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Part A-3

Progress Report

WATERFOWL POPULATIONS, PRODUCTION AND HABITAT ECOLOGY ON THE YUKON-KUSKOKWIM DELTA, ALASKA

Populations and Ecology of Cackling Geese

by

Peter G. Mickelson

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Department of Interior
Bureau of Sport Fisheries and Wildlife
Fish and Wildlife Service
Bethel, Alaska

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FOREWORD

The attached report by Peter G. Mickelson is submitted as a progress report for Refuge Management Study No. 3, Part A-3 - Populations and Ecology of Cackling Geese.

The report summarizes the results of a comprehensive study of cackling geese conducted by Mickelson in partial fulfillment of requirements for the degree of Doctor of Philosophy at the University of Michigan. The study was initiated during the summer field season of 1970 and will be completed in the season of 1972.

Nearly the entire world population of cackling geese nests on the Yukon Delta and of these, most nest in a relatively narrow coastal segment of the Clarence Rhode National Wildlife Range. Because of the limited breeding range and the concentration of most of the breeding population within the boundaries of a wildlife refuge, we consider this study to be of particular importance to refuge management, as well as being significant to waterfowl management in the Pacific Flyway. There has been no prior study of the ecology of this smallest and most colonial of all the Canada geese.

Principal support for this study has been provided by the National Geographic Society and the Bureau of Sport Fisheries and Wildlife. Support by the Bureau consisted chiefly in providing logistical services, including use of aircraft and boats, furnishing field camps, equipment, and various supplies, assisting in banding programs, and providing results from censuses and surveys conducted prior to and during the study.

Calvin J. Lensink
Refuge Manager
Clarence Rhode National Wildlife Range

BREEDING ECOLOGY OF THE CACKLING GOOSE (*BRANTA CANADENSIS MINIMA*) ON THE YUKON-KUSKOKWIM DELTA, ALASKA--1971.

by

P.G. Mickelson

December 2, 1971

A progress report on a dissertation
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
(Wildlife Management)
in The University of Michigan

Not for Publication

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INTRODUCTION

The purpose of this paper is to summarize the results of the 1971 field research on the "Breeding Ecology of the Cackling Goose (Branta canadensis minima) on the Yukon-Kuskokwim Delta, Alaska". A literature review is not included since this is merely a progress report.

The primary objectives of my study on the Cackling Goose are:

1. to determine nesting phenology during four breeding seasons
2. to determine the factors limiting goose nesting density (availability of nest sites, competition for nest sites, and territorial behavior of geese)
3. to describe the nesting habitat of the Cackling Goose in comparison with that of other goose species
4. to determine reproductive success
5. and to determine the effect of predation on each sex of all ages of Cackling Geese.

A fundamental purpose of this study is the collection of life history data for the Cackling Goose. This information will be available for comparison with any future study on the Taverner's Canada Goose which nests nearby and further inland.

Also, by studying the factors limiting goose nesting densities on my Study Area, the conclusions I reach may be applied towards management efforts to increase goose nesting densities of other areas.

Special objectives for the 1971 field season included:

1. observe territoriality
2. observe copulatory behavior
3. record vocalizations
4. observe geese in order to locate color leg-banded yearlings and adults
5. sample food habits--especially foods of young goslings
6. sample flying insect abundance
7. determine the relative abundance of mammals
8. estimate primary terrestrial production

9. and collect soil and plant samples for nutrient analyses.

Four summers will be spent on this project as I want to follow one age class of Cackling Geese from hatching to sexual maturity.

For further specific information on the 1969 and 1970 field seasons, please refer to the previous unpublished progress report available at: School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48104.

Acknowledgements

I wish to acknowledge the assistance of Dr. John A. Kadlec for his criticisms of this manuscript. I received many suggestions concerning planning for the 1971 field season from Drs. John A. Kadlec, Dale R. McCullough, Robert W. Storer, Calvin J. Lensink, and Gary W. Fowler. Thanks are due to the staff of the Clarence Rhode National Wildlife Range, student David Eisenhauer of the University of Montana, and student Carl Strang of Purdue University for help during banding drives. Equipment and lodging was made available by the U.S. Fish and Wildlife Service. Photographic equipment was supplied by the National Geographic Society.

Financial support for this study was provided by the National Geographic Society and the Wildlife Management Institute.

Description of the Study Area

My four-square-mile Study Area is located 25 miles southeast of Hooper Bay, Alaska, and is six miles east of the Bering Sea (Figure 1). The center of the area is at latitude 61° 21' north and longitude 165° 27' west. This land is administered by the staff of the Clarence Rhode National Wildlife Range with headquarters in Bethel, Alaska. The Range operates a field station at Old Chevak, five miles north of the Study Area (Figure 2).

A lowland floodplain interspersed with many shallow ponds and meandering sloughs characterizes the Study Area. Most ponds are less than two acres in size, have many small islands, and have highly irregular shorelines. Much of the land area (95 per cent) can be best described as a wet meadow 1½ feet above mean high tide and is underlain by permafrost. *Carex rariflora*, *Carex mackenziei*, and *Poa eminens* are the most abundant plant species. The remaining land area is tundra (4 feet above mean high tide) where lichens, *Sphagnum* spp., *Empetrum nigrum*, *Ledum decumbens*, *Salix ovalifolia*, and *Betula nana* are the predominant species. Ponds and sloughs make up approximately 50 per cent

FIGURE 1. Location of Study Area.

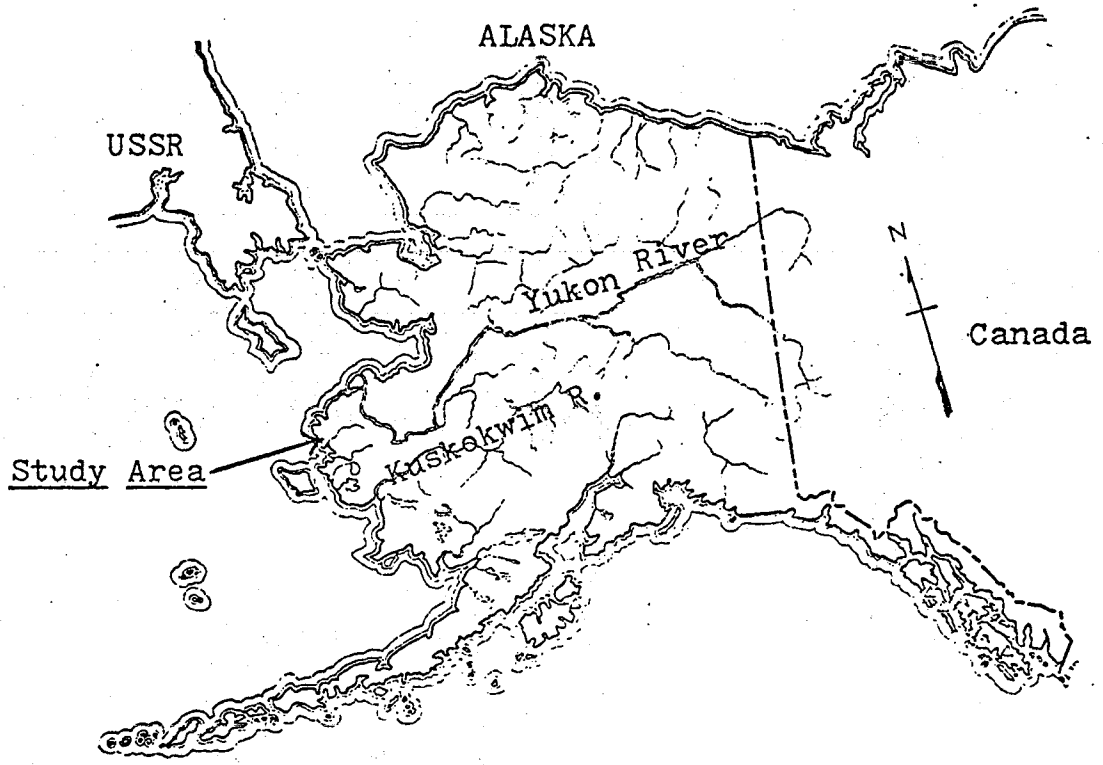
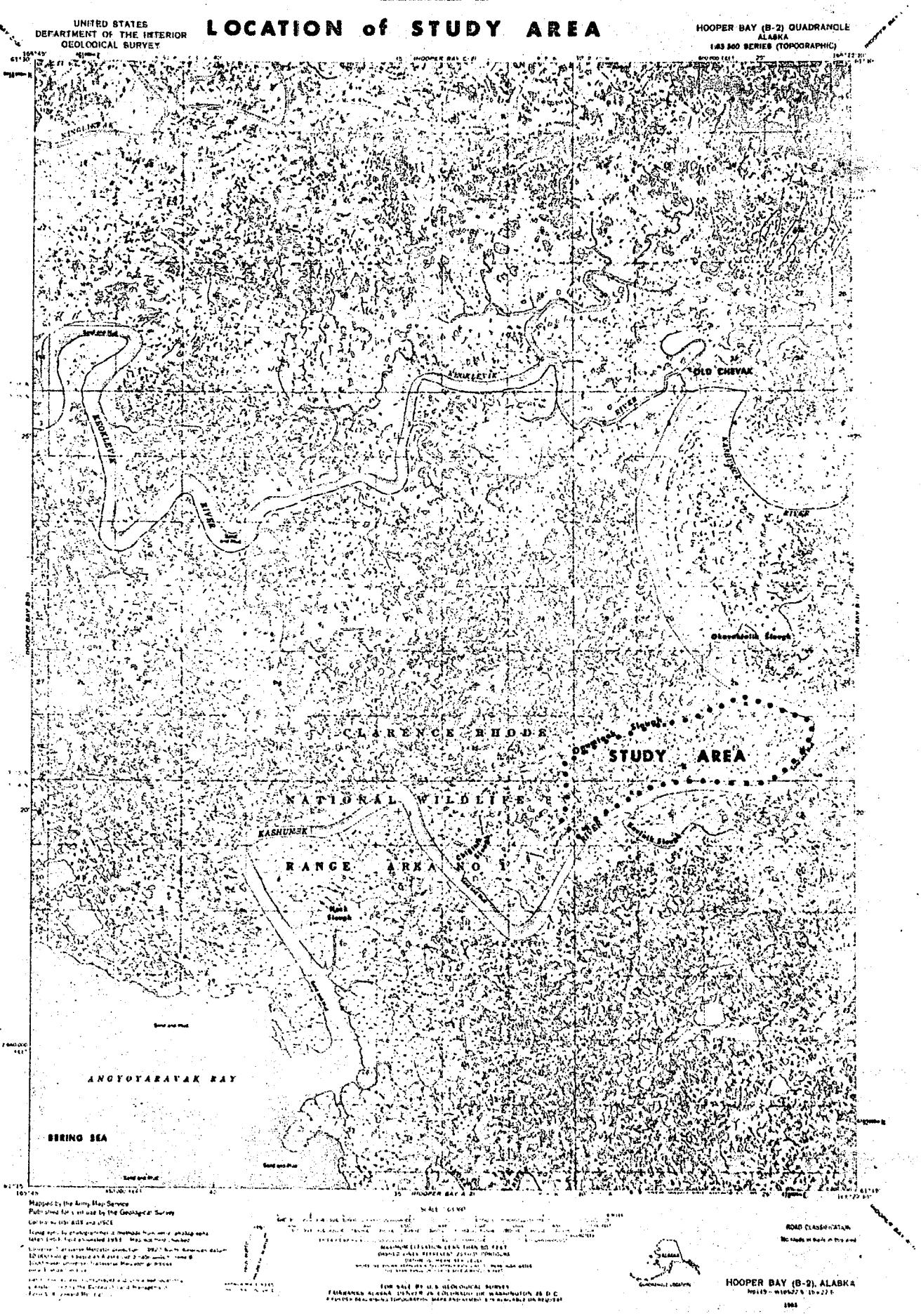


Figure 2


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
LOCATION of STUDY AREA
HOOPER BAY (B-2) QUADRANGLE
ALASKA
1:63 360 SERIES (TOPOGRAPHIC)
KINGLEKLEVIK
KOOKLEVIK
RIVER
OLD CHEVAK
KASHUNUK
RIVER
Chevakatolik Slough
CLARENCE RHODE
STUDY AREA
NATIONAL WILDLIFE
RANGE AREA NO. 1
KASHUNUK
RIVER
Black Slough
ANGYOYARAVAK BAY
BERING SEA
HOOPER BAY (B-2), ALASKA
1965

of the Study Area (Figure 3).

METHODS AND MATERIALS

General Observations

Observations of bird migration, snow and ice cover on the Study Area, weather conditions, animals seen, predation, and mortality were taken each day on the Study Area from May 16 to September 6, 1971.

Behavioral Observations

Most observations of behavior were made from an 8 ft. x 10 ft. plywood shack (which served as my camp), and from eight blinds. Each blind was 4 ft. x 4 ft. x 5 ft., constructed of nylon or canvas. Two blinds were portable and supported by aluminum tubular frames. The other six blinds were placed on wooden frames constructed on the top of wooden towers ten feet tall.

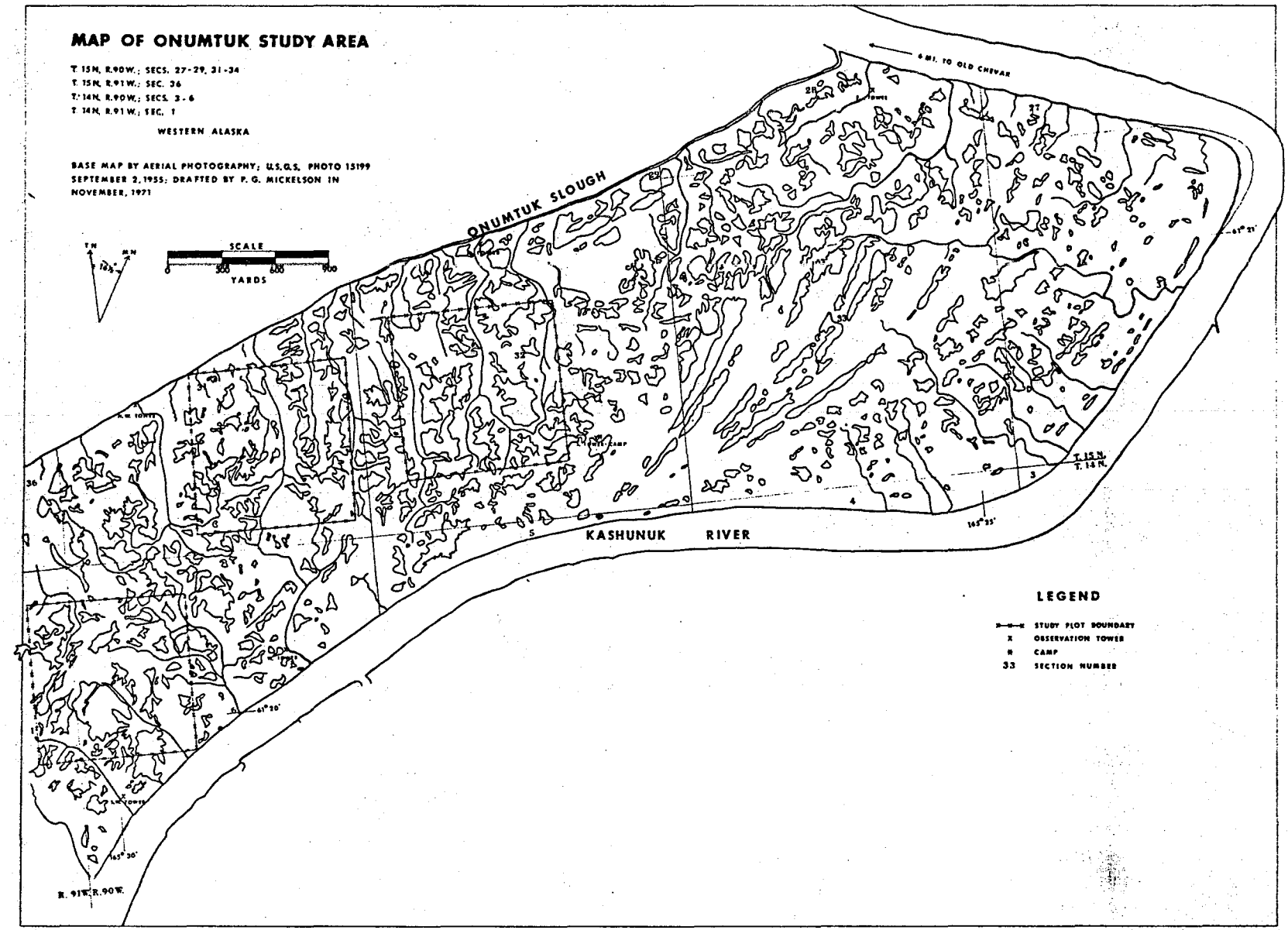
The portable blinds and the shack were essential for observations of territorial behavior, copulations, and foods eaten by geese. An additional use was for photographing behavior of geese.

Many of the observations on activities of nesting geese and their mates, and brood counts were made from the elevated blinds. Also, rough census estimates were obtained from counts taken while on the wooden towers.

Blinds were used every day of the field season. Equipment used within the shack and the blinds included: a 10 x 40 binocular, a spotting scope with 20x and 32x lenses, a portable cassette tape recorder, a portable 4-speed tape recorder, two 35 mm single lens reflex cameras with 55mm, 135mm, 200mm, 300mm, and 400mm lenses.

Observation periods usually lasted 1½ hours, but were occasionally up to eight hours long. From May 31 until June 7 I confined myself inside the shack for a continuous 111 hour period. During this time I recorded 16 observations on territoriality, 27 bird copulations, and observed 7 different color-banded Cackling Geese. In a typical observation period the following was recorded: location, time of day, weather conditions, and activity of the geese, whether mating, defending a territory, incubating eggs, feeding, or loafing.

FIGURE 3. Map of Onumtuk Study Area.



An attempt was made to record the calls of Cackling Geese. I used a Uher portable, 4-speed, tape recorder and Sennheiser microphone which was mounted in a window of my shack. Recordings were made when geese were within 30 yards of the shack and the wind speed was less than three knots.

Nesting

During the latter half of the laying period and in the early incubation period I systematically searched the islands and peninsulas of each pond for Cackling Goose nests. Nests of other species were also found during this initial search, but most were located in the mid- or late incubation period. Each nest was marked with a numbered, six-inch long tongue depressor shoved into the ground along the nest rim. The information for a nest was recorded on a standard Nest Data Form (Figure 4). All nest locations were marked on a map (scale: 6 in. = 1 mi.) of the Study Area.

Study Plots

In 1969 three $\frac{1}{4}$-square-mile plots were established on the Study Area (Figure 3). These plots were chosen to correlate predation on Cackling Goose eggs , and Cackling Goose nest density, with human visitations. The easternmost plot (1) was visited four times before the peak of hatching in 1971, plot 2 was visited eight times before the peak of hatching, and plot 3 (the westernmost) was visited six times before the peak of hatching.

Artificial Islands

In 1971 one artificial nesting island was constructed in a pond one-half mile northeast of camp (Figure 3). Materials used were similar to those used for the three islands constructed in 1970 (a 55 gal. drum, mud, chicken wire, boards, and sod). The artificial island was designed to simulate a natural nesting island.

Broods

Observations of brood sizes were made daily throughout the brood season. Most counts were made while watching from towers, although some counts were made from camp and from a motorized, 16 ft. boat.

FIGURE 4. Nest Data Form

Species_____ Nest #_____ Date_____ Location_____

_____ Island__Peninsula__Shore__Length___Width_____Elevation____Height____Nest Size: Depth_____

Dia. I.(in.)_____Dia. O.(in.)_____Material_____In Form_____

Distance to Nearest Neighbor:_____Dist. to Nearest Island:_____Dist. to Shore:_____

Date	Time	Sky	Wind	Rain	Male Present			Female		Eggs	Down	Eggs	Dist.	Incub.	Eggs				Remarks
					P.	Dist.	Fem.	P.	Dist.	#		Cov.	H_2O	Stage	#	Width	Length	Fate	

Nest Trapping

It was necessary to band a number of breeding Cackling Geese on their nests in order to identify pairs, and hens with broods. Four bow-net nest traps (described in Addy, 1956) with up to 700 feet of string (used to manually trip the trap) were used. When the trap was in place over a nest with incubated eggs, I waited at the end of the trip cord until the hen sat on the eggs. Then the trip cord was pulled to entrap the goose.

Banding and Marking

At least two leg bands were placed on all adult or class IIc or III Cackling Geese captured. The standard U.S. Fish and Wildlife Service monel band and one or more colored-plastic leg bands were used on all birds. A color code was arranged to distinguish individual nesting hens; adult males, local males and females, and local web-tagged males and females. The colored bands were obtained from A.C. Hughes, 1 High Street, Hampton Hills, England.

In addition, nest-trapped hens had parts of their plumage dyed. White, red, green, orange, yellow, and black dyes were applied to feathers on the breast, belly, upper and lower tail, flank, and upper wing (secondaries only). The dyes were purchased from Speedry Chemical Products Company, 8400 73rd Avenue, Glendale, New York 11227.

Also, all Cackler (Cackling Goose--male or female, any age) goslings found in (or as they were leaving) nests were marked with a size one, numbered, fingerling-fish tag attached to the right half of the right foot in the web. The purpose of the web-tag was to individually identify each marked gosling recaptured. The technique is more fully described and illustrated in Grice and Rodgers (1965). Web-tags were purchased from National Band and Tag Company, Newport, Kentucky.

Most of the Cacklers banded on the Study Area were captured by driving them into a trap. A banding drive covered an area slightly larger than one-square mile with four people participating in each drive. A small corral made of fish net hung on stakes plus up to 800 feet of net for each wing lead was used in the trap.

Captive Birds

Two pipped Taverner's Canada Goose eggs and two pipped

Cackling Goose eggs were taken from goose nests in the vicinity of Old Chevak. All four eggs hatched. These goslings, plus an orphaned Cackler gosling and a Black Brant gosling, were kept in a 20 ft. x 60 ft. chicken wire pen at Old Chevak. All were fed dog food and had access to water and green vegetation. These birds were weighed, measured, and their plumage recorded at weekly intervals.

Measurements of Birds

All captured or dead Cacklers were weighed and measured with all information recorded on a standard Data Form (Figure 5).

Food Habits

Adult and young Cackling Geese were observed feeding, then collected by shooting or caught by hand. Immediately, the gizzard and esophagus were removed, slit open, and their contents placed in a labeled bottle with 30 ml. of 70 per cent ethyl alcohol. The entire operation--from collection of the bird to alcohol emersion of the food contents--was completed in less than ten minutes. The bottles containing foods were returned to my camp where the contents were weighed, their volume determined, and species of foods identified.

Determination of Insect Abundance

To correlate the amount of insects in the diet of Cackling Geese with abundance and availability of flying insects, sticky boards were placed on the grass flats and tundra to catch flying insects. The technique of using sticky-boards to trap insects is described by Southwood (1968, pp. 196-197). Each sticky-board consisted of a one-square-foot piece of floor tile with a mottled green-gray pattern. Two pieces of tile were nailed (in a vertical position) to a wooden support so that the bottom edge of the tile was six inches above the ground. The boards were aligned facing northwest and southeast. A thin coat of Tree Tanglefoot resin was placed on each sticky board weekly. One station (two boards) was set up near camp on June 19. On June 19 sixteen sticky-boards were randomly placed in a one-square-mile area around the shack (Figure 6). These eight stations were reduced to four on July 23. The four remaining stations were operated until August 14, then only the station near camp was maintained until August 31.

FIGURE 5. BIRD DATA FORM

Species_____ USFW#_____ Date_____
Location_____
Habitat_____
Age____ Sex____ Class____ Weight_____ Nares_____ Culmen_____
Tarsus Total_____ Tarsus diag._____ Middle Toe____ Wing____ Tail____
Plumage_____
Marking: Left Leg_____/_____ Right Leg_____/_____
Dye_____
Time_____ am pm Sky: Clear___ Rain_____ Wind_____ Temp._____
Method of Collection_____ Collector_____
Bursa_____ Blood Smear_____

Cause of Death_____ Date Found_____
Est. Date Died_____ Time of Death_____ am pm
Location_____ Total Length_____
Ovary/Testes: Left_____ Right_____
Right Adrenal_____ Left Adrenal_____ Thyroid Rt._____
Thyroid Lt._____ Fat:_____
Emaciation Index_____
Food: Gizzard: volume_____ weight_____

Proventriculus: volume_____ Weight_____

Parasites:_____ None_____
Ectoparasites_____

Species lg. int. sm. int. caeca Gizzard Esoph. trachea Liv. Kidney

Specimen Mounted_____ Stored At_____
Parts Saved_____

Food Contents Saved_____ None_____

FIGURE 6. Location of insect sampling stations, mammal trapline, vegetation plots, and soil sampling sites.

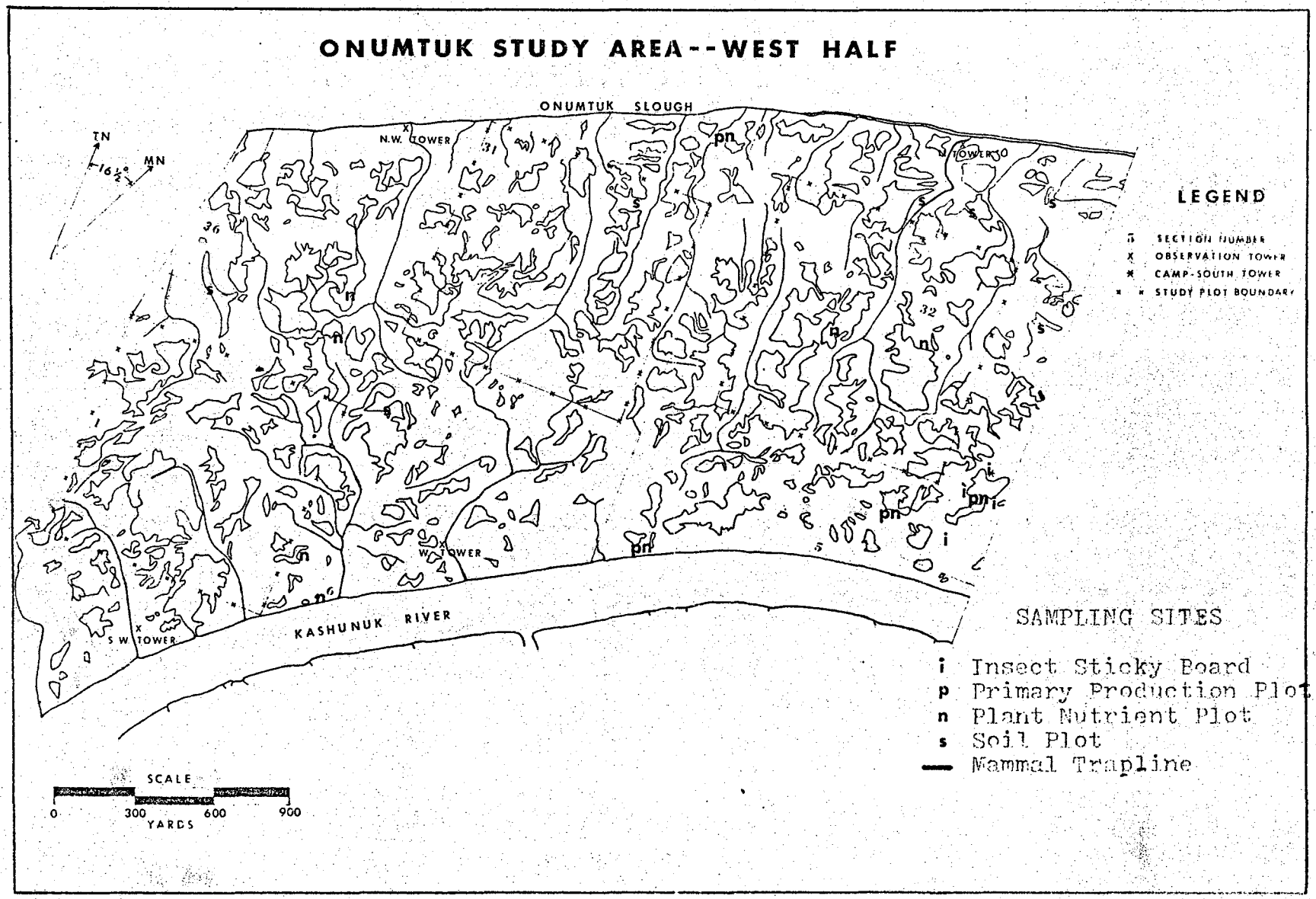
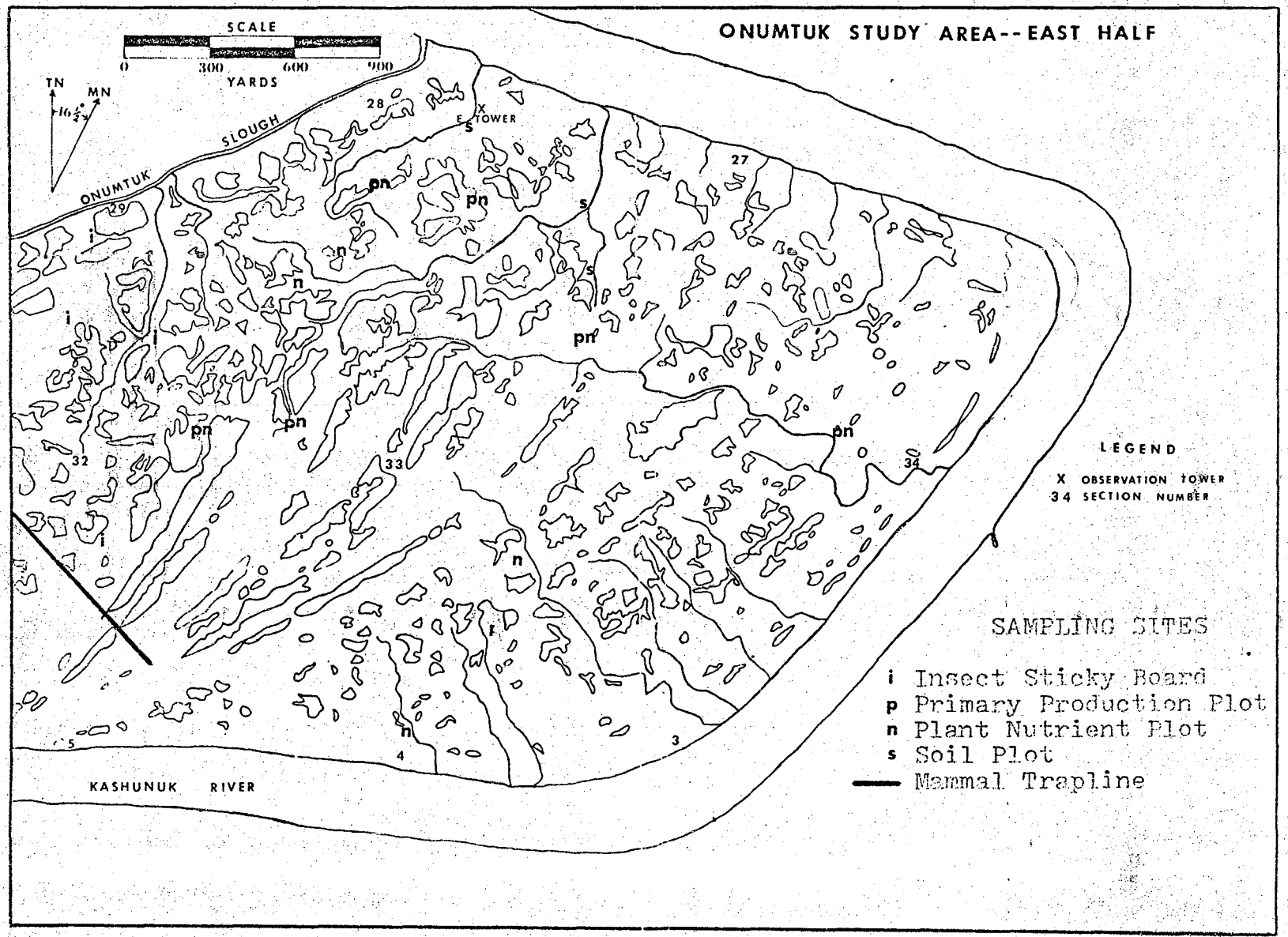


FIGURE 6. (cont.)



Each station was checked at approximately 86 hour intervals, on Tuesday mornings and Friday evenings. The weaker flying insects became trapped on the sticky-boards and remained until removed. All insects were identified by family, then enumerated as they were scraped off each board with a knife. Insects were categorized as craneflies (Tipulidae), large Dipterans (mainly houseflies), mosquitos (Cuculidae), midges (Chironomidae), and blackflies (Simulidae).

Determination of Mammal Abundance

Observations of Arctic Fox (Alopex lagopus), Tundra Hare (Lepus othus), and Harbor Seal (Phoca vitulina) were recorded as number seen and date seen. To determine abundance of microtines a mammal trapline was established on August 1 and removed August 7. The center of the transect was randomly chosed (Figure 6) using a random numbers table. A trap was placed every 100 feet along the transect. Traps used included the standard Victor house mouse snap-traps and small mammal live traps. The bait consisted of a mixture of oatmeal and peanut butter. The two kinds of traps were alternately placed at 100 foot intervals along the 2000 foot transect. The trapline was checked once daily, in the morning.

Estimation of Primary Terrestrial Production

To estimate primary terrestrial production ten sampling areas (each 2500 sq. ft.) were randomly chosen using a random numbers table (Figure 6). Each area was sampled at ten day intervals by tossing (over my shoulder) a wooden frame containing an area of 0.1 sq. M. All above-ground vegetation was clipped and placed in a marked plastic bag. The clipped area was marked with a flag and no further clippings were made within a three foot radius.

Contents of each clipped plot were separated into grasses, sedges, and "other" vegetation. The three groups were weighed, oven-dried for three hours at 300° F., and reweighed. The drying process removed approximately 95 per cent of the plant water content. The ten plots were clipped over a three day period beginning June 24, approximately the beginning of the growing season. Clipping of the last 10 plots was completed by August 25, about the time vegetation ceased growing.

Plant Nutrient Analyses

Two pooled samples of terrestrial vegetation from the sedge

grass portion of the Study Area were analyzed for the following nutrients: nitrate, protein, carbohydrates, P, K, Ca, Mg, Na, Al, Ba, Fe, Sr, B, Cu, Zn, Mn, and Cr. In addition, the per cent nitrogen as ammonia, ash content, ether extract, fiber content, caloric content, and moisture content were determined. All tests were performed by the WARF Institute, Inc. of Madison, Wisconsin.

Each sample consisted of 20 subsamples (each 0.005 sq. M.) randomly chosen in the manner as described for the primary terrestrial production plots.

The first sample was taken July 16 and 17, at the peak of growth before seed heads formed. The last sample was collected August 3 and 5 when vegetation was at the fruiting stage (fruits not fully matured and dried). Each sample was prepared in the same manner as described for vegetation clipped from the primary terrestrial production plots.

Soil Nutrient Analyses

Five soil samples were collected from the Study Area on August 31. Each of the five samples consisted of subsamples from 10 locations (Figure 6) randomly chosen using a random numbers table. At each of the 10 locations a cylinder of soil (one inch in diameter and 6 inches deep) was removed from under the nearest *Poa eminens*, *Elymus arenarius*, *Carex mackenziei*, *Carex rariflora*, and tundra.

The soil was placed in a labeled plastic bag and shipped for nutrient analysis to the Department of Crop and Soil Science, Michigan State University, East Lansing, Michigan 48823. For each sample the following was determined: pH, content of P, K, Fe, Na, Ca, Mg, Zn, Mn, Cu, and per cent carbon.

Mapping Vegetation

Mapping vegetational groups of the Study Area was completed in the late summer of 1971. A total of eleven vegetation groups were created. Maps of a scale six inches to a mile were used.

RESULTS

General Observations

The chronology of major events in the past three field seasons was:

	1969	1970	1971
arrival on Study Area	May 12	May 4	May 16
first Cackling Goose seen	May 12	May 9	May 16
meltwater flooding Study Area	May 13	May 18	May 28
first waterfowl nest started (Whistling Swan)	May 20	May 19	May 29
first Cackler copulation observed	May 13	May 18	May 31
last day of Spring snowfall	--	--	June 2
snow cover gone	May 25	May 27	June 5
first Cackling Goose nest found	May 20	May 19	June 6
ice cover gone	May 25	May 27	June 11
beginning of Kashunuk River ice breakup	May 25	May 31	June 11
Kashunuk River free of ice	June 1	June 4	June 19
first green grass and sedge shoots	June 9	June 12	June 18
first Cackling Goose eggs hatched	June 19	June 19	July 1
peak of Cackling Goose egg hatching	June 25-26	June 27	July 7
beginning of the rainy season	July 13	July 7	July 10

	1969	1970	1971
end of the nesting season for all waterfowl	July 21	July 15	July 25
Cackler goslings ½ grown; adults molting	July 14	July 15	July 26
beginning of goose banding season	July 28	July 31	August 11
end of goose banding season	August 7	August 9	August 13
end of rainy season	August 17	August 29	August 17
adult geese flying	August 7	August 6	August 20
all Cackler goslings fledged; some families migrating south	August 18	August 20	August 27
Opening of Migratory Bird Hunting season	September 1	September 1	September
end of field season	September 1	September 1	September
most locally breeding geese have migrated	August 26	August 29	September 7

The 1971 field season began on May 16 when I reached the Study Area by chartered ski-equipped aircraft. Poor flying conditions during the first two weeks of May delayed my arrival, however most geese had not yet migrated to the Study Area (Figure 7).

Snow and ice gradually receded during May and early June. The result was a 10 to 13 day delay in nesting, hatching, and molting compared with the 1970 breeding season--which was one or two days later than in 1969. As in 1969, the northern and eastern edges of the Study Area were flooded before the begirning of nesting. Additional flooded areas included a 100 yard strip along the north bank of the Kashunuk River and about 15 acres along the northeast, north, and west sides of camp. Waterfowl utilized these flooded areas for feeding, loafing, and mating.

Snowfall for the 1970-1971 winter was normal--slightly more than in 1969 and 1970. Total rainfall for 1971 was less than for 1970. More precipitation fell in May and June and less fell in July and August compared with 1970 (Table 1). A heavy rain fell the day of the peak hatch of Cackler eggs--with apparently no effect on gosling survival. Rain during the brood season was

FIGURE 7. Swan and goose migration peaks in 1971, spring.

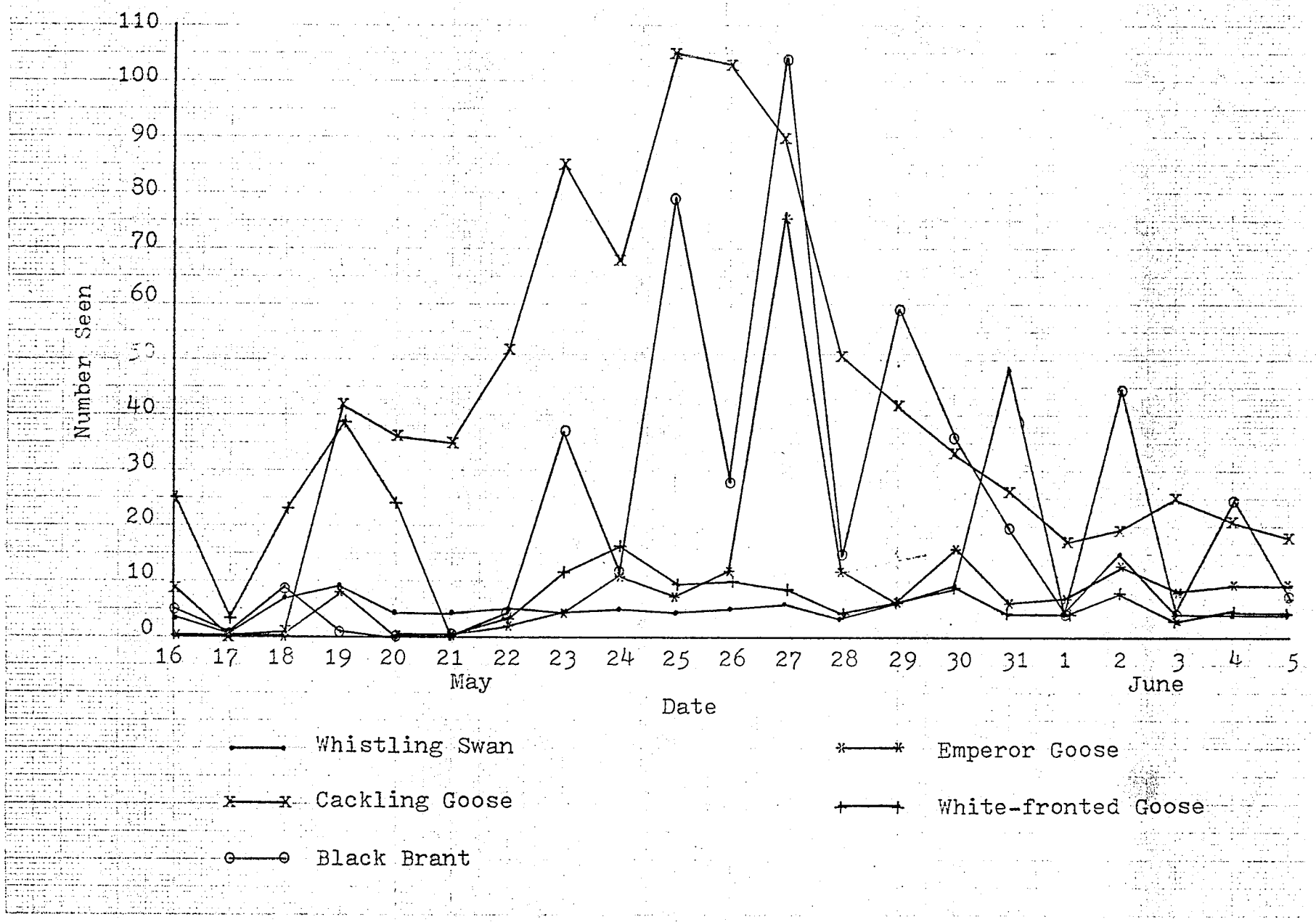


TABLE 1. Summarized weather data for 1970 and 1971.

Month	Average Maximum Temperature (F.°)		Average Minimum Temperature (F.°)		Total Precipitation (Inches)	
	1970	1971	1970	1971	1970	1971
May*	44.1	36.8	30.2	32.1	0.18	0.36
June**	56.1	47.2	37.1	39.9	0.94	1.57
July	53.0	54.3	44.2	45.3	3.01	2.85
August	53.9	57.6+	44.4	44.7+	4.05	2.30++

High for the Field Season: 70° on June 5, 1970 and 74° on July 3, 1971

Low for the Field Season: 15° on May 9, 1970 and 24° on May 16, 1971

Date of all Snow Cover Gone: May 27, 1970 and June 5, 1971

Date of Kashunuk River Ice Breakup: May 31, 1970 and June 11, 1971

* Data available from May 4 to May 31, 1970 and May 16 to May 31, 1971

** Temperatures available from June 1 to June 16, 1970

\+ Data available for 15 days only in August, 1971

++ Data available for 20 days only in August, 1971

considerably less than that for the 1970 brood season.

The peak of fall migration was 10 to 12 days later than in 1970.

The 1971 field season was characterized by a conspicuous lack of Tundra Voles (Microtus oeconomus). None were seen by myself or Range personnel during the summer. Only one Short-eared Owl was seen on the Study Area in 1971.

Other vole predators including the Glaucous Gull and Parasitic Jaeger were common, with the jaegers more abundant than in 1970. One, possibly two, Arctic Fox ranged over the Study Area. No Red Foxes (Vulpes vulpes) were seen in 1971. Birds lost as a result of predation, and other mortalities are recorded in Table 2.

During the 1971 field season seven species of birds not seen in previous seasons were recorded. These included the: Knot, Hudsonian Godwit, Pomerine Jaeger, Aleutian Tern, Cliff Swallow, White-crowned Sparrow, and Snow Bunting. A complete list of species seen (date first seen, date last seen, and breeding status) is given in Table 3.

Resightings of Marked Cackling Geese

During the 1971 field season a total of 19 color-banded or marked Cackling Geese were observed (Table 4). Of these, three were year-old birds. A yearling female was seen feeding on June 11 and June 14 (same bird?) in the south-central Study Area. She did not appear to be paired, although three other Cackling Geese fed with her. Another yearling female was sighted just northwest of camp on June 26 and June 30. This female was paired, and was incubating a nest with four eggs. Another yearling, a male, was spotted August 28 feeding with five other Cackling Geese.

Only one two-year-old, marked Cackling Goose was observed in 1971. On June 1 a female resting with its mate was seen just west of camp.

Eight adult, marked Cackling Geese were resighted in 1971. Four of these hens were spotted in the same location as they were banded (three at their nests). Two other individuals were spotted less than ½-mile from where they were nest-trapped (one in 1969 and the other in 1970).

Only two color-banded, adult male Cackling Geese were observed in 1971. A male banded in June 1969 at a nest was resighted

TABLE 2. Bird mortalities in 1971.

Species	Age	Sex	Date Found	Estimated Date Died	Remains Found	Location	Cause
Unknown Goose	Ad	unk	6/19	6/14	wing	nest 192	fox?
Raven	Ad	unk	7/1	last Fall	skeleton, wings	nest 307	shot
Cackling Goose	1 day	unk	7/7	7/7	whole bird	nest 80	Exposure
Cackling Goose	1 day	unk	7/8	7/8	none	nest 55	Glaucous Gull
Cackling Goose	1 day	unk	7/8	7/8	none	nest 56	Glaucous Gull
Sabine's Gull	Ad	unk	7/26	7/12	wings	nest 15	unknown
Black Brant	Juv	unk	7/28	7/20	legs	nest 111	Glaucous Gull
Unidentified Gosling	Juv	unk	7/28	7/20	legs	nest 111	Glaucous Gull
Glaucous Gull	Juv	unk	7/28	7/15	whole bird	nest 111	unknown
Black Brant	Juv	unk	7/29	7/27	legs, pelvis	nest 199	Glaucous Gull
Cackling Goose?	Ad	M?	8/3	7/10	wings, sternum	nest 18	fox?
Cackling Goose	Juv	unk	8/13	8/6	whole bird	nest 111	Glaucous Gull
American Widgeon	Ad	unk	8/18	8/11	wings, sternum	nest 224	fox?
Cackling Goose	Juv	unk	8/20	Aug., '70	tarsus w/band	nest 220	Glaucous Gull?
Glaucous Gull	Juv	unk	8/21	8/15	whole bird	nest 296	unknown

TABLE 2. (cont.)

Species	Age*	Sex**	Date Found	Estimated Date Died	Remains Found	Location	Cause
White-fronted Goose	Ad	unk	8/21	Early July	skeleton, feathers	nest 227	fox?
Emperor Goose	Juv	unk	8/22	8/8	legs, wings	nest 250	Glaucous Gull
Emperor Goose	Juv	F?	8/22	8/12	wings, legs, and sternum	nest 274	Glaucous Gull
Pintail	Ad	M	8/23	8/1	skull, vertebrae, sternum, wing	nest 59½	unknown
Emperor Goose	Juv	unk	8/28	8/23	skeleton, wings	nest 163	Glaucous Gull

* Ad is adult, Juv is juvenile, and unk is unknown

** M is male, F is female, and unk is unknown

TABLE 3. Bird species--date first seen, date last seen, and breeding status.

Species	Date First Seen*	Date Last Seen**	Status***
Arctic Loon	May 23	September 7	b
Red-throated Loon	May 20	July 27	n
Whistling Swan	May 16	September 7	b
Cackling Goose	May 16	September 7	b
Taverner's Canada Goose	May 19	June 19	n
Black Brant	May 16	September 7	b
Emperor Goose	May 19	September 7	b
White-fronted Goose	May 16	August 30	b
Snow Goose	May 23	May 29	m
Mallard	May 23	August 19	b
Pintail	May 20	September 7	b
Green-winged Teal	May 27	September 5	b
American Widgeon	May 24	September 5	m
Shoveler	June 28	August 29	n
Greater Scaup	May 27	July 29	b
Oldsquaw Duck	May 28	September 2	b
Steller's Eider	May 29	June 1	n
Spectacled Eider	May 24	September 4	b
Common Scoter	June 12	June 27	n
Marsh Hawk	May 20	May 20	m
Peregrine Falcon	May 17	May 17	m
Willow Ptarmigan	May 16	August 30	b
Sandhill Crane	May 16	September 6	b
Black-bellied Plover	May 17	September 7	n
Golden Plover	August 20	September 7	n
Ruddy Turnstone	May 18	July 28	n
Black Turnstone	May 18	August 30	b
Common Snipe	August 31	September 1	n

TABLE 3. (cont.)

Species	Date First Seen*	Date Last Seen**	Status***
Whimbrel	June 28	August 29	m
Bristle-thighed Curlew	June 12	August 28	m
Rock Sandpiper	May 19	August 8	n
Sharp-tailed Sandpiper	July 29	September 7	m
Knot	May 28	June 12	m
Dunlin	May 19	September 6	b
Long-billed Dowitcher	May 22	September 7	n
Western Sandpiper	May 18	August 28	b
Bar-tailed Godwit	May 18	September 7	b
Hudsonian Godwit	June 25	August 14	m
Red Phalarope	May 28	August 15	b
Northern Phalarope	May 20	September 7	b
Pomerine Jaeger	May 25	May 28	m
Parasitic Jaeger	May 16	September 6	b
Long-tailed Jaeger	May 20	August 20	b
Glaucous Gull	May 16	September 7	b
Mew Gull	May 16	September 6	b
Sabine's Gull	May 16	September 1	b
Arctic Tern	May 19	August 30	b
Aleutian Tern	June 29	June 29	m
Short-eared Owl	May 23	May 23	n
Tree Swallow	May 16	June 23	n
Cliff Swallow	May 29	May 29	m
Yellow Wagtail	June 4	August 22	n
Common Redpoll	May 29	June 23	n
Savannah Sparrow	May 19	September 6	b
White-crowned Sparrow	August 30	August 30	m
Lapland Longspur	May 16	September 7	b
Snow Bunting	May 16	May 23	m

* Arrived on Study Area May 16
** Departed from Study Area on September 7
*** Status: b=nesting on Study Area; n=nesting with 10 miles
m=migrant

TABLE 4. Resightings of color-banded Cackling Geese--1971.

Band Number or Description	Sex	Age	Date Seen	Date Banded	Distance Moved
897-10083	F	Ad	5/31	6/28/70	no movement
			6/1		no movement
			6/5		no movement
897-10005	F	Ad	6/1	6/21/69	1/3 mi.
897-10077	F	Ad	6/1	6/24/70	200 yds.
			6/2		300 yds.
			6/4		400 yds.
			6/21		400 yds.
Green left	F	2	6/1	8/--/69	½-3 mi.
US right	M	Ad	6/2	unknown	unknown
Red left, US right	F	Ad	6/3	6/--/69	100 yds.-2 mi.
897-10079	F	Ad	6/7	6/24/70	100 yds.
Orange left, US right	F	Yr	6/11	7/31-	1 mi.
			6/14	8/1/70	3/4 mi.
897-10012	M	Ad	6/13	6/29/69	½ mi.
White left, US right	F	Yr	6/26	7/31-	3/4 mi.
			6/30	8/1/70	3/4 mi.
White Throat	F	Ad	7/4	seen June, '69 and '70	no movement
897-10081?	F	Ad	7/8	6/25/70	no movement
897-11364	F	Ad	8/12	8/1/70	no movement
897-11659	M	Ad	8/17	8/12/71	1 mi.
			8/18		1 mi.
			8/20		1 mi.
897-11657	F	Juv	8/17	8/12/71	1 mi.
			8/18		1 mi.
			8/20		1 mi.
Orange right, US left	M	Yr	8/28	7/31- 8/7/70	½-1 mi.

(defending his nest territory) on June 13 one-half mile away. Another male with a brood of four was banded on August 12, 1971. He and his brood were seen on three separate days (August 17, 18, and 20) feeding and loafing one mile from the banding site.

Behavioral Observations

Thirteen observations of nest site inspection were made in 1971. The first of these was on May 31, the last on June 2. Both sexes inspected each site together.

Three pairs of Cackling Geese were observed defending nest sites from other waterfowl species (Table 5). The size of the defended area varied from 10 sq. ft. to 2100 sq. yds. Observations were made from June 1 to June 13. Defense against a single Cackler by an adult male Cackler of his brood (feeding) was observed on August 28.

In 1971 Cackling Goose copulations were recorded on the following dates: May 31, June 1-5, and June 7 (Table 6). Of the 11 copulations, 6 were known to be successful. Several of the unsuccessful attempts were by a Cackler male who appeared to be inexperienced. He would not properly align himself by his mate prior to mounting.

Recording vocalizations of Cackling Geese was attempted several times in early June. Unfortunately, only six hours during June was free of winds over three miles per hour. Ten minutes of recording several bird species including Cackling Geese were made on June 2. On June 7 five minutes of recordings of a paired, male Cackler answering calls of other Cackler pairs were made. Calls of Black Brant, Emperor Geese, and Cackling Geese in a holding pen during a banding operation were recorded on August 10. In addition, recordings were made of calls of young captive goslings.

Nest behavior observations were made at 13 nests in 1971 (Table 7). When a hen was off the nest as I entered a blind, she would return to the nest from three to 30 minutes later, except when a nest-trap had been set. The males of the pairs were observed from four feet to 20 yards away from their incubating hens.

Nesting

On my four-square-mile Study Area a total of 337 waterfowl nests were found in 1971 (Table 8 and Figure 8). This is a

TABLE 5. Observations of territorial behavior by Cackling Geese in 1971.

Date	Location	Time	Size of Defended Area	Behavior of Male	Behavior of Female
6/1	Camp	5:15 pm 5:30 pm 8:00 pm	20 ft. diameter around pair	ran after a Cackler Pair, used coil-down posture all three times	coil-down posture same same
6/2	Camp and Tower Pond	2:00 pm 2:30 pm 3:30 pm	1800 sq. yds. same same	drove off male of a Cackler pair drove off a Cackler pair twice	feeding same same
6/3	Camp	11:15 am	mate	tried to drive off a Cackler male, but could not so fed	feeding
6/4	Camp and Tower Pond	noon 8:35 pm	1800 sq. yds. 900 sq. yds.	drove Cackler pair 100 yds. N. (flying) flew after a Cackler pair 20 yds., then drove 2 intruding Cackler pairs away	feeding stood
6/5	Camp and Tower Pond	12:30 pm 7:30 pm	1800 sq. yds. mate	flew 60 yds. after a Cackler pair called as Emperor pair landed 30 yds away	stood feeding
6/6	Camp and Tower Pond	11:05 am 3:45 pm	1800+ sq. yds. mate	flew 40 yds. after a Cackler called as a pair of Whitefronts landed 20 ft. away	stood rested

TABLE 5. (cont.)

Date	Location	Time	Size of Defended Area	Behavior of Male	Behavior of Female
6/6	Camp and Tower Pond	9:00 pm	1800 sq. yds.	flew 25 yds. after a single Cackler	stood
6/7	Tower Pond	7:00 pm	1800 sq. yds.	flew to within 30 ft. of an Emperor pair, then called	stood
		8:00 pm	2100 sq. yds.	called as a single Cackler approached feeding	feeding
	Nest 2	8:30 pm	400+ sq. yds.	drove off a Spectacled Eider pair twice when 20 yds. away	on nest
6/13	Nest 101	noon	600+ sq. yds.	rushed in coil-down posture at 3 Emperors within 20 ft. of nest	incubating
8/28	Near W. Tower	12:30 pm	200 sq. ft.	used head low posture driving a feeding flock of 6 Cacklers (8 ft. away); also drove off a single Cackler feeding 6 ft. away	feeding

TABLE 6. Bird copulations observed in 1971.

Species	Date	Time	Successful	Unsuccessful	Unknown
Unidentified Goose	5/29	9:10 am	x		
Sabine's Gull	5/29	8:00 pm			x
Sabine's Gull	5/30	unknown	x		
Sabine's Gull	5/30	unknown	x		
Black Brant	5/30	7:30 pm	x		
Spectacled Eider	5/30	7:35 pm	x		
Spectacled Eider	5/30	7:35 pm	x		
Oldsquaw Duck	5/30	unknown			x
Cackling Goose	5/31	5:40 pm	x		
Oldsquaw Duck	5/31	8:00 pm	x		
Sabine's Gull	5/31	unknown			x
Sabine's Gull	5/31	unknown			x
Cackling Goose	6/1	9:15 am		x	
Cackling Goose	6/1	11:30 am	x		
Cackling Goose	6/1	1:00 pm	x		
Spectacled Eider	6/1	11:00 am		x	
Cackling Goose	6/1	8:40 pm		x	
Mew Gull	6/1	9:30 pm		x	
Black Turnstone	6/1	9:30 pm		x	
Arctic Tern	6/1	3:00 pm			x
Cackling Goose	6/2	4:10 pm		x	
Sabine's Gull	6/2	2:00 pm			x
Willow Ptarmigan	6/2	3:40 pm		x	
Cackling Goose	6/3	10:30 am		x	
Cackling Goose	6/3	7:50 am	x		
Black Turnstone	6/3	8:30 am	x		
Cackling Goose	6/4	9:15 pm		x	
Sabine's Gull	6/4	4:00 pm		x	
Black Turnstone	6/4	6:30 pm		x	
Cackling Goose	6/5	5:30 am	x		

TABLE 6. (cont.)

Species	Date	Time	Successful	Unsuccessful	Unknown
Sabine's Gull	6/5	9:00 am		x	
Willow Ptarmigan	6/5	4:40 pm	x		
Arctic Tern	6/5	6:30 pm	x		
Arctic Loon	6/6	9:50 am	x		
Cackling Goose	6/7	10:00 pm	x		
Red Phalarope	6/7	9:05 am			x
Greater Scaup	6/7	2:05 pm	x		

TABLE 7. Behavior of nesting Cackling Geese in 1971.

Date	Nest Number	Location of Observer	Distance to Nest	Time	Total Time Observed	Activities of Hen	Distance to Male	Activities of Male
6/13	98	West Tower	60 yd.	12:30pm	40 Min.	returned to nest in 1 min. turned eggs ½ hr. later	50 ft.	standing
6/21	98	West Tower	60 yd.	1:20pm	1 hr.	returned to nest in 10 min., turned eggs after 50 min.	20 ft.	standing
	93	West Tower	300 yd.	1:20pm	1 hr.	incubating	20 yd.	standing
	92	West Tower	350 yd.	1:20pm	1 hr.	incubating	4 ft.	standing
	96	West Tower	150 yd.	1:20pm	1 hr.	returned to nest in 25 min	20 ft.	standing
6/28	98	West Tower	60 yd.	12:05pm	½ hr.	returned to nest in 5 min.	2 ft.	standing
	93	West Tower	300 yd.	12:05pm	½ hr.	incubating	50 ft.	standing
	228	West Tower	300 yd.	12:05pm	½ hr.	incubating	20 yds.	standing
6/29	5	Camp	1/3 mi.	12:30pm	¼ hr.	stood on nesting island while fox was 30 ft. away	2 ft.	standing with wings outstretched

TABLE 7. (cont.)

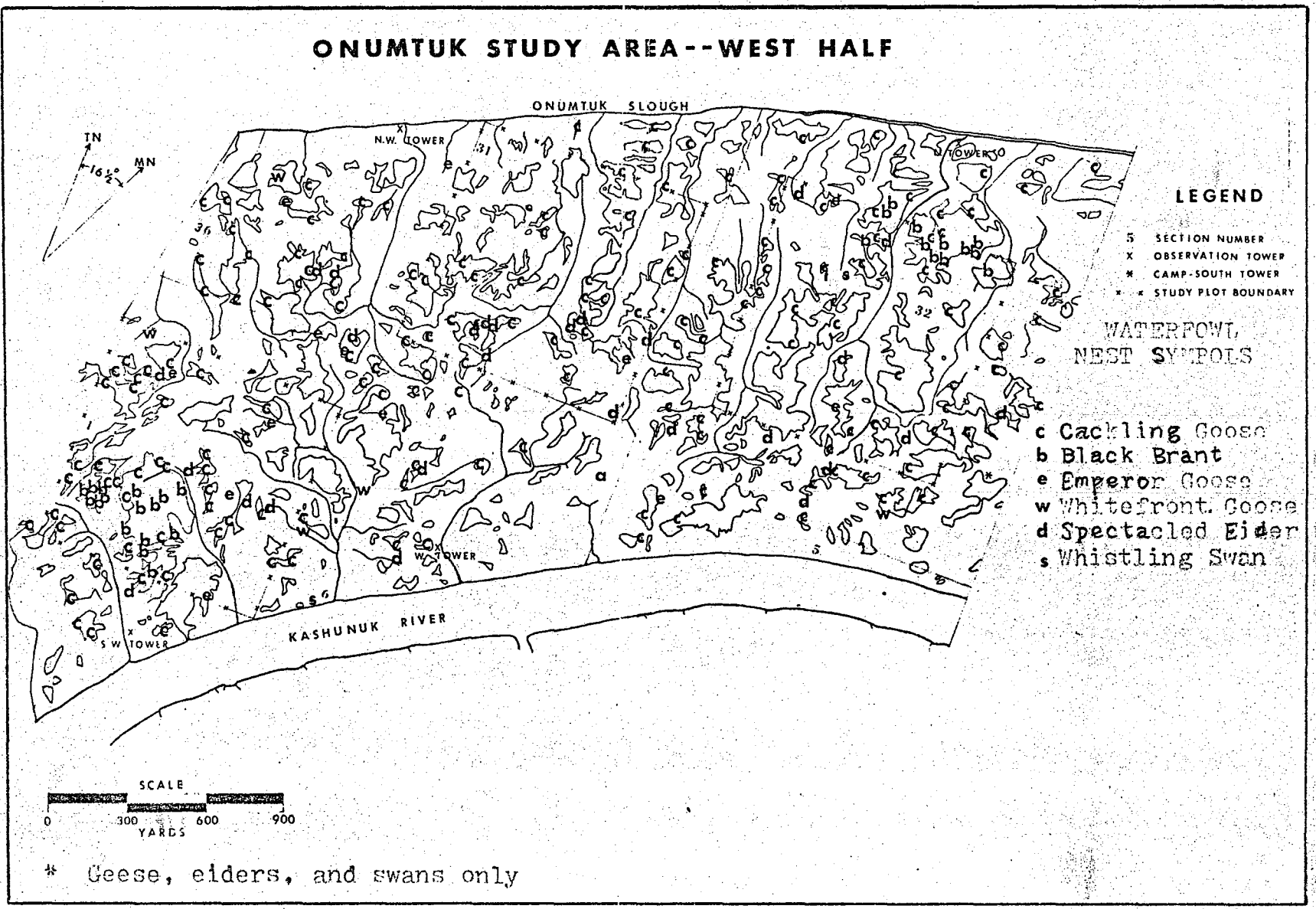
Date	Nest Number	Location of Observer	Distance to Nest	Time	Total Time Observed	Activities of Hen	Distance to Male	Activities of Male
6/29	259	Camp	300 yds.	12:30pm	10 min.	incubating with fox 50 ft. away	2 ft.	standing on nesting island
7/1	23	North Tower	300 yds.	11:50am	½ hr.	returned to nest in 10 min.	20 yds.	standing
	303	North Tower	300 yds.	11:50am	½ hr.	incubating	5 ft.	standing
	305	North Tower	270 yds.	11:50am	½ hr.	incubating	12 ft.	standing
	22	North Tower	300 yds.	11:50am	½ hr.	incubating	4 ft.	standing
	295	North Tower	500 yds.	11:50am	½ hr.	returned to nest in 30 min.	--	--
7/2	165	Southwest Tower	250 yds.	7:00pm	45 min.	incubating	20 yds.	standing
	96	West Tower	150 yds.	8:00pm	1½ hrs.	returned to nest-with a nest trap--in 1½ hrs.	--	--

TABLE 8. Bird species nesting on Study Area during 1971.

Species*	Number of Nests	Per Cent Successful
Arctic Loon	17	52.8
Whistling Swan	2	100.0
Cackling Goose	200	63.5
Black Brant	36	50.0
Emperor Goose	20	100.0
White-fronted Goose	17	82.3
Mallard	1	100.0
Green-winged Teal	1	100.0
Pintail	6	undetermined
Greater Scaup	1	100.0
Oldsquaw Duck	4	0.0
Spectacled Eider	32	50.0
Total Waterfowl	337	
Willow Ptarmigan	2	50.0
Sandhill Crane	3	33.3
Bar-tailed Godwit	1	100.0
Long-tailed Jaeger	1	100.0
Parasitic Jaeger	2	100.0
Glaucous Gull	3	100.0
Mew Gull	6	100.0
Total Nests	355	

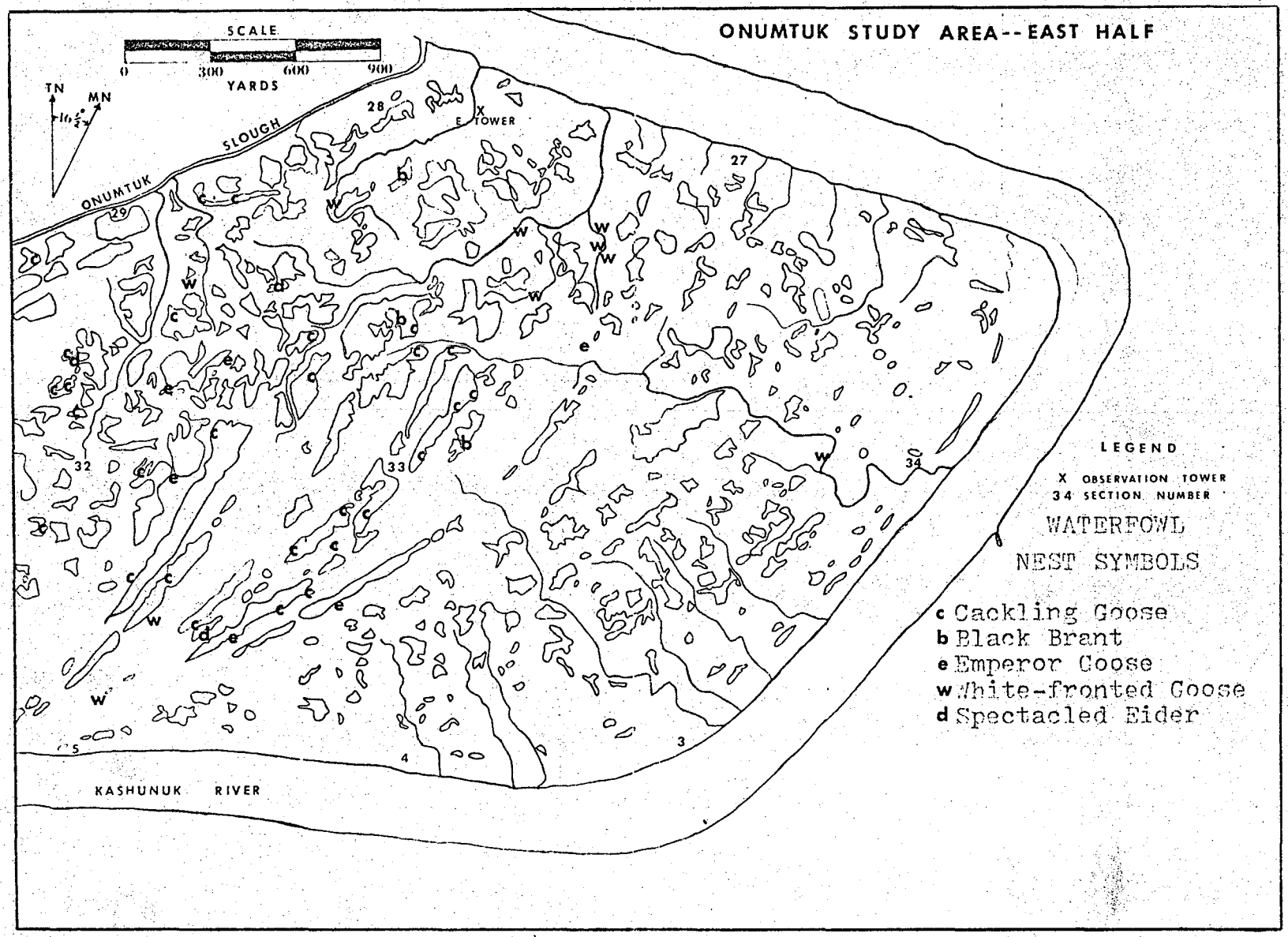
* Excludes small shorebirds, small larids, and all passerines.

FIGURE 8. Location of 1971 waterfowl* nests on Study Area.



* Geese, eiders, and swans only

FIGURE 8. (cont.)



decrease from the 355 nests found in 1969 and 413 nests found in 1970. Nest searching efforts were of an intensity equal to that of 1970. The decline in nesting can be attributed to the lateness of spring.

The frequency of 1971 Cackling Goose nests found in or near 1969 and 1970 goose and eider nest forms is presented in Table 9. Many of the same nest forms on islands were reused each year, often by the same species and possibly the same female.

Only one case of nest parasitism was recorded in the 1971 field season. A Spectacled Eider nest was found with six eider eggs and one Cackling Goose egg. This nest was abandoned by the eider hen during late incubation. The eider eggs were subsequently destroyed by an avian predator. I removed the Cackling Goose egg.

Incubation periods for Cackling Goose eggs averaged 26 days, the same as for both previous nesting seasons (Table 10).

In Table 11 are the known hatching dates for Cackling Goose clutches in 1971. July 6 and 7 was the 1971 peak, 9 to 13 days later than in 1969 and 1970.

Total eggs laid, average clutch size, and nesting success for geese and eiders during 1971 are presented in Table 12. Emperor Geese had the highest nesting success, with all 20 nests successful. Cackling Geese exhibited the greatest nesting density and White-fronted Geese the lowest. Black Brant had a somewhat higher nesting success than usual.

A total of 25 unhatched eggs were removed from Cackling Goose nests after the hatching period. Of these eggs, eight were addled, ten were infertile, and seven were undetermined. Four of the 25 eggs were buried in the bottom of four nests and were unturned during the incubation period. Each of the eggs may have been the first of the clutch, then the hen built up the nest to keep the other eggs drier. Several buried eggs were also found during the 1970 nesting season.

Completely destroyed goose and eider nests are summarized in Table 13. For those nests whose date of destruction was known, the majority of predation on goose eggs occurred during late incubation. Most egg losses can be attributed to Glaucous Gull and Parasitic Jaeger predation. An Arctic Fox was seen taking eggs from a Cackling Goose nest and from a Spectacled Eider nest. Fox predation on eggs was very light in 1971.

As in 1969 and 1970, a greater per cent of the Cackling Goose nests located on islands were successful (Table 14).

TABLE 9. Frequency of 1971 Cackling Goose nests found in or near 1969 and 1970 nest forms.

Category	Total Number of 1971 Cackler Nests	Frequency by Location		
		Island	Peninsula	Shore
In 1969 Cackler Forms	19	19	0	0
Found Within 18 in. of 1969 Cackler Nests	1	1	0	0
Found Within 5 ft. of 1969 Cackler Nests	3	3	0	0
In 1970 Cackler Forms	40*	39	1	0
Found Within 18 in. of 1970 Cackler Nests	8	7	1	0
Found Within 5 ft. of 1970 Cackler Nests	16	14	2	0
In 1969 Goose or Eider Nest Forms	1	0	1	0
Found Within 18 in. of 1969 Goose or Eider Nest Forms	1	1	0	0
Found Within 5 ft. of 1969 Goose or Eider Nest Forms	2	2	0	0
In 1970 Goose or Eider Nest Forms	3	2	1	0
Found Within 18 in. of 1970 Goose or Eider Nest Forms	1	1	0	0
Found Within 5 ft. of 1970 Goose or Eider Nest Forms	1	1	0	0

* Fourteen of these 40 nests were also in the same 1969 Cackling Goose nest forms.

TABLE 10. Cackling Goose incubation periods in 1969-71.

Incubation Period* (+ or - one day)	Distribution of Nests 1969	1970	1971
24	4	3	2
25	2	6	1
26	2	2	5
27	4	4	0
28	2	1	1
29	1	1	0
30	0	1	0
31	1	0	0
Total	16	18	9
Average	26±1	26±1	26±1

* Beginning with the day the last egg was laid

TABLE 11. Distribution of known hatching dates for Cackling Goose clutches in 1971.

Hatching Date	Distribution
July 1	2
July 2	5
July 3	7
July 4	10
July 5	8
July 6	24
July 7	19
July 8	16
July 9	8
July 13	1
July 18	1
Total	101

TABLE 12. Eggs laid and average clutch size for goose and eider nests started, nests incubated, and successful nests in 1971.

	Cackling Goose	Black Brant	Emperor Goose	White-frt. Goose	Spect. Eider
Total Nests Started	200	36	20	17	32
Total Eggs Laid	755	84	84	70	135
Average Clutch*	4.44	3.36	4.20	4.11	4.82
Number of Nests**	170	25	20	17	28
Total Nests Incubated	163	24	20	17	28
Total Eggs Incubated	736	81	84	70	135
Average Clutch*	4.51	3.37	4.20	4.11	4.82
Number of Nests**	163	24	20	17	28
Total Successful Nests	127	18	20	14	16
Total Eggs Hatched	504	49	80	49	69
Average Clutch	3.97	2.72	4.00	3.50	4.31
Per Cent Success	63.5	50.0	100.0	82.3	50.0

* Excluding nests with unknown clutch sizes

** Number of nests for which clutch size is known and used in calculation of average clutch size

TABLE 13. Completely destroyed goose and eider nests in 1971.

Species	Number of Nests Destroyed	Per Cent Destroyed	Period in which Destroyed			
			Laying	Incubation Early	Incubation Late	Unknown
Cackling Goose	57*	24.5*	8	10	7	32
Black Brant	18	50.0	0	0	6	12
Emperor Goose	0	0.0	0	0	0	0
White-fronted Goose	3	17.7	0	0	3	0
Spectacled Eider	16	50.0	0	0	6	10

* Excludes 16 nests destroyed as a result of nest trapping

TABLE 14. Success of goose and eider nests in relation to nest locations--1971.

Species	Location of Nests	Total Nests	Per Cent of Total	Successful Nests	Per Cent of Successful Nests
Cackling Goose	Island	157	78.5	107	84.2
	Peninsula	36	18.0	18	14.2
	Shore	7	3.5	2	1.6
	Totals	200	100.0	127	100.0
Black Brant	Island	34	94.4	17	94.4
	Peninsula	0	--	--	--
	Shore	2	5.6	1	5.6
	Totals	36	100.0	18	100.0
Emperor Goose	Island	4	20.0	4	20.0
	Peninsula	3	15.0	3	15.0
	Shore	13	65.0	13	65.0
	Totals	20	100.0	20	100.0
White-fronted Goose	Island	0	--	--	--
	Peninsula	0	--	--	--
	Shore	17	100.0	14	100.0
	Totals	17	100.0	14	100.0
Spectacled Eider	Island	11	34.4	5	31.3
	Peninsula	8	25.0	4	25.0
	Shore	13	40.6	7	43.7
	Totals	32	100.0	16	100.0

Study Plots

Three ¼-square-mile study plots were set up in 1969 to estimate predation on Cackling Goose eggs and the effect on nesting density as a result of human disturbance of nesting geese. For each of the three areas, the following was recorded during the 1971 nesting season: number of visits by myself, number of nests found, number of eggs in each nest, and nesting success. The most frequently visited plot (two) had a 76.0 per cent nesting success for 25 nests (Table 15). Both plots one and three were visited only twice before hatching. Plot one had a 56.5 per cent nesting success with 23 nests started and plot three had 93.5 per cent nesting success for 31 nests (Figure 3).

Artificial Nesting Islands

In August, 1970 three artificial nesting islands were constructed in three ponds which had no natural nesting islands for geese. These islands (made of 55 gal. drums covered with sod) were carefully inspected in June, 1971. Two were tilted sideways and part of the sod had been blown and washed away. The third was partly tilted, but held a Cackling Goose nest with a clutch of five eggs. All eggs successfully hatched on July 1. The hen was nest-trapped and all five goslings were web-tagged. In August the three islands were repaired.

Broods

Brood sizes for all broods seen where definite counts were possible, are presented in Tables 16-19. Cackler class I (using plumage classes of Gollop and Marshall, 1954) brood sizes averaged 4.0 for 10 broods, but the average dropped to 3.40 for 43 fledged broods. Emperor Goose brood sizes dropped from 4.00 for 5 class Ia broods to 2.90 for 20 fledged broods.

Little time was devoted to brood movement studies due to a lack of conspicuously marked Cackler adults. Only one web-tagged Cackler gosling was recaptured before the banding season. It was found two and one-half miles east of the nest it was tagged in 27 days earlier. A brood of four Cacklers were color leg-banded on August 12 and resighted one mile south on August 17, 18, and 20. However, the young were seen flying on August 20 and may have flown the mile south.

TABLE 15. Total eggs and average clutch size for each of the three Cackling Goose study plots in 1971.

	Plot One	Plot Two	Plot Three
Total Nests Started	23*	25	31
Total Eggs Laid	74	117	140
Average Clutch	3.22	4.68	4.52
Total Nests Incubated	16	21	30
Total Eggs Incubated	63	109	138
Average Clutch Incubated	3.94	5.19	4.60
Successful Nests	13	19	29
Total Eggs Hatched	47	88	114
Average Clutch Hatched	3.61	4.63	3.93
Per Cent Successful	56.5	76.0	93.5
Number of Visits until First Eggs Hatched	2	4	2
Number of Visits until Peak of Hatching	4	8	6
Number of Visits until 80 per cent of Eggs Hatched	7	12	8

* Excludes 2 nests destroyed as a result of nest trapping

TABLE 16. Cackling Goose brood size observations for 1971.

Location	Age Class*	Frequency by Size of Brood 1	2	3	4	5	6	7	8	Totals Broods	Young	Young/Brood
On	Ia	1	0	0	6	3	0	0	0	10	40	4.00
Study	Ib	0	6	5	6	7	4	0	0	28	110	3.93
Area	IIa	2	4	2	4	2	1	0	0	15	48	3.20
	IIb	1	6	2	5	2	0	0	0	16	49	3.06
	IIc	0	2	1	5	1	0	0	0	9	32	3.56
	III	1	3	2	4	3	1	0	0	14	50	3.57
	F	5	9	6	12	9	2	0	0	43	146	3.40
Off	Ia	0	1	1	0	1	1	0	0	4	16	4.00
Study	Ib	0	1	0	2	1	0	0	0	4	15	3.75
Area	Ic	0	0	1	2	2	0	1	0	6	29	4.83
But	IIa	0	3	4	4	6	2	0	0	19	76	4.00
Within	IIb	1	6	2	5	2	0	0	0	16	49	3.06
5 Miles	F	3	3	6	7	1	2	0	0	22	72	3.27

* No observations were made of age classes Ic On; and IIc and III off Study Area

TABLE 17. Black Brant brood size observations for 1971.

Location	Age Class*	Frequency by Size of Brood 1	2	3	4	5	6	Grouped Broods** Pairs	Young	Totals Broods	Young	Yg/Br.
On	Ia-c	2	1	4	4	5	2	2	6	20	75	3.75
Study	IIa	2	1	1	1	0	0	0	0	5	11	2.20
Area	IIb	0	0	1	0	0	0	0	0	1	3	3.00
	IIc	0	0	1	1	0	0	0	0	2	7	3.50
	III	1	1	2	0	2	0	0	0	6	19	3.17
	F	1	1	4	3	0	0	0	0	9	27	3.00
Off Study	Ia-c	1	0	0	0	1	0	0	0	2	6	3.00
Area, but	IIa	0	1	1	0	0	0	0	0	2	5	2.50
Within	IIc	0	2	0	1	0	0	0	0	3	8	2.67
5 Miles	F	1	2	2	0	0	0	0	0	5	11	2.20

* No observations were made of age classes IIb and III off the Study Area

** Young seen with more than two adults

TABLE 18. Emperor Goose brood size observations for 1971.

Location	Age Class*	Frequency by Size of Brood 1	2	3	4	5	6	7	8	9	Totals Broods	Young	Young/Brood
On	Ia	0	0	1	3	1	0	0	0	0	5	20	4.00
Study	Ib	0	0	3	4	1	1	1	0	0	10	39	3.90
Area	Ic	0	4	1	1	0	0	0	0	0	6	15	2.50
	IIa	1	1	2	2	1	1	0	0	1	9	37	4.11
	11c	0	1	3	4	1	0	0	0	0	9	32	3.56
	III	2	1	2	1	1	2	0	0	0	9	31	3.44
	F	3	6	5	3	2	1	0	0	0	20	58	2.90
Off	Ib	1	0	2	1	0	0	0	0	0	4	11	2.75
Study	IIa	0	0	3	4	2	0	0	0	0	9	35	3.89
Area, but	IIb	1	0	0	1	0	0	0	0	0	2	5	2.50
Within 5	III	0	2	2	2	0	0	0	0	0	6	18	3.00
Miles	F	1	2	3	2	3	0	0	0	0	11	34	3.09

* No observations were made of age classes IIb on the Study Area; and Ia, Ic, and IIc off the Study Area

TABLE 19. Brood size observations for White-fronted Geese and Spectacled Eiders--1971.

Species and Location	Age Class*	Frequency by Size of Brood 1	2	3	4	5	6	Broods	Totals Young	Young/Brood
White-fronted	Ib	0	0	1	0	1	0	2	8	4.00
Geese	Ic	0	1	0	0	2	0	3	12	4.00
on	III	0	1	0	0	0	0	1	2	2.00
Study Area	F	0	0	0	0	1	0	1	5	5.00
Whitefronts	IIa	0	1	1	2	2	1	7	29	4.14
Off Study Area	III	1	0	0	0	0	0	1	1	1.00
Spectacled	Ia	0	0	0	0	3	2	5	27	5.40
Eider	Ib	0	1	0	1	0	1	3	12	4.00
on	Ic	0	2	0	2	2	1	7	28	4.00
Study Area	IIa	0	0	0	0	0	1	1	6	6.00
	IIb	0	0	0	0	0	1	1	6	6.00
	III	0	0	0	1	0	1	2	10	5.00
	F	0	1	2	1	0	1	5	18	3.60

* No observations were made of Whitefront brood classes Ia, and IIa-c on the Study Area; and Ia-c, IIb, IIc, and F off the Study Area.

Nest Trapping

Only 13 Cackling Geese were nest-trapped in 1971 despite the use of four nest-traps. Parasitic Jaeger predation on eggs in nests with set traps, and my lack of time, resulted in a less than expected catch. All Cackling Geese nest-trapped were color-marked and color-banded, each with a combination of colors in order to recognize individuals.

Banding and Marking

A total of 123 Cackling Geese were banded (USFW and color leg bands) on or within two miles of the Study Area in 1971. During the Cackler hatching period, 261 goslings from 70 nests were web-tagged in or nearby the nest (Table 20). Most geese were leg-banded during three banding drives.

As of December 10, 1971 seven band returns have been received from Cackling Geese banded on the Study Area. Banding returns are presented in Table 21.

Captive Birds

Several Cackler and Canada goslings were held captive to compare their growth and development with wild birds. Two Taverner's Canada and three Cackler goslings were raised from pipped eggs to flight stage at Old Chevak. These goslings were weighed, measured, and their feather development recorded at weekly intervals.

Measurements

Banding operations made a large number of Cackling Geese available for measurements. Measurements were obtained from 7 Cackler goslings still in the nest, 4 half-grown goslings, 22 local males, 18 local females, 4 adult males, and 20 adult females. These measurements have not been summarized.

TABLE 20. Cackling Geese marked and banded in 1971.

Age	Sex	Web-Tagged	Nest-Trapped	On Study Area	Within Two Miles*	Total
Local**	U	X		261		261
Local	M			18	23	41
Local	F			14	22	36
Local	M	X		4	0	4
Local	F	X		4	0	4
Adult	M			4	6	10
Adult	F			6	9	15
Adult	F		X	13	0	13
Total Geese Leg Banded						123

* Banded off Study Area, but within two miles of its boundary

** Web-tagged, but not necessarily leg-banded

U--Unknown; M--Male; F--Female

TABLE 21. Cackling Goose band recoveries--1969-1971.

Band Number	Age	Sex	Date Banded	Location Banded	Date Recovered	Location Recovered
897-10038	Juv	M	8/5/69	N. Cor. Sec. 32-3	Fall '69	California
897-10046	Juv	F	8/5/69	N. Cor. Sec. 32-3	12/27/69	California
897-10001	Ad	F	6/18/69	Nest 255	10/21/70	Tulelake, Calif.*
897-10024	Juv	M	8/5/69	N. Cor. Sec. 32-3	10/24/70	Mount Dome, Ca.**
Pink Band	Juv	-	8/12-3/71	Study Area	11/2/71	Tulelake, Calif.*
897-11693	Juv	F	8/13/71	Nest 121	11/9/71	Tulelake, Calif.*
897-11689	Juv	F	8/13/71	Nest 121	11/11/71	Tulelake, Calif.*

* Shot on Tule Lake National Wildlife Refuge

** Shot on Lower Klamath National Wildlife Refuge

Food Habits

During the 1971 field season one adult Cackling Goose and four goslings were collected for determination of contents of their digestive tracts. The hen, shot on June 9, contained several seeds of Poa eminens and a few shoots of dried Carex sp. Unfortunately, this hen was nesting 100 yards west of my camp. Thus, her nest was unsuccessful. I refrained from collecting additional adults due to disruption of breeding pairs.

Two goslings, six to nine days old; one 12 days old, and another three weeks old, were sacrificed for food content determination. All contained seeds and stems of Carex (mackenziei?). One gosling, about 12 days old, had what appeared to be small (one mm long), black, insect larvae in its proventriculus. No flying insects were found in any of the birds.

Twenty hours of Cackling Goose feeding observations were made during late July and August in the vicinity of my camp. Adults with broods fed primarily on shoots of Carex rariflora and Carex mackenziei until seed heads developed. Then both shoots and seed heads were taken. Adults occasionally took seed heads of Chrysanthemum arcticum. During late August crowberries (Empetrum nigrum) were added to their diets. On no occasion were flying insects observed to be taken by geese.

Determination of Insect Abundance

To correlate species and number of flying insects in the diet of Cackling Geese, with availability of insects, up to 16 one-square-foot sticky-boards were set up. The relative abundance of insects was determined by the catch over a given period of time with known wind conditions. Insect sticky boards were in use from June 19 through August 31. The average catch for this period is given in Figure 9.

Determination of Mammal Abundance

From my record of daily observations of mammals (Table 21), the population of Arctic Foxes ranging on the Study Area was no more than two. One Arctic Fox was seen on three occasions, twice within one-half mile of my camp and once two miles from camp. One fox could easily range over the entire Study Area.

More Tundra Hares were seen in 1971 than in any of the

FIGURE 9. Average sticky-board catch of flying insects in 1971.

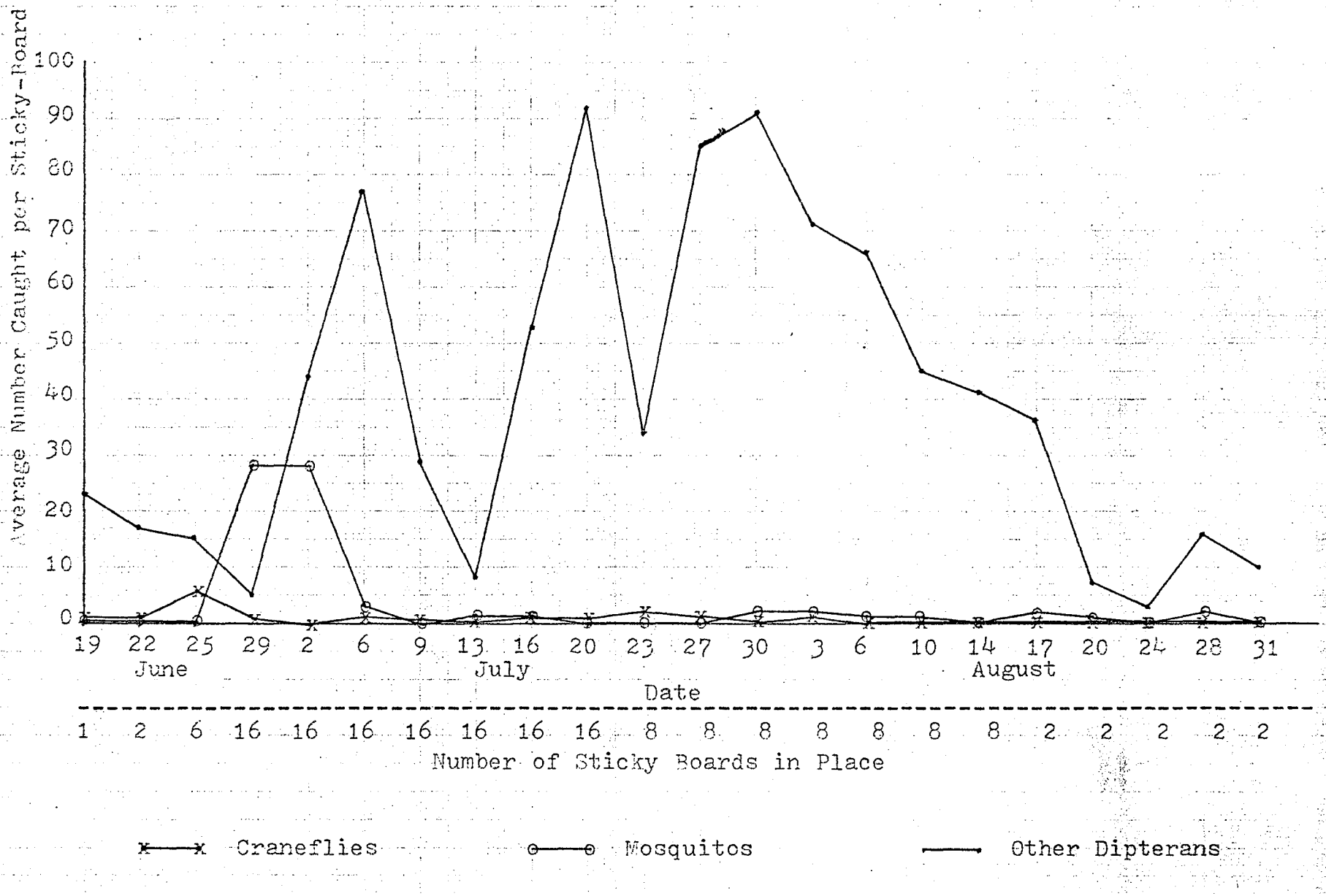


FIGURE 9. (cont.)

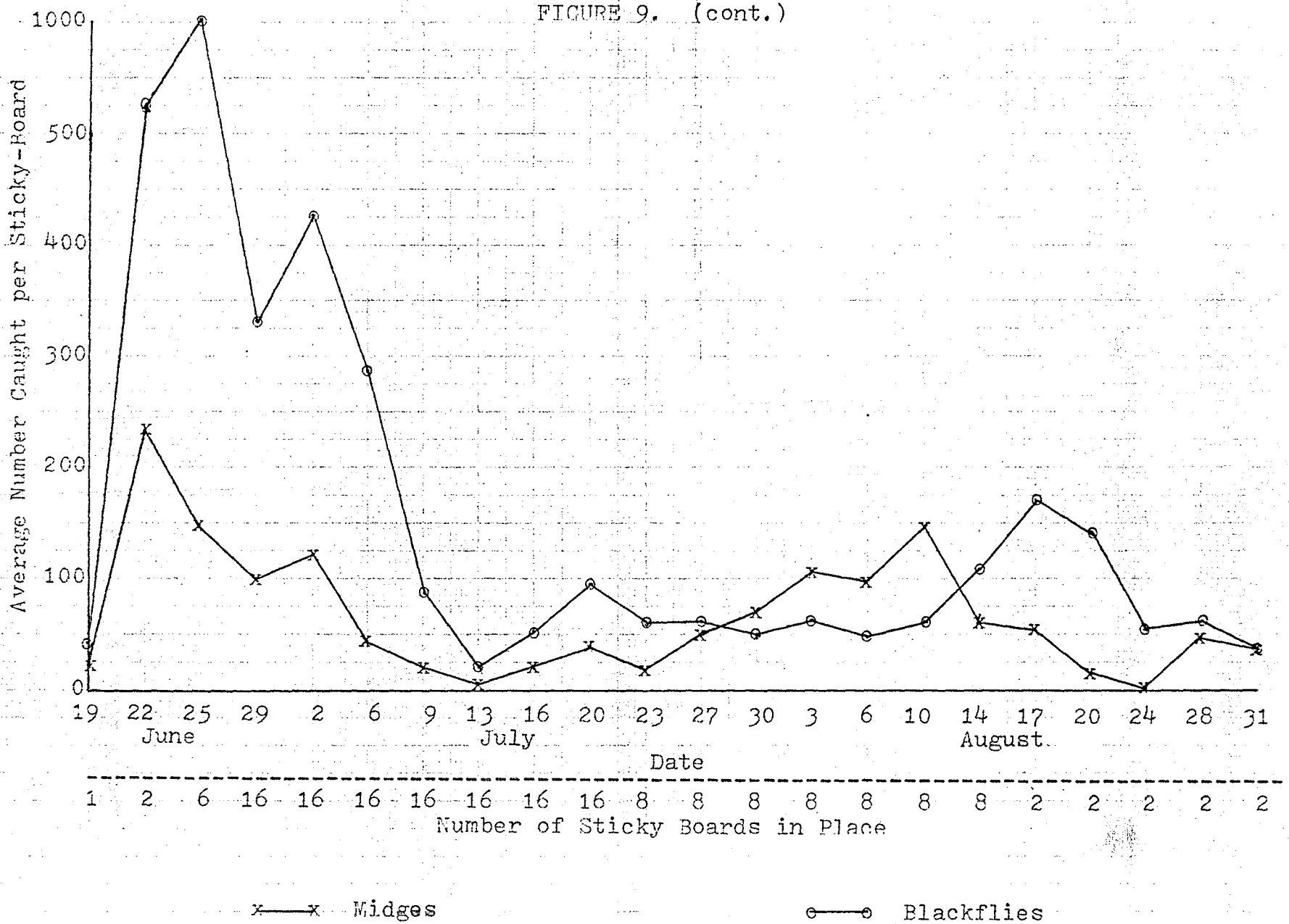


TABLE 22. Date and number of mammals seen on Study Area in 1971.

Date	Tundra Hare	Arctic Fox	Harbor Seal
May 22	4		
May 23	2		
May 30	2		
June 6	1		
June 8	2		
June 13	1		
June 19		1	
June 29		1	
July 2			1
July 3			1
July 14			1
July 21	1 young		
July 28	1 young		
July 29		1	
August 25			1
August 29	1 young		1
August 31			1
September 3			1
September 7			1

previous three years spent on the Yukon Delta. Hares were observed on nine different days. Two pregnant, adult females were collected in late May. I believe only one family resided on the Study Area. One young hare was seen three times, in July and August, all in one-half section of land.

Harbor Seals were spotted on eight occasions in the Kashunuk River around the south edge of the Study Area. Twice a single adult seal was seen resting on the north bank of the Kashunuk River.

No microtine rodents were seen on the Study Area in 1971. A trapline of 10 live and 10 snap traps placed at 100 foot intervals along a transect yielded no mammals during the period from August 1 to August 7. Ten traps were sprung--probably by passerines and by rain. The only animals caught were one Savannah Sparrow and one Lapland Longspur.

Estimation of Primary Terrestrial Productivity

Ten randomized, 0.1 sq. M. plots were clipped at ten day intervals from June 24 through August 25. Oven-dried weights for sedges, grasses, and the remaining vegetation are graphed in Figure 10. A further explanation of the results is presented in the Discussion.

Plant Nutrient Analyses

Two samples from the grass-sedge flats of the Study Area were analyzed for nutrient content. Each vegetation sample consisted of 20 randomized subsamples each 0.005 sq. M. The vegetation clipped for each sample was approximately one quart in volume after drying. The results of the analyses are given in Table 22. The first sample was taken at the peak of growth before fruiting; the second during development (late) of fruit.

Soil Nutrient Analyses

Five soil samples taken on August 31, 1971 were analyzed for nutrient contents. Each sample consisted of ten randomized subsamples each six cu. in. in volume. The results of the analyses are presented in Table 23.

FIGURE 10. Oven-dried weights of vegetation clipped from ten 0.1 sq. M. plots during 1971.

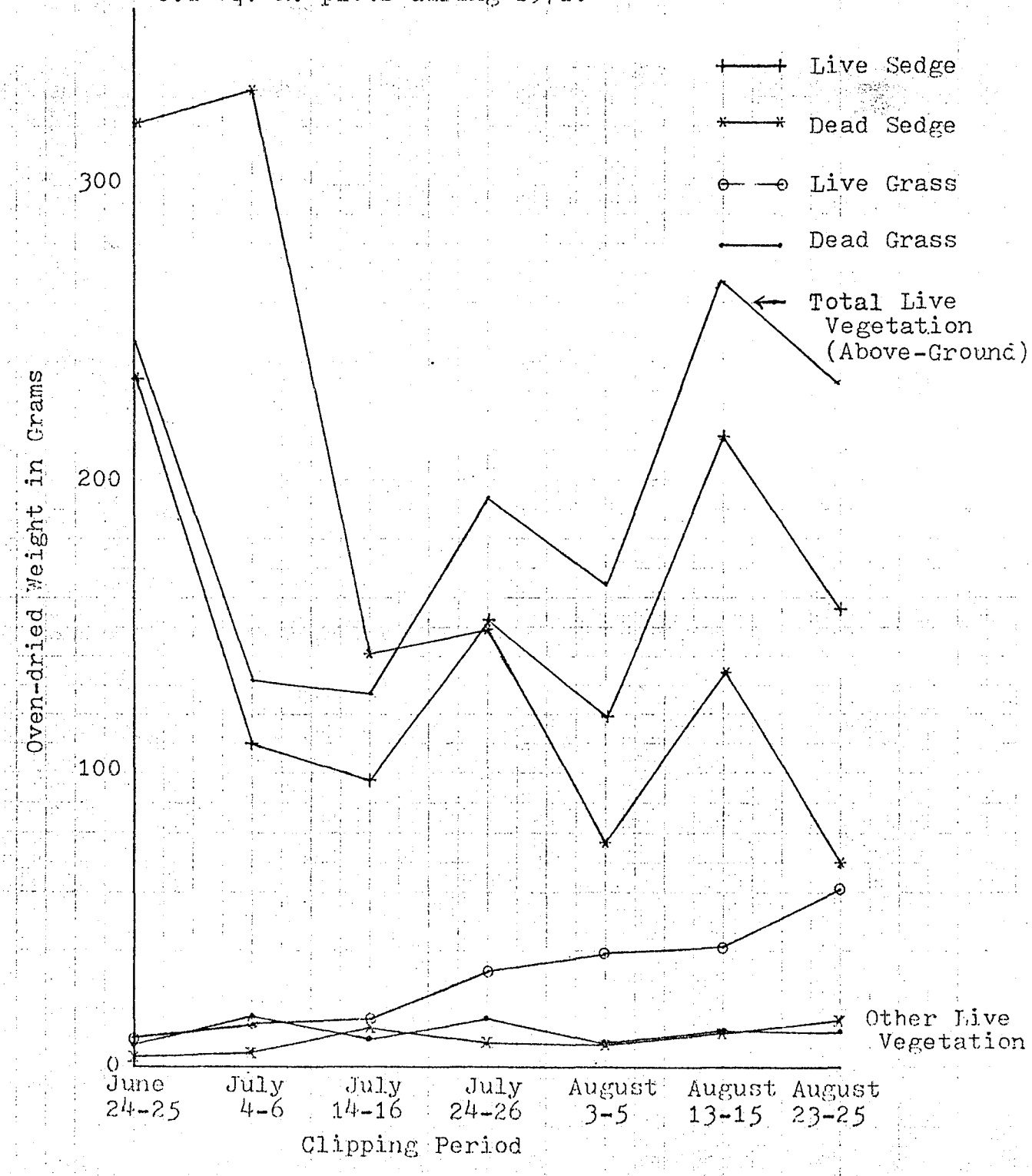


TABLE 23. Results of analyses of two vegetation samples taken from the Study Area in 1971.

Analysis* (in Per Cent unless otherwise stated)	Sample One	Sample Two
Caloric (cal/100 gm)	338	291
Moisture Content	1.5	0.9
Ash	4.8	5.8
Fiber	14.7	24.4
Protein	15.1	12.0
Carbohydrate	59.6	53.8
Ether Extract (Fat)	4.3	3.1
Nitrate (ppm)	<20	46.6
Nitrogen as NH_3^-	--	<0.1
Nitrite (ppm)	--	<1.5
P	0.49	0.27
K	2.5	2.1
Ca	0.11	0.058
Mg	0.29	0.28
Na	0.61	0.43
Al (ppm)	114	52
Ba (ppm)	6.0	<2.0
Fe (ppm)	320	215
Sr (ppm)	30	24
B (ppm)	13	17
Cu (ppm)	9.4	113
Zn (ppm)	26	27
Mn (ppm)	124	134
Cr (ppm)	<3.0	3.0
Dry Weight (gms)	12.50	26.75
Dates Collected	July 16-17	August 3, 5

* Conducted by WARF Institute, Inc., Madison, Wisconsin 53701

TABLE 24. Results of analyses of five soil samples taken from the Study Area on August 31, 1971.

Analysis*	Tundra	*Poa eminens*	*Elymus arenarius*	*Carex rariflora*	*Carex mackenziei*	Average
pH	5.3	6.5	7.1	6.7	6.3	6.4
Carbon (per cent)	6.2	7.2	5.7	5.2	11.8	7.2
P (ppm)	4.5	9.0	3.5	10.0	7.0	6.8
K (ppm)	97.5	188.5	236.0	168.5	184.5	174.6
Ca (ppm)	167.0	259.0	351.5	351.5	259.0	277.4
Mg (ppm)	292.5	514.5	606.5	564.0	482.0	491.6
Zn (ppm)	6.0	12.4	14.0	12.0	14.4	11.6
Mn (ppm)	14.0	73.0	222.0	240.0	17.0	113.2
Cu (ppm)	12.0	20.0	27.0	20.0	24.0	20.6
Na (ppm)	372.0	1728.0	1694.0	2232.0	3859.0	1976.0
Fe (ppm)	576.0	1008.0	1104.0	552.0	1008.0	849.6

* Analyses conducted by Department of Crop and Soil Science, Michigan State University, East Lansing, Michigan 48823

Mapping Vegetation

Vegetation on the Study Area was categorized into eleven groups and mapped during August, 1971. The completed map is given in Figure 11. A description of the vegetation types is given in Table 25.

DISCUSSION

General Observations

The late spring snow and ice conditions provided an unusual opportunity to observe birds whose migrations were delayed and to document the effect on waterfowl production. Spring migrants not seen in previous years included: Knots, Pomerine Jaegers, and Snow Buntings.

Other bird species recorded for the first time on the Study Area were: Aleutian Terns in late June, Hudsonian Godwits in late June and mid-August, a Cliff Swallow in late May, and a White-crowned Sparrow in late August. Twenty-eight bird species bred on the Study Area in 1971. The total number of bird species seen in the past three field seasons was 61. Only one Short-eared Owl was seen (on May 23). Their scarcity can be directly related to the overwinter crash of the microtine population. Surprisingly, more than the usual number of Parasitic Jaegers were seen. This year, for the first time in three years, two pairs of Parasitic Jaegers were known to nest on the Study Area. One pair was nest-trapped and color-marked to study their movements. The pair ranged over two square miles in the central Study Area.

Observations in previous years indicate that White-fronted Geese were the first species to arrive on the Study Area. The migrating geese seemed to follow the 35°F. isotherm. As soon as snow cover melted off the upland tundra they moved north and inland in pairs or in small flocks of less than seven birds. Whistling Swans also arrived early. Like White-fronted Geese, swans exhibited no peak in migration in 1971 and flew in pairs or in very small flocks. The first Cackling Geese reached the Study Area soon after White-fronted Geese. In 1971 the number of migrating Cacklers steadily increased to a peak on May 25, then gradually declined. Cackling Geese arrived in pairs or in flocks as large as 13 birds. Black Brant arrived on the Study Area several days after the first White-fronted Geese were seen. Brant moved onto the Study Area as pairs. However, flocks of 50 to 75 brant were seen flying north during the peak of migra-

FIGURE 11. Vegetation map of Onumtuk Study Area.

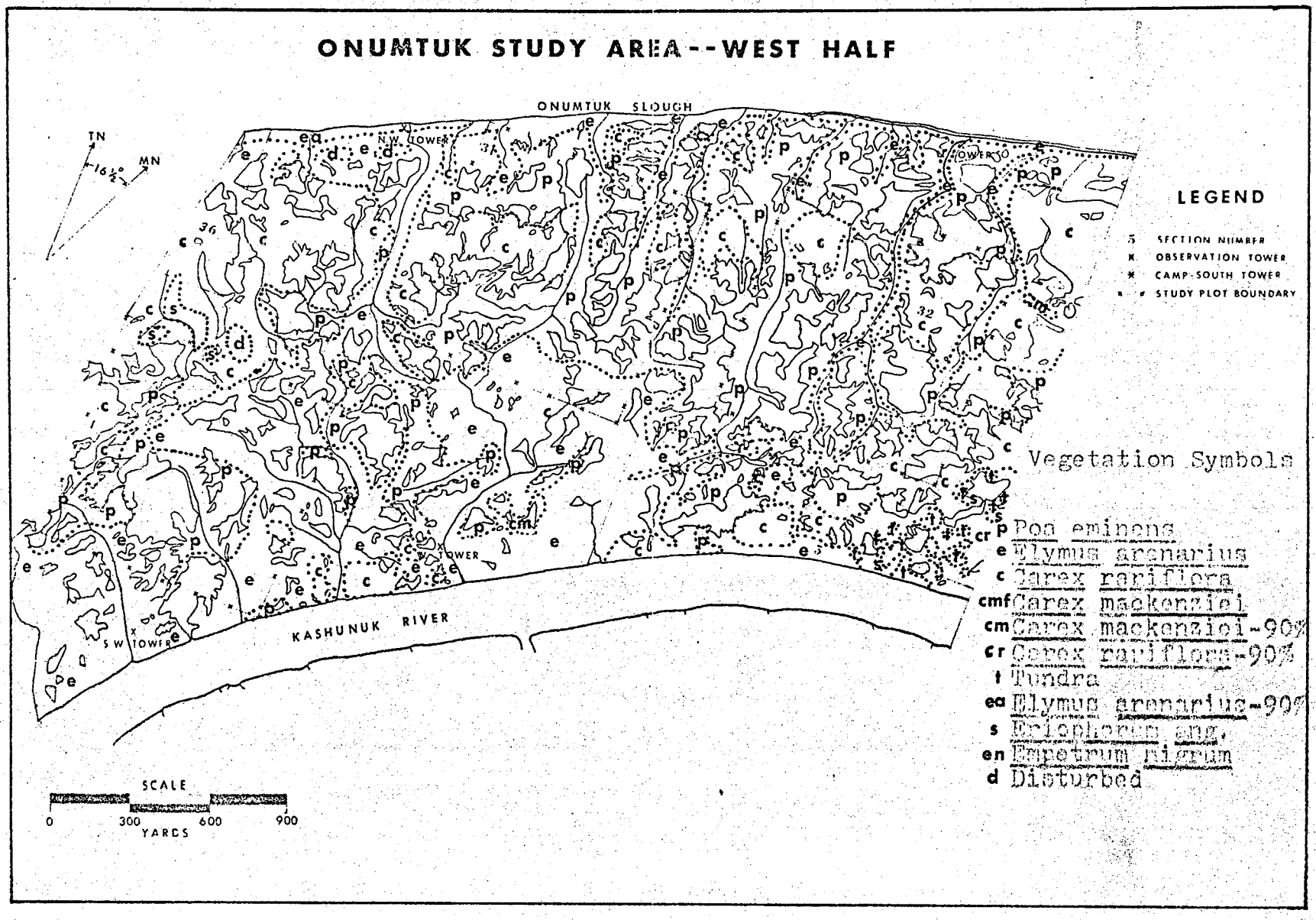


FIGURE 11. (cont.)

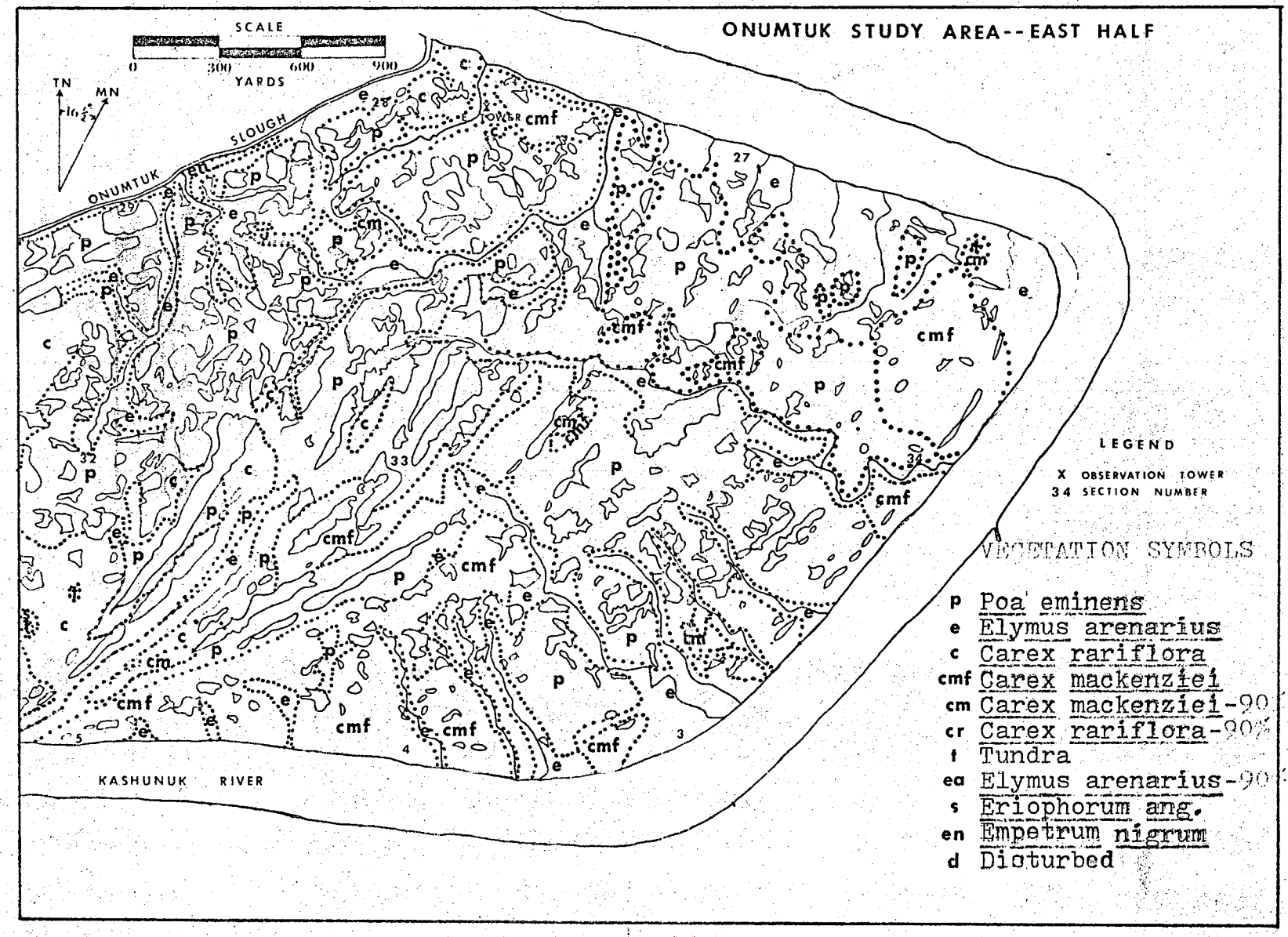


TABLE 25. Per cent occurrence of vegetation types on Study Area.

Vegetation Type (Dominant Species--Sub-dominant)	Per Cent Occurrence
Poa eminens--Carex rariflora, Calamagrostis deschampsiodes	39.61
Elymus arenarius--Calamagrostis deschampsiodes, Carex rariflora, Salix ovalifolia	31.00
Carex rariflora--Calamagrostis deschampsiodes, Festuca rubra, Salix ovalifolia, forbs	16.60
Carex mackenziei--forbs	9.66
Carex mackenziei (about 90 per cent)	1.19
Carex rariflora (about 90 per cent)	0.72
Tundra	0.43
Elymus arenarius (about 90 per cent)	0.37
Eriophorum angustifolium--Carex lyngbyaei, Carex aquatilis	0.14
Empetrum nigrum--Salix ovalifolia	0.14
Disturbed--forbs	0.14
Total	100.00

tion on May 27. The latest arriving species was the Emperor Goose. These birds arrived one week after White-fronted Geese. Although a few small flocks of three to 10 birds were seen flying north, most Emperors arrived as pairs.

Pre-nesting waterfowl use was related to the abundance of shallow, meltwater ponds along the south edge and eastern third of the Study Area. These were flooded in 1969 and 1971, and were used for resting, feeding, and copulating.

The number of mortalities recorded in 1971 was greater than in 1970. The increase in waterfowl predation by jaegers, gulls, and foxes may be due to a lack of voles as a buffer species.

Use of the Study Area as a feeding grounds by Bristle-thighed Curlews and Whimbrels continued in June and July, 1971. One adult Bristle-thighed Curlew was collected on June 26 for the Clarence Rhode National Wildlife Range Museum. The bird was a female banded near Lisianski Island, Hawai on September 1, 1967.

The fall migration of geese was not an abrupt departure. After broods reached flight stage and increased their fat reserves, families moved south. The usual southward movement of families of Emperor Geese and Cackling Geese across the Study Area was not observed this past fall. Departures were delayed as a result of the late spring and consequent late nesting and molting.

Resightings of Marked Cackling Geese

At least three one-year-old Cackling Geese were observed on the Study Area in 1971. One female was paired and nested. An attempt was made to nest trap her, but she deserted her four eggs, two of which were fertile. This was the first case of a yearling Cackling Goose nesting. Only one other case of a yearling goose (Branta canadensis interior) nesting has been reported in the literature (Hall and McGilvrey, 1971). Another yearling which may have been mated was seen on June 11 with three other Cacklers. The third yearling was a male seen on August 28 feeding with five other Cackling Geese. Lack of additional observations of yearlings indicates they summer off the Study Area at an undetermined location.

Resighting of marked adults near the site of banding indicates a strong tendency to return to the same or nearby nest site year after year. One adult hen has nested on the same pond three years in succession.

Behavioral Observations

As found in 1970, nest site selection appears to be correlated with the availability of suitably sized, dry islands or peninsulas in ponds with no other territorial geese nearby (within 40 yards?). Time of nesting appears to be dependent on the dryness of the nest site. The first nest started by a Cackling Goose in 1971 was located on an artificial island. The top of the island was 10 to 14 inches above the pond water and ice level, and obviously was not flooded by meltwater. Other nests started early in the nesting season were often located on islands six to 10 inches above the pond water level.

Defense of a nesting territory was commonly only by the male of a pair. The male can be recognized from its mate by:

1) a more erect posture and greater alertness

2) response to calls of other Cackler males and pairs; the male was usually the only bird to respond to these calls and was always first to answer a call

3) slightly larger size, particularly of the breast and head proportions.

These conclusions are based on observations of marked, paired birds.

The male defending an area, whether feeding or resting, will immediately assume an "erect" posture (described by Blurton Jones, 1960) when a Cackling Goose pair closely approaches or enters his territory. As the intruding pair comes closer to the male, he assumes a "bent-necked" posture (Blurton Jones, 1960) and will run at the intruding male in a "forward"(Blurton Jones, 1960) or "extended low-coil" (Klopman, 1968) posture. This aggressiveness by the territorial male is usually sufficient to chase off the intruding pair.

However, a more aggressive behavior, running in the "extended low-coil" position, then flying at the intruding male, has been observed. Often the female will fly with her mate while defending the area. After the aggressive encounter, the male returns to the female and "greets" (Klopman, 1961) her. The sequence of aggressive postures appears to be exactly the same as described by Klopman (1968) for Canada Geese.

The aggressive postures exhibited by a Cackler male towards other Cacklers, have been seen while a male defended his territory from an intruding Spectacled Eider pair on June 7, and

when another male defended his territory from three Emperor Geese on June 13.

Upon arrival on the Study Area, adult males defend only themselves and their mates. Once a nest site has been selected, the pair defend an area as large as 2100 sq. yds. The size of the territory may decrease as incubation progresses. After hatching, only a small area (20 feet in diameter?) around the mate and brood are defended.

Eleven copulations by Cackling Geese were observed in 1971. The mating behavior of Cackling Geese is quite similar to that described for Canada Geese (Klopman, 1962). However, the head-dipping behavior may be more vigorous as the male will submerge the entire head instead of only the bill.

Observations of the feeding behavior of Cackling Goose families were easily obtained while watching from my camp. Both adults and young paid little attention to flying insects. The adults would shake insects from the bill or head region. Geese consumed Carex rariflora and Carex mackenziei shoots and seeds primarily. However, the adults would occasionally sample Rumex arcticus leaves and eat the flowers of Chrysanthemum arcticum. The goslings were never seen taking chrysanthemums until August 24. A hen and a gosling were feeding side by side. The hen nibbled on a chrysanthemum flower and the young also began nibbling. Several minutes later this young began adding an occasional chrysanthemum flower to its diet.

Nesting

A total of 200 Cackling Goose nests were found on the Study Area in 1971. The nesting density was somewhat lower than in previous years (Table 26). Spectacled Eider nesting density was much lower than in 1970. The slowness of spring snow and ice melt-off reduced the number of available nest sites at the beginning of the nesting season. Some pairs may not have found suitable nest sites and therefore did not nest.

Average clutch size for incubated nests was normal for Cackling Geese, Emperor Geese, and Spectacled Eiders, but was low for Black Brant and White-fronted Geese. Average clutch size at hatching showed a greater reduction than in previous years. The greater loss of eggs can be attributed to more intense predation by Parasitic Jaegers and Glaucous Gulls.

Of the nests that were started in 1971, more than usual

TABLE 24. Number of nests, average clutch size, total eggs hatched, and nesting success for geese and eiders in 1969, 1970, and 1971.

	Cackling Geese			Black Brant			Emperor Geese		
	1969	1970	1971	1969	1970	1971	1969	1970	1971
Total Nests Started	225	226	200	30	38	36	20	19	20
Average Incubated Clutch	4.60	4.64	4.51	3.93	4.29	3.37	4.90	4.53	4.20
Total Successful Nests	142	136	127	4	9	18	18	13	20
Total Eggs Hatched	644	612	504	18	38	49	88	58	80
Average Clutch Hatched	4.53	4.50	3.97	4.50	4.22	2.72	4.88	4.46	4.00
Per Cent Success	63.1	60.2	63.5	13.3	23.7	50.0	90.0	68.4	100.0

	White-fronted Geese			Spectacled Eider		
	1969	1970	1971	1969	1970	1971
Total Nests Started	25	23	17	40	70	32
Average Incubated Clutch	4.64	5.30	4.11	4.11	4.80	4.83
Total Successful Nests	20	21	14	21	49	16
Total Eggs Hatched	86	102	49	83	235	69
Average Clutch Hatched	4.30	4.86	3.50	3.95	4.79	4.31
Per Cent Success	80.0	91.3	82.3	52.5	70.0	50.0

were successful. The shorter nesting season may have discouraged birds which lacked a strong nesting drive.

Three Black Brant nests were found in the eastern third of the Study Area. Brant have never nested there before, thus the nests represent new pioneer nesting.

As in previous years, a much greater percentage of Cackling Goose nests were on islands. These nests suffered less predation than those on peninsulas or shores where foxes have access (Table 14). Also, clutch sizes for island nests averaged 0.25 eggs larger than for nests on other sites. Thus, the most productive nests were located on islands.

Some Cackling Geese return to the same nest site to nest each year. From Table 9, almost one-third of the 1971 Cackling Goose nests were located in or near a nest site previously used by a goose or eider. Also, 14 Cackling Goose nests of 1971 were located in the same Cackling Goose nest form used in 1969 and reused in 1970. Unfortunately, none of the hens on the 14 nests were color leg-banded, thus whether the same individuals nested three consecutive years is unknown.

The peak of hatching for Cackling Goose eggs was July 6 and 7 (Table 11) or 9 to 12 days later than in 1969 and 1970. Almost 80 per cent of the eggs hatched in a five day period in 1971 compared with an eight day period in both 1969 and 1970. Only two 1971 nests hatched late, suggesting that they may have been renesting attempts.

The nesting cycle from time of nest construction to hatching of eggs averaged 31 days for Cackling Geese. This includes an average incubation period of 26 days. The first egg laid in 1971 was on June 3; the last nest to hatch was on July 18. The length of the 1971 nesting period for Cackling Geese was 46 days. The nesting period lasted 62 days in 1969 and 63 days in 1970.

Study Plots

The three study plots provided useful information on the effect of human disturbance on nesting geese. All three plots were not visited until clutches were complete. Plot one, whose boundary is 175 yards from my camp (Figure 3), had the lowest density of nesting Cackling Geese. Plot three, two miles from camp, had the highest density. A similar situation was recorded in 1970.

Plot one, which was the least frequently visited plot (Table

15), had the lowest percentage of successful nests of the three plots. The reverse would be expected if human disturbance was a factor inducing predation. My activities around camp, and checking nests around plot one and nearby plot two, may have disturbed nesting geese. However, casual observations of geese in plot one did not reveal any hens leaving their nests while I worked outside the plot.

Plot three, which was visited at a moderate intensity, exhibited an abnormally high nesting success for Cackling Geese. The increased success could be the result of having no Glaucous Gull nest (and consequent egg predation) along the south edge of the plot in 1971. A pair of Glaucous Gulls had nested there both in 1969 and 1970. The pair of gulls apparently destroyed many of the Black Brant nests found in the large lake in the extreme southwest Study Area. In 1971, both Black Brant and Cackling Geese had a higher than normal nesting success with fewer of their nests in the southwest being destroyed.

It is interesting to note that plot two, the most frequently visited plot, had a higher nesting success than did all the Cackling Geese on the entire Study Area. This was not the case in 1970 when the most visited plot (one) had a success 7.6 per cent below that for the entire Study Area. Also, plot two has had no nesting Glaucous Gulls during the 1970 and 1971 field seasons.

I conclude that human activities within one-third mile of geese selecting nest sites does reduce goose nesting density. Disturbance of nesting geese, where Glaucous Gulls are also nesting, may increase egg losses.

Artificial Nesting Islands

The three artificial islands constructed in 1970 were designed to simulate the typical island used by nesting Cackling Geese. Vegetation placed as sod on the islands was sufficient for nesting in June, 1971. However, two of the islands were tilted and had pieces of sod washed away. The third island, which was also tilted, was used by a Cackling Goose as a nest site. The hen was nest-trapped and color banded. Hopefully, she will return in 1972 to nest on the same island.

The two damaged islands were repaired in August, 1971. All three islands had good growths of vegetation suitable for nesting in 1972.

One new artificial island was built in 1971. This was located two-thirds mile northeast of camp on a pond with no natural

islands.

The use of an artificial island indicates that Cackling Goose nesting habitat can be created and nesting densities (at least in low quality habitat) can be increased.

Broods

Data collected on broods have been limited to brood size counts. However, on July 19, a clear day with good visibility, I climbed the six observation towers to census the Study Area. It was difficult to determine whether all pairs seen had broods. Undoubtedly some broods along the southeast Study Area were missed. The count was made so that no broods could be counted twice. In Table 27 are the results of the census. If the broods counted are compared with the number of successful nests as given in Table 12, there is a movement of Cackling Geese, Black Brant, and White-fronted Geese off the Study Area. Apparently there is a movement of Emperor Goose broods on to the Study Area. A similar movement was evident during the 1970 brood season.

Average brood size from class Ia to class F indicates a loss of 0.6 young per Cackling Goose brood and a loss of 1.1 young for Emperor Goose broods. Looking at the average brood sizes shown in Table 16, there is a sharp drop in size of Cackler broods in the class Ib to II period. Goslings in this period are 10 to 20 days old. At this age they are still susceptible to predation by Glaucous Gulls. However, Emperor brood sizes drop in the class III group (age about 50 days). Emperor young of this age are normally safe from Glaucous Gulls. Thus, the loss of Emperor young can not be entirely attributed to avian predation. Perhaps the larger Emperor broods moved off the Study Area due to a change in food habits. At this time crowberries and cloudberries (Rubus chamaemorus) were ripening. Most of these berries were found just south of camp and to the east of the Study Area on tundra. Since the larger Emperor broods were seen along the periphery of the Study Area, these birds may have left, to feed on berries, before other broods.

Nest Trapping

Nest trapping efforts were devoted to catching Cackling Geese whose nests were nearby camp or the observation towers. Four bow-net traps with extra long trip cords were used. Only 13 hens were captured. More would have been caught, but at

TABLE 27. Results of goose brood counts made from six observation towers on the Study Area on July 19, 1971.

Species	NW	N	E	S	W	SW	Totals
			Towers				
Cackling Goose	24	22	6	17	8	13	90
Black Brant	2	0	0	11	0	1	14
Emperor Goose	0	3	7	20	0	0	30
White-fronted Goose	1	1	0	2	0	0	4
Totals	27	26	13	50	8	14	138

least one Parasitic Jaeger was destroying eggs in nests with traps. Sixteen nests were destroyed as a result of nest trapping.

Banding and Marking

A greater number (261) and a greater percentage (51.8) of Cackler goslings were web-tagged during 1971 compared with 1970 and 1969. Hatching dates for eggs were calculated using the egg flotation technique (Westerkov, 1950) of estimating incubation stage. As many nests as possible were visited on the date the eggs were predicted to hatch.

Two banding drives on the Study Area yielded a catch of 50 Cackling Geese of which eight were web-tagged young. Two drives conducted off the Study Area yielded a catch of 60 more Cacklers. The reduced catch can be attributed to lack of manpower, fewer drives, and size of the drive area being too large for Cackling Geese. Broods can seldom be driven more than one-half mile. The Cackling Geese will stop and hide in tall grass or in sloughs, then escape between the drivers. The solution to the problem of low catches seems to be a reduction of the area driven, and conducting more drives.

Banding returns from seven Cackling Geese indicate that Cacklers from my Study Area migrate to northcentral California by November. They gradually move further south in late November and in December. Apparently, wildlife refuges are extensively used by wintering Cackling Geese. The estimated wintering population of Cacklers numbers close to 300,000 (pers. comm., E.J. O'Neill).

Captive Birds

Captive geese held at Old Chevak were useful for correlating age and feather development. Despite their almost unlimited diet of dog food, they reached flight stage one week behind unpenned wild birds of the same age. Lack of exercise may explain the delay. Their growth did appear to be normal. All geese rapidly gained weight until their primaries broke through the sheaths. Once the flight feathers were fully developed, the birds again gained weight.

Young, unpenned, Cackling Geese reached flight stage in 40 to 46 days. Another six to 12 days were required for geese to gain fat reserves and flight experience before migrating south. Thus, the total minimum time young spent on the Study Area was 46 days.

Food Habits

Feeding observations and studies of crop and gizzard contents of Cackling Geese suggest that adults (before time of new vegetation growth) fed on seeds and roots of Carex rariflora, Carex mackenziei, Poa eminens, and probably some Elymus arenarius. When green shoots of Carex spp. and Poa eminens were available, these were heavily grazed. Both young and adults grazed green sedge shoots until seed heads were formed; then these became the predominant food. Once crowberries ripened, there was a shift in diet. Birds grazed sedges and ate berries until they departed on their southward migration.

More study of the food habits of goslings during their first ten days is necessary to determine if insects are taken. From the insect sticky-board data of 1971 (Figure 9), crane-flies, mosquitos, and midges were not common during most of the 10 day period following the peak of hatching on July 6 and 7.

Young captive goslings, particularly a Black Brant, would readily take flying mosquitos which were attracted to any human entering their pen at Old Chevak. Collection of very young wild goslings will be necessary to answer the question of how much insects are a part of their diets.

There appeared to be little competition for grazing areas among goose species. Cackling Goose families grazed sedges in large expanses of the sedge vegetation types, especially Carex rariflora. Emperor Geese preferred to graze short sedges along the edges of ponds. Fewer seed heads were taken by Emperors. Some conflict may have occurred when both species and Black Brant grazed the very short sedges in the few tidal ponds where sedges were growing. Black Brant generally fed on sedges along the Kashunuk River bank. Food habits of White-fronted Geese were not studied. However, this species was commonly seen in the taller grass species--Poa eminens, and Elymus arenarius.

Insect Abundance

The sticky board technique proved quite useful for determining the relative abundance of flying insects. Mosquitos, midges, and blackflies were common during the last of June and in early July, when the warmest summer temperatures were recorded. The insects categorized as "other Dipterans" included houseflies. They appeared to be oversampled as few were seen except on sticky-boards. Unfortunately, mosquitos were able to extricate themselves from sticky-boards. Estimations of their daily abundance

indicated that most were seen during early and late July, and early August. They were most bothersome (to humans) on humid days with little wind. Another problem with sticky-boards was that crawling insects and spiders were not sampled. Crane-flies were more abundant than suggested by the sticky-board catch. Perhaps several plots could be watched for timed periods to determine abundance of crawling insects during the 1972 field season.

Abundance of Mammals

The summer of 1971 was the low in the microtine population cycle and the high in the Tundra Hare population. Probably due to a lack of Microtus oeconomus, Arctic Foxes were not common. No Red Foxes were seen on the Study Area. One was seen two miles to the north in July.

Primary Terrestrial Production

The graphs for live vegetation production in Figure 10 show an initial period of rapid growth, followed by a decline, an increase, and finally a decline in growth. Clearly, there was a problem in the sampling design--not enough 0.1 sq. M plots were clipped to give reliable data. The high values for the first clipping period were probably the result of misclassifying some greenish sedge shoots which were not living matter produced in 1971. The July 24 to 26 and August 13 to 15 peaks for sedge growth were due to an abundance of Eriophorum angustifolium (cottongrass) in the sample plots.

Disregarding the figures for the first clipping period, the total above-ground production averaged 187 grams (dry weight)/sq. M. per 10 day period. Peak production (over 250 gms./sq. M.) was reached in early August, before fruits had fully developed. Carex rariflora, Elymus arenarius, Poa eminens, Carex mackenziei, and Eriophorum angustifolium accounted for the majority of production.

Preliminary data indicate that above-ground primary production was almost twice as great as 1970 values calculated for the Barrow, Alaska region (Brown and West, 1970). Also, time of peak production agreed with that for Barrow in 1970. However, the shortened growing season on my Study Area in 1971 was still a few days longer than the 1970 growing season at Barrow. Additional field work involving a larger number of plots may provide more reliable data to compare with other arctic and alpine production figures.

Plant Nutrient Analyses

Comparision of two, pooled samples of vegetation analyzed for nutrients has shown some trends in nutrient content. The two analyses showed a drop (from mid-July to early August) in all nutrients except nitrate, B, Cu, Al, Mn, Cr, and the ash and fiber contents (Table 23). The decline in nutrients can be correlated with production of fruit and possible onset of greater nutrient storage in underground parts of plants during early August. A similar trend was reported for nitrogen and phosphorus contents of foliage collected at Barrow, Alaska in mid-July and early August, 1970 (Brown and West, 1970).

In Table 28 nutrient analyses of vegetation (all species sampled) collected from my Study Area on July 16 and 17 are compared with a sedge species, Eriophorum angustifolium collected at Barrow on July 15, 1970. Analysis techniques were similar for vegetation from both sites. From two to 40 times as much macronutrients were found in the sample from my Study Area compared with that from Barrow. Comparable data (which is in press) for the Barrow region in 1971 and for the eastern Arctic will be of use to better determine the quality of vegetation on the Yukon Delta.

Soil Nutrient Analysis

Soil tests in 1971 indicate the soil types on the Study Area consist of loams and silty-loams with high organic contents. The phosphorus content of the soil samples was very low as was the calcium content (Table 24). Both the magnesium and iron values were high; magnesium may occur in amounts approaching toxicity.

For comparative purposes, results of soil tests conducted on loam soils from Barrow and from the Study Area are presented in Table 29. Soils on the Study Area have from 40 to 200 times the nutrient concentrations at Barrow.

The higher nutrient content of both the soil and plants on my Study Area compared with Barrow is related to the land formation and climate of the two areas. The Barrow region is tundra. The soil is poorly drained and is frozen for a longer time compared to soil on my Study Area. Chemical alteration of minerals and plant decomposition is slower in tundra regions. In contrast, the Study Area is a floodplain with silty organic soil which is thawed for long periods in the summer. The active thawed zone is also deeper than at Barrow. In addition, the

TABLE 28. Comparison of plant nutrient analyses in mid-July at my Study Area (1971) and Barrow (1970).

Nutrient	Content (grams per sq. M) Study Area*	Barrow**
P	0.61	0.030
K	3.12	0.155
Ca	0.12	0.023
Mg	0.36	0.022
Fe	0.04	0.001
Zn	0.003	0.001
Mn	0.015	0.002

* For foliage of all plant species sampled

** For foliage of Eriophorum angustifolium only (average of six samples) from Brown and West (1970)

more abundant bird life on the Yukon Delta provides a greater amount of fertilizer. Consequently, plant production and nutrient content are higher.

Mapping Vegetation

From Table 25, the Poa eminens vegetation type is the most common on the Study Area. However, Carex rariflora is the most abundant plant species as it occurs in several vegetation types. Elymus arenarius is another common species found in the more saline areas, especially along banks of sloughs. Sedge-grass meadows account for 99.5 per cent of the total vegetated area. Tundra makes up the remaining 0.5 per cent.

A total of 3.21 sq. mi. (76.1 per cent) of the Study Area is terrestrial vegetation. The remaining 1.02 sq. mi. consists of ponds and sloughs. Most of the ponds have Hippuris tetraphylla (mare's tail) growing along the shoreline in shallow water. In the middle of the ponds, in deeper water, Potamogeton filiformis and Potamogeton pectinatus are the common species.

The majority of Cackling Goose nests, Black Brant nests, and Spectacled Eider nests are on ponds surrounded with either of two vegetation types--Carex rariflora or Poa eminens. Emperor Goose nests may be found in any vegetation type. White-fronted Geese and Whistling Swans nest on tundra or in the Elymus arenarius vegetation type.

TABLE 29. Comparison of soil tests on my Study Area in 1971 with soil tests at Barrow in 1970.

Test (ppm)	Study Area*	Barrow**
K	174.6	1.28
Ca	277.4	8.94***
Mg	491.6	3.93***
Na	1976.0	10.66
Fe	849.6	3.48
Mn	113.2	0.40
pH	6.4	6.4

* Average of 5, pooled-samples

** Average of 3 samples of clay loam soil (Brown and West, 1970)

*** Data available for only 2 samples

Additional Information Not Summarized

1. summary and analysis of goose measurements
2. analysis of egg measurements for all waterfowl species--size range per species, size range per clutch, and size correltation with fate of egg
3. analysis of nest site preference by each waterfowl species and correlation of nest site with availability of nest sites
4. territory size as indicated by distances between nests
5. analysis and summary of nest dimensions
6. analysis and summary of nest vegetation

Most of this work will be completed this winter after transferring all data to computer files.

Plans for the 1972 Field Season

The following is a list of questions concerning Cackling Geese which may be partially answered by conducting one more summer of research:

1. What is the degree of fidelity exhibited by a pair for a particular nest site or area?
2. What per cent of the first year breeders return to their hatching grounds?
3. What per cent of Cackling Geese breed as one-year-olds, as two-year-olds, and as three-year-olds?
4. What per cent of the late nests are renests?
5. Over how large an area do broods move before gaining flight?
6. Is there a molt migration by non-breeders?
7. Is there a differential spring migration for various age groups?

All of these questions can be answered by observing

individually marked birds. Much of May and June will be spent watching for marked geese.

Pre-Nesting and Nesting

I plan to continue taking observations on bird migration, and recording bird species seen each day. Individual Cackling Geese from odd-numbered, migrating flocks will be shot. These birds will be weighed, measured, sexed, and aged. Hopefully, some yearling birds will be collected in this manner. Daily activity of Cackling Geese will be noted--especially nest site selection, copulatory behavior, and territorial defense behavior.

Once nesting is initiated, the Study Area will be systematically searched for nests. Information similar to that collected in previous years will be recorded for each nest found. Nesting hens will be observed to determine if any are color-banded. An attempt will be made to induce renesting by destroying several nests of marked Cacklers. All nesting Cackling Geese will be removed from an 0.125 square mile area. This area will be watched to see if nest sites are again chosen by geese nesting later in the season. Any new nesting geese will be removed to determine their age. By removal shooting, more data can be gathered on the minimum breeding age of Cackling Geese. The three Cackling Goose study plots will be maintained to evaluate the effects of human disturbance. Artificial nesting islands will be checked for nesting waterfowl.

No Cackling Geese will be nest-trapped, therefore more time can be spent observing color-banded geese. Several nesting pairs of Glaucous Gulls and Parasitic Jaegers will be nest-trapped for color marking. These predatory birds will be observed to evaluate their predations on goose eggs, and to determine the size of their feeding areas.

One 80 acre plot will be set aside as a census area for all nesting birds. A tally of birds seen and nests found will be made twice during the nesting season.

I also plan to hire an assistant. He can check nests while I watch from a blind. In this manner I can observe the effect of human disturbance on nesting geese--record goose behavior, and any predation.

Brood Season and Fall Migration

Cackler goslings will be web-tagged while in or near nests. Time will be spent observing broods of color-banded geese in order to study brood movements.

Brood counts will be made throughout the summer following hatching. Census of geese will be attempted from the six observation towers.

Daily activity of broods will be observed, with special attention to feeding behavior and food habits during the first three weeks of the brood season. Goslings will be sacrificed for a food habits study. At regular intervals, young Cacklers will be captured, measured, and released. Their measurements will be compared to those of known-age, captive goslings.

Incidental Information

A census of all birds on 80 acre plots will be conducted several times throughout the summer. Information on weather, depth to permafrost, snow and ice conditions, birds seen, mammals seen, and abundance of insects will be recorded each day of the study.

The following will be recorded for each goose captured or found dead: date, time, location, sex, age, weight; bill, tarsi, and wing measurements, and plumage characteristics. In addition, ingested food of dead birds will be collected.

Energy Budget Study

With the help of an assistant an attempt will be made to estimate the total energy budget of the Study Area.

Primary production will be estimated by clipping at 10 day intervals the vegetation in 25 plots each 0.1 sq. M. Plots will be randomly located so that both terrestrial and aquatic plants are clipped. The clippings will be separated into grasses, sedges, and forbs; weighed, dried, and reweighed.

In addition, several vegetation samples will be analyzed for nutrient content, caloric content, protein, fat, and carbohydrate percentage.

Twenty water samples will be taken for chemical analyses.

Vole population size and composition will be estimated by trapping along a transect at bi-weekly intervals throughout the summer.

Vegetation removed but not consumed will be estimated by sampling nest materials of birds, voles, and hares.

Insect populations will be studied by observing insects on one sq. M plots for given time periods. Also, eight sticky-boards will be used to sample abundance of flying insects. At ten day intervals, ten, six-inch soil cores will be examined for Arthropods.

Fish populations will be sampled using traps and nets.

Consumption of vegetation by herbivores will be estimated from published data.

Data on avian populations will be gathered during the normal course of the study.

The energy budget study will be the first for a waterfowl breeding area and should provide meaningful results for comparison with other arctic areas.

Summary and Conclusions

This progress report covers observations on the 1971 Cackling Goose breeding season. The four-square-mile Study Area was located 20 miles south of Hooper Bay on the Yukon-Kuskokwim Delta, Alaska. My primary interests of the 1971 study were to document: nesting phenology, nesting densities, waterfowl production, and effect of predation on waterfowl, especially Cackling Geese. Secondary objectives included: observations of territorial, copulatory, and feeding behavior of Cackling Geese; determination of flying insect, and mammal abundance; observations on food habits of geese, estimation of primary terrestrial production, and collection of soil and vegetation samples for nutrient analyses.

General observations indicated the 1971 breeding season was delayed 10 days by late snow and ice melt-off as a result of cloudy, cool weather in May. Consequently, nesting, hatching, molting, fledging, and migrating were also delayed about 10 days. Arrival of the first geese in the spring of previous field seasons was related to the appearance of food and the exposure of nesting cover on tundra. White-fronted Geese were the first waterfowl species to arrive on the Study Area, Whistling Swans were the second, followed by Cackling Geese, Black Brant, and Emperor Geese. Most swans and geese were first seen as single pairs. Only Cackling Geese, Black Brant, and Emperor Geese had a peak in the 1971 spring migration over my Study Area. Once geese arrived they fed, loafed, and mated in areas covered by shallow meltwaters. These flooded areas were located along the south edge and the eastern third of the Study in 1969 and 1971. Geese in 1970 utilized a flooded area on the south bank of the Kashunuk River south of camp.

Seven new species of birds were recorded on the Study Area in 1971--raising the total tally to 61 bird species seen in the past three summers. A minimum of 26 bird species have nested on the Study Area each year of my study.

The number of bird mortalities in 1971 was greater than in 1970. The increase in predation on waterfowl may have been due to a lack of Tundra Voles as a buffer species.

In 1971 19 color-banded or marked Cackling Geese were observed. The most notable marked bird was a yearling female which nested and produced four eggs, two of which were fertile. This was the first case of a yearling goose breeding. Resightings of marked adults near the site of banding indicated a strong tendency to return to the same or nearby nest site year after year.

Behavioral observations made on Cackling Geese have shown that Cacklers copulated about one week before nesting commences. Pairing and courtship behavior did not occur on the Study Area. Nesting began as soon as dry nest sites were available in ponds with no other territorial geese. Once a nest site was chosen by the pair, the male defended from other waterfowl an area as large as 2100 square yards. Size of the territory declined through the remainder of the breeding season.

An average density of 71 goose (50 Cackler) nests per square mile was recorded in 1971, while the average was 76 (56 Cackler) in both 1969 and 1970. The delay in the breeding season plus human activity near geese selecting nest sites reduced goose nesting densities in 1971. Clutch sizes were slightly lower in 1971 than in previous years. The frequency of the clutches with seven and eight eggs was markedly lower. The shortened nesting period may have induced a premature end to egg laying in 1971.

Cackling Geese exhibited a remarkable degree of breeding synchrony. Data collected on hatching dates indicated that 80 per cent of the eggs hatched in a five day period in 1971 and in an eight day period in 1969 and 1970.

Most Cackling Goose nests were located on islands. These nests suffered less predation, and had larger clutches, hence greater production than nests located on other sites.

The length of the nesting cycle (egg-laying to hatching) for Cackling Geese averaged 31 days for all three years of the study. The Cackling Goose nesting period, date the first egg was laid to the date the last nest hatched, was 46 days in 1971 compared with 62 days in 1969 and 63 days in 1970.

Construction of artificial nesting islands in low quality habitat can increase the nesting density of Cackling Geese. One of three artificial islands was used as a nest site in 1971.

The most significant cause of egg loss was predation by Glaucous Gulls. Human disturbance of nesting geese, especially near a Glaucous Gull nest, increased predation on goose eggs. Glaucous Gulls, and especially Parasitic Jaegers, did learn to follow a human who was checking nests, nest-trapping geese, or moving through a nesting area. The jaegers would peck eggs in unattended nests as near as 80 yards from the human.

Nesting success has been relatively constant in the past three breeding seasons for all goose species except Black Brant. Brant have had increasing success possibly as a result of the decline in nesting pairs of Glaucous Gulls.

Average clutch size at hatching for Cackling Geese was 3.97 in 1971 and an average of 3.4 young reached flight stage. Goslings gained flight in a minimum of 40 days after hatching.

Cackler broods after hatching moved to nearby feeding areas (sedge vegetation) on the Study Area or to the south, west, or north. Brood census figures and recaptured marked young indicated that only three-fourths of the Cackler broods which hatched on the Study Area remained there. In contrast, Emperor broods moved from the south and east on to the Study Area.

Little competition over feeding areas existed between Cackling Geese and Emperor Geese. Cacklers preferred shoots and seeds of Carex rariflora and Carex mackenziei, while Emperor families commonly grazed the short sedges along shores of ponds.

A total of 261 Cackler goslings were web-tagged, 13 hens neck-ringed and color-banded, and another 110 Cacklers color leg-banded in 1971. The most effective method of capturing geese was by drive-trapping an area of about one square mile with a minimum crew of four.

Banding returns from Cackling Geese banded on the Study Area show that Cacklers arrived in the Lower Klamath-Tule Lake National Wildlife Refuge system in November. These birds remained in the vicinity through November and early December before moving further south in California.

Primary, terrestrial, above-ground production reached its peak in early August (over 250 grams/sq. M.). Carex rariflora, Elymus arenarius, Poa eminens, Carex mackenziei, and Eriophorum angustifolium accounted for the majority of production.

Soil tests run in 1971 indicated that loams and silty-loams with high organic contents made up the soils of the Study Area. Phosphorus was found to be in low quantities. Magnesium was in amounts approaching toxicity.

Two plant nutrient analyses in 1971 reflected the soil conditions. High percentages of magnesium, manganese, iron, and sodium were found. Phosphorus was in low quantities and appeared to be the macronutrient limiting plant production.

The Study Area is composed of 76.1 per cent terrestrial vegetation of which 39.6 per cent is in the Poa eminens vegetation type. Carex rariflora is the most abundant plant species. The sedge-grass meadows account for 99.5 per cent of the total terrestrial vegetation; tundra composes the remainder.

Cackling Goose, Black Brant, and Spectacled Eider nests were associated with the Poa eminens and Carex rariflora vegetation

types. White-fronted Goose and Whistling Swan nests were commonly found on tundra or in Elymus arenarius. Emperor Geese nested in all vegetation types.

Additional data collected in 1971, but not yet summarized and analyzed includes: measurements of geese and their eggs, description of nest sites, and occurrence and frequency of nest vegetation.

The 1972 field research will repeat much of that for 1971. Migrating Cackling Geese in odd-numbered flocks will be collected in an attempt to gather more data on yearlings. Removal shooting of nesting geese will be conducted to determine minimum breeding age of Cackling Geese and to correlate late nests with the age of the breeders. Nests of several marked birds will be destroyed in an effort to induce renesting. Geese of all ages will be collected for a food habits study. With the help of an assistant more information on the effect of human activity on nesting geese will be determined, a greater number of vegetation production plots will be clipped, and better sampling of microtine and insect populations will be possible. Additional data on fish populations and avian populations will be collected as part of an energy budget study for the Study Area.

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