% surface under water 10 to 50 cm deep; lake margins, shallow ponds and streams

10.0 - hydric sites very large amount of moisture; 100% of surface under water 50 - 150 cm deep; lakes, streams

ANIMAL/BIRD/HUMAN ACTIVITY

0 No sign present
1 Some sign present, no disturbance
2 Minor disturbance or extensive sign
3 Moderate disturbance; light grazing or small dens
4 Major disturbance; very noticable trampling and grazing or multiple dens
5 Very major disturbance; very extensive trampling and grazing

Checklist

- [ ] Veg photos
- [ ] Mark on map
- [ ] Plant collect
- [ ]
- [ ]
- [ ]

Cover Class

1	1
2	<5(few,seldom)
3	<5(many indiv.)
4	6-25
5	26-50
6	51-75
7	76-100

Site# [ ][ ] 47. Airphoto [ ][ ] 48. Viereck Code [ ] 49. Community _____

GENERAL INSTRUCTIONS

ITEM

1. SITE NUMBER - Combination of study area code, transect number and plot number.
   A. Study Area Codes: Nunivac 01, Andreafsky 02, Eek 03.
   B. Transect Number: Two digits representing consecutive transects (ie. first transect on Nunivac will be 01)
   C. Plot number: Two digits representing consective plots along a transect.
2. DATE - Enter year, month, day (ie. June 1, 1985 = 85/06/01).
3. OBSERVER(S) - Enter last name of all observers. NOTE: no initials.
4. TOWNSHIP - Enter three character whole township number followed by N or S, indicating direction from baseline (ie. T47N = 043N).
5. RANGE - Same as for township (ie. R33w = 033W).
6. SECTION - Enter section number (1-36).
7. QUARTER SECTION - Enter NE, SE, SW, NW.
8. QUAD NAME - Enter name of topographic map.
9. ASPECT - Enter N, NE, E, SE, S, SW, W, NW.
10. SLOPE - Enter estimated percent.
11. ELEVATION - Enter in 50's of feet right justified (ie. 250 ft = 0025).
12. PHOTOS - Enter 6 digits; first two are study area code, second two are roll number, third two are exposure number.
13. PLOT SIZE - Circle the appropriate size (square meters) or enter different size in space after 100.
14. GENERAL SITE DESCRIPTION - Enter any information that will further or more exactly identify and describe the plot and surrounding area.

15-22. STRATIFICATION - Enter percent cover for various life forms.

23-25. DOMINANT SPECIES - Enter those species with percent cover greater than 30.

26-44. ASSOCIATED SPECIES - Enter all other species within the plot.
NOTE: The cover class codes for each species are found at lower right corner of data sheet.

45. SITE MOISTURE- Circle appropriate numeric value. NOTE: 1.0-4.0 are dry 5.0-7.0 are moist, 8.0-9.0 are wet and 10.0 is aquatic.
46. DISTURBANCE FACTOR - Circle appropriate value.
47. AIR PHOTO - Enter aerial photograph number.
48. VIERECK CODE - Enter 3 digit level IV codes for describing vegetation units. If uncertain about level IV codes use level III and further describe in item 14.
49. COMMUNITY - Enter plant community based on the following: A. Moisture Level, B. Dominant Species, C. Plant Growth Forms, D. Physiognomy.

Appendix E-3

Mammal Capture data form

M A M M A L S

AREA: _____ DATE: _____ TIME: _____

LOCATION: _____ HABITAT: _____

COMMENTS: _____

SPECIES	TRAP	SEX	AGE	STATUS	WEIGHT	LENGTH

Appendix E-4

Fish Capture data form

1985 YDNWR FISH DATA FORM

LOCATION: _____

DATE & TIME SET _____ DATE & TIME PULLED _____

WEATHER CONDITIONS _____ SURROUNDING HABITAT _____

FLOW RATE _____ SUBSTRATE _____ CLARITY _____

DEPTH _____ WIDTH _____

COMMENTS _____

DEVICE	SPECIES	AGE	SEX	STATUS	FORK LENGTH	COMMENTS

KEY TO FISH DATA FORM

Location: study area (Nunivak Isl., Eek River, etc.), Township Section, 1/4 Section, map name, specific name (Rainy Creek, Eek Lake, etc.)

Date and Time Set: day, month, year, and 24 hour time device was set

Date and Time Pulled: day, month, year, and 24 hour time device was pulled

Weather Conditions: temperature, precipitation, wind, etc.

Surrounding Habitat: general habitat types that characterize the area surrounding the body of water sampled (shrub tundra, spruce forest, etc.), type and description of aquatic vegetation present

Flow Rate: slow, medium, or fast

Substrate: mud, sand, gravel, boulders, bedrock

Clarity: clear, murky, or opaque

Depth: of body of water being sampled (m)

Width: of body of water being sampled (m)

Comments: were all panels used, type of bait used in minnow trap, etc.

Device: GN = gill net Mesh Size 1-5 smallest to largest (1 = 1/2" mesh, 2 = 1" mesh, etc.)
MT = minnow trap

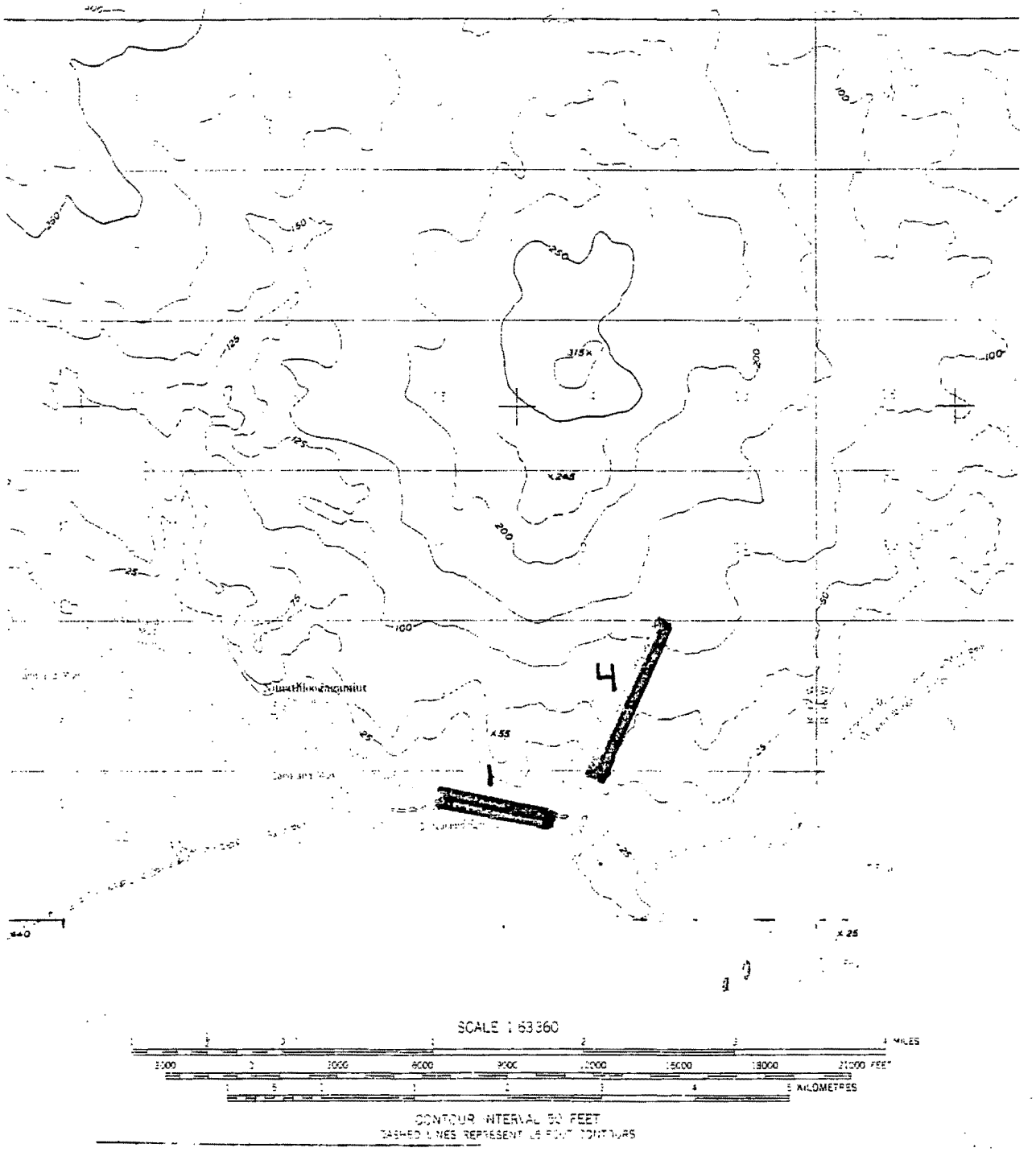
Species: be specific as possible

Age: A = adult J = juvenile U = undetermined

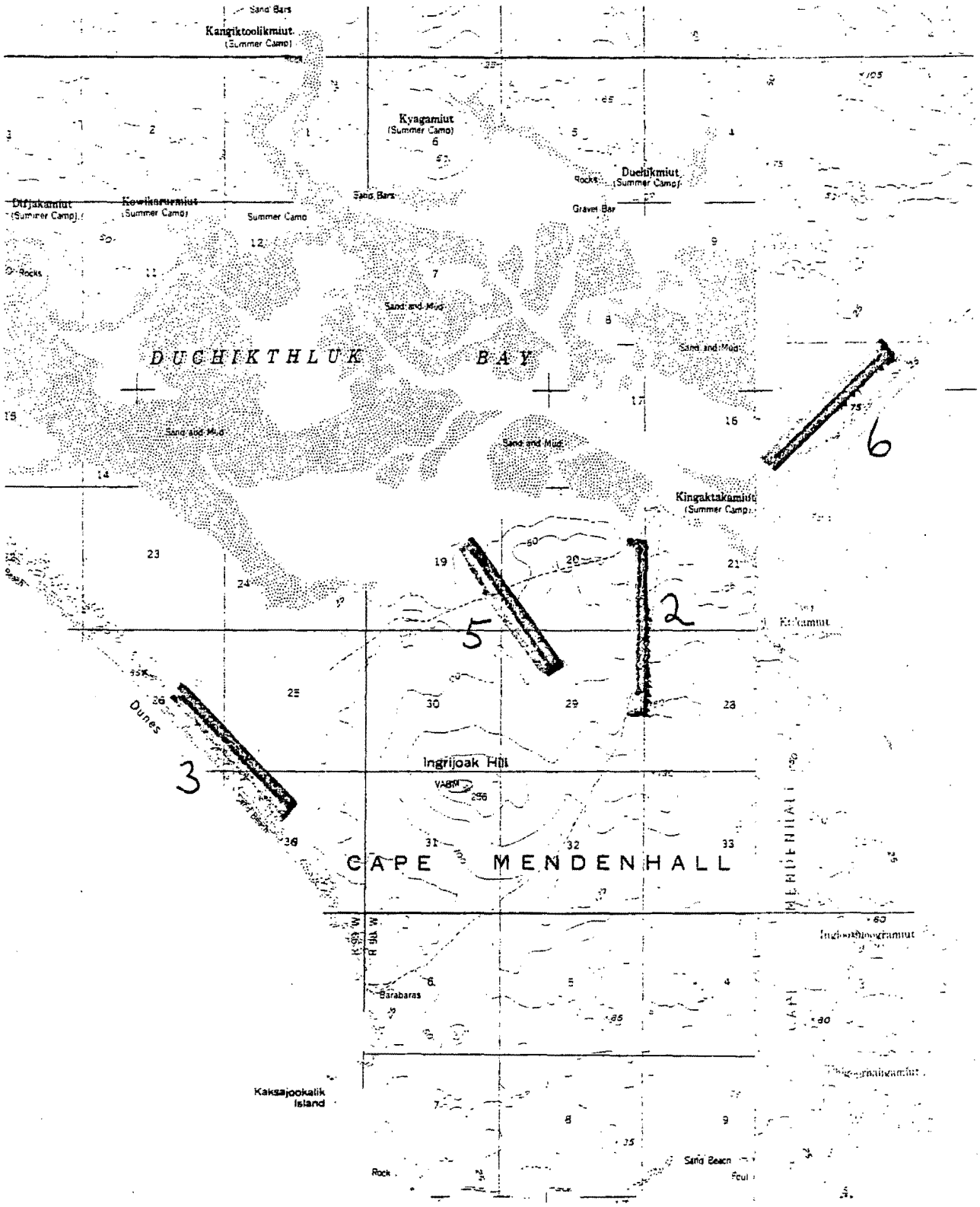
Sex: M = male F = female U = undetermined

Status: G = gravid female

Fork Length: length from snout to tail fork (cm)



Appendix F1. USGS Topographic map (Cape Mendenhall D-3) showing locations of bird census transects 1 and 4.



Appendix F2. USGS Topographic map (Cape Mendenhall D-4,D-3) showing locations of bird transects 2, 3, 5, and 6.

Appendix G. Locations of bird census transects.

Transect #	Location (USGS Topo Map) Cape Mendenhall (D3,D4)	Elevation (meters)	Azimuth (degrees)
1.	NW1/4, NE1/4; S34; R97W; T4S	MSL	110
2.	SE1/4, NE1/4; S20; R98W; T4S	15.2	180
3.	NW1/4, NW1/4; S36; R99W; T4S	MSL	330
4.	SW1/4, SE1/4; S26; R97W; T3S	7.6	45
5.	SW1/4, NE1/4; S19; R98W; T4S	7.6	140
6.	SE1/4, SE1/4; S16; R98W; T4S	MSL	45

MSL = Mean Sea Level.