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AN EVALUATION OF PRODUCTIVITY AND MORTALITY

FACTORS INFLUENCING GOOSE POPULATIONS

-- a status report of the 1984  
waterfowl monitoring effort  
at Old Chevak field camp

by

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Pacific white-fronted geese

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P.O. Box 346, Bethel, Alaska 99559

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## I. Introduction

During spring and summer 1984 data were obtained from nine field camps located on the Yukon Delta National Wildlife Refuge (YDNWR): one cooperative camp and eight refuge camps. This report documents methodologies used at the Old Chevak field camp. Additionally, this report describes the daily weather conditions; the chronology of snow-melt; the arrival, harvest, production and habitat utilization by Pacific black brant (Branta bernicla nigricans), cackling Canada geese (B. canadensis minima), emperor geese (Chen canagica) and Pacific white-fronted geese (Anser albifrons frontalis) at the Old Chevak field camp.

This camp was established in 1974 and data have been gathered almost continually since then. The 1984 field effort was the initial effort to establish the refuge's waterfowl monitoring program (Garrett, Butler, Wege 1983). The two goals of this effort are: first, to critically evaluate waterfowl productivity, particularly species of emphasis such as the Arctic nesting geese; and second, to determine both qualitatively and quantitatively what mortality factors are influencing goose nesting populations of the Yukon-Kuskokwim Delta.

The field effort focused primarily upon cacklers and white-fronts. This was a natural outfall because emperor nesting biology is being addressed, in the main, by members of the F&WS Research Division and because only a few pair of brant annually nest on the study area.

The purpose of this field camp report is to present the results of the 1984 field season. The Old Chevak field camp was given four basic objectives:

1. Determine the chronology of goose nesting, with particular emphasis being placed upon cacklers and white-fronts. These data are utilized first to establish efficient field inventory schedules for prescribed population sampling, and secondly for comparative purposes, i.e., comparisons between locations and between years.
2. Determine the sources and rates of depredation for nesting geese at the study plots at Old Chevak.
3. Obtain phenological, production and depredation data on other nesting species as opportunity allows.
4. Provide to the biological staff preliminary productivity statistics for geese by the second Monday in July.

## II. Study Area

The Old Chevak field camp (61°22'N, 165°30'W) is located along the Kashunuk River, 6.4 km south of the Old Chevak village site (Figure 1). A two-person camp was established and maintained between April 30th and July 13th, 1984 (Julian days 120-194). During the second half of the field season, one or two additional field personnel were occasionally present at the field camp.

### III. Methods

#### A. Weather

Weather conditons such as: wind direction, wind speed, visibility, temperature, percent cloud cover, type of clouds and the occurrence of precipitation were recorded daily at even numbered hours. The daily maximum and minimum temperatures and amount of precipitation were also recorded.

#### B. Snow Cover Transects

The portion of the study area that was accessible during "break-up" was an approximately semicircular-shaped area 6.4 km long and 1.7 km wide along the western bank of the Kashunuk River. Two approximately 2.0 km long transects located 1.0 km north and 0.5 km south of the camp site were established within five days after arrival of the field crew (Figure 2). Snow cover transects were established in order to sample former goose nesting areas.

Snow transects were usually monitored every other day but less frequently if the prevailing weather conditions resulted in a decrease in the rate of snow-melt. Each transect contained sampling sites (at the beginning and the end of the transect and at 0.4 km intervals). At each sampling site two observers independently estimated the amount of ground covered by snow, melt-water, ponds or sloughs for a rectangular-shaped area extending 100 m on both sides of the transect line and 200 m in both directions along the transect (Figure 2). The perimeter of these rectangles were visually estimated each time the transect was walked since permanent boundary markers were not used. Additionally, a "NEWS" (exposure to the North, East, West and South) photograph was taken at each sample site. Snow cover estimates were averaged and adjusted to the nearest 10 percent.

#### C. Chronology of Migration

Dates of first arrival and peak arrival and the chronology of pre-nesting behavioral changes were obtained daily. Observations were made a few meters south of camp and during two-hour observation periods beginning at either 0700, 0800 or 0900 hours. The activity of birds within a 90 degree area defined by two stakes placed 10 m from the observer was observed.

With the aid of binoculars, all birds were identified, enumerated, flight direction recorded and behavior described during each observation period.

#### D. Study Plot, Location and Search

Study plots were established on the basis of previous field work (Figure 2). In addition, four Cackler Plots were surveyed. Except for Cackler Plots, the size of each study plot was determined by the area searched by two people in six to eight hours.

Each study plot was divided into subplots bounded by irregular boundaries usually established along natural physiographic features such as slough banks, pond edges, etc. The size of each subplot was determined by the area searched by one person in 60 minutes (+ 10 minutes). In each portion of the study plot, nesting waterfowl were located utilizing one of four data gathering strategies: Calibration, Validation, Primary Census and Secondary Census. Each study plot is named by the data gathering strategy used. This multilevel strategy was designed to determine rates of depredation and the plots were studied with different levels of intensity.

Calibration Plots were intended to be thoroughly searched every third day beginning during nest initiation and continuing through hatch. Located nests, therefore, were to be revisited every third day. In this way, the chronology of reproductive events and the occurrence of depredation were detectable. In practice, only three or four thorough searches were made in each Calibration Plot; subsequent observations were made at identified nests. During each nest visit, specific data were recorded and defined as nest "handling time" (Appendix I). Each nest was marked with a stake or flag placed 5 m from the nest.

Validation Plots were thoroughly searched shortly after the onset of incubation. The data recording procedure was the same for Calibration Plots. All nests were visited a second time just prior to the calculated hatch date. A third visit to the nests was made as soon as possible after the goslings had left the nesting area.

Primary Census Plots were searched and nest data recorded similarly during mid- to late-incubation. All nests were also revisited as soon as possible after the goslings had left the nesting area.

Secondary Census Plots were searched and data recorded as soon as possible after the goslings had left the nesting area.

In 1984, 12 study plots were delineated: three Calibration, four Validation, four Primary Census and one Secondary Census. Each plot was searched for nests, with primary emphasis given to islands, pond shores and slough banks. Nest locations were categorized into three types: island, peninsula and "others"; these data were recorded for each nest that was located. The "others" category contains nests located on pond shores, slough banks, pingo tops, "grass flats", displaced islands, islands on mud flats and islands surrounded by dry Hippuris.

#### E. Nest Initiation

Nest initiation dates were calculated by back-dating nests found in Calibration Plots. Except for visiting a nest at hatch, the frequency that nests were revisited did not allow calculation of the initiation dates in Validation and Primary Census Plots. For nests found in Calibration Plots during egg-laying, back-dating occurred from the day the nest was found. Determination of the hatch date allowed back-dating to initiation for nests found after egg-laying had ended. It was assumed that one egg was laid per day up to four eggs and then one day was skipped for clutches of five or more. Incubation periods were

assumed to be 23 days for brant, 26 days for cacklers and white-fronts and 24 days for emperors. Nest initiation dates were compared between study plots and between nest locations.

#### F. Clutch Size Determination

Calibration Plots: Nests found during egg-laying were used to determine "complete" clutch size. Typically these nests contained between one and three eggs. A clutch was considered "complete" if the number of eggs present did not change on two successive visits to the nest. Clutches found after the egg-laying period had ended were termed "incomplete" because "complete" clutch size would probably be underestimated due to the potential for egg loss occurring prior to locating the nest.

Validation Plots: Since these plots had only two pre-hatch visits, "complete" clutch size was not determined. "Incomplete" clutch size was calculated on the basis of the most eggs observed at either of the two pre-hatch visits made to a particular nest.

Primary Census Plots: "Incomplete" clutch size was determined by the number of eggs present at the only pre-hatch visit.

Thus, data for "complete" clutches were compared between species, between nest locations and according to initiation date as calculated from Calibration Plot data.

#### G. Hatch Date Determination

Incubation was assumed to begin with the laying of the last egg and incubation periods were used as determined previously. Hatch dates were calculated from nests in Calibration Plots only.

#### H. Nest Success

Nest success was expressed as the percentage of nests that hatched at least one egg from all the nests whose status was determined. The presence of detached egg shell membrane(s) indicated hatch. Nests which were not relocated or nests where the condition of the nest and egg shell fragments (even if present) did not allow determination of whether or not hatching occurred were defined as "undetermined status". Nest success was analyzed according to species, nest location, clutch size and the number of revisits made by the field crew.

#### I. Nest Depredation

Average clutch size at the end of incubation was calculated for all study plots. The number of eggs present at the pre-hatch visit to Primary Census Plots, at the second pre-hatch visit to Validation Plots and at the last pre-hatch visit to Calibration Plots was used in this calculation.

Since the number of eggs present was recorded for each nest visit, nests sustaining depredation reflected the number of eggs lost. While nest depredation may ultimately result from a wide array of environmental

factors (weather, tides, predation, disturbance or unhatched eggs), the condition of the down lining of the nest whether undisturbed or scattered outside of the nest bowl and the presence of cracked eggs or egg shell fragments determined the cause of "animal" predation. Human predation (egging) occurred if a nest contained no eggs or egg shell fragments, the down lining was intact and either human foot prints or people were observed in the area.

#### J. Egg Photographs

For as many nests as possible, all eggs were photographed. Each egg was labeled according to nest number and egg number. Eggs were numbered 1, 2, 3, etc. when the order of laying (based upon darkest to lightest coloration) was determined. When the order of laying could not be determined, eggs were labeled 1A, 1B, 1C, etc. Photographs were taken after egg-laying had ended.

#### K. Waterfowl Harvest

No attempt was made to meet hunters, determine the precise nature of their visit or to determine the length of their stay on the study areas. Binoculars were used, however, to determine the number of people present; and the number of gun shots heard was recorded, but only while conducting two-hour migration observations. Shots heard at other times of the day were recorded as "few" or "many". Gun shots indicated the attempt to harvest birds. Egging was indicated by individuals carrying pails or the occurrence of people at or in the vicinity of empty nests.

#### L. Brood Size

Brood counts were made during the time when adults and goslings congregated along slough and river banks. With the use of binoculars, the species was identified and brood size was recorded.

#### M. Habitat Description

The habitat was only described for areas which were searched for nesting geese. Each study plot was mapped using the 16 previously determined ecological formations (Appendix II; Byrd and Ronsee 1983).

In addition, each nest site was characterized using the following procedure. A metal, rectangular frame (20 x 50 cm) was used to determine vegetative cover and species composition. Each species falling within the frame was identified and the percent cover of that species was determined in relation to the total vegetated area within the rectangle. The percent of the rectangle covered by water or bare ground was also estimated. Cover estimates within the frame were determined in four directions (north, east, west and south) from the nest. In addition, color photographs were taken in each direction with the frame in place by standing directly above the nest and looking down. The lens was held as close as possible to the vegetation while still including the entire frame. An identification card containing the nest number and direction was included in the photograph.

The distance in meters from the nearest open water or wet marsh was also recorded. If the nest was located on an island, peninsula or shoreline (pond or slough), the following information was collected: (a) height (cm) of nest rim above high water line, (b) depth of pond/lake or slough and (c) the number of islands and peninsulas in the pond/lake.

Water samples from ponds or lakes were taken along a transect placed in two study plots. The salinity of these samples was later determined in Bethel.

Lastly, egg shells were collected from nests in conjunction with the habitat work. Each sample was labeled with the species and nest number.

#### IV. Results

##### A. Weather

No major spring storms occurred this field season. In general, the resultant weather pattern was warm, calm and dry. The first daily maximum temperatures above 60°F. resulted in nest sites becoming available about May 20th, Julian day 140 (Figure 3). A cooling trend occurred during the next 10 days with the last snowfall on May 27th, day 147, and the last below freezing temperature on May 30th, day 150. Precipitation occurred on only one of the next 18 days. With steadily increasing daily minimum temperatures and relatively warm daily maximum temperatures, the conditions appeared favorable for nesting geese. Between June 18th and July 10th, days 169-191, precipitation occurred on 13 days (57%). These showers produced an accumulation of only 0.6 inches.

##### B. Snow Cover Transects

Different snow melt and melt water run-off patterns were observed on the two transects (Figure 4). The transect north of camp was in an upland area interspersed with ponds and small areas of lowland. In contrast, the transect south of camp was through a primarily lowland area. Snow disappeared first from upland areas, but melt water from snow melt and run-off from upland areas formed in lowland areas. Between 18-20 May, days 138-140, the first potential waterfowl nest sites were created. By June 3rd, day 154, all melt water had drained.

##### C. Chronology of Migration

Both emperor geese and Pacific white-fronted geese were observed while enroute to establish the field camp (April 30th, day 120). It was clear, therefore, that emperor and white-fronted geese were present in the area of the field camp prior to April 30th. Cackling Canada geese, however, were first observed on May 7th, day 127, and Pacific black brant on May 16th, day 136. Peak arrival occurred between 10-12 May, days 130-132, for cacklers and white-fronts, between 13-15 May, days 133-135, for emperors and between 17-19 May, days 137-139, for brant.

#### D. Study Area Search

Density: A total of 181 nests were located. We observed 14 brant, 114 cackler, 30 emperor and 23 white-front nests (Tables 1-4). The number of nests per square kilometer averaged 5 for brant, 11 for cacklers and 3 for emperors and white-fronts.

Nest Location: Species specific nesting preferences were apparent (Table 5). Brant nest site selectivity data show that most of their nests were located on islands (57%) with small proportions on peninsulas (36%) and "others" (7%). Similarly, most emperor nests were on islands (53%) with smaller proportions on "others" (37%) and peninsulas (10%). In contrast, islands were overwhelmingly selected by cacklers (88%) while white-fronts in a similar overwhelming manner selected "others" (87%) as nest sites (see Methods section D for definition of "others").

#### E. Nest Initiation

The date of nest initiation was determined for 15 (1 cackler, 6 emperor and 8 white-fronts) of the 25 nests located in three Calibration Plots (Table 6). The small number of initiation dates did not allow further interspecific comparisons regarding earliest nesting, nest site selection or length of the nest initiation period (Tables 7-9).

While thorough nest searches were conducted, it was assumed that some active nests were not located. Repeated searches of Calibration Plots allowed calculation of the proportion of the unlocated nests for each search (Tables 10-12). These data for Calibration Plots indicate the number of nests found and those which were unlocated but determined to be active by back-dating to initiation. The proportion of unlocated-active nests was highest for cacklers (100%, n=2) and similar for emperors (38%, n=8) and white-fronts (40%, n=10).

#### F. Clutch Size Determination

Average "complete" clutch size was similar for emperors (5.2 eggs, n=4) and white-fronts (5.4 eggs, n=5; Table 13). No data were available for brant or cacklers. The small sample sizes for "complete" clutches did not allow further interspecific comparisons regarding nest location or initiation date (Tables 14-19).

Average "incomplete" clutches were only slightly smaller for each species (cackler = 4.2 eggs, n=31; emperor = 5.1 eggs, n=19; white-front = 4.9 eggs, n=18; Tables 20-23).

#### G. Hatch Date Determination

For the limited number of nests in Calibration Plots, hatch occurred between June 18th and July 1st, days 169-182 (Table 24). Only one cackler nest hatched, June 25th, day 176. White-front nests (n=7) hatched between 19-27 June, days 170-178. The hatch of emperor nests (n=4) spanned the entire period of hatch.

#### H. Nest Success

General: Nesting success varied widely between the four species (brant = 0%, cacklers = 18.8%, emperors = 60.0% and white-fronts = 87.0%; Tables 1-4).

Nest Location: For a limited number of emperor (n=30) and white-front (n=23) nests, intraspecific nesting success was similar at all nest locations (Table 25). In contrast, the only successful cackler nests were located on islands (Table 26). Hatching success for a limited sample of "complete" clutches did not allow comparisons to be made (Tables 27-28).

Number of Nest Revisits: Nests in Calibration Plots were visited as many as 11 times during the course of field work (Tables 29-36). Although most nesting loss, 62%, occurred between May 30th and June 9th, days 150-160, data from the limited number of Calibration Plot nests appear to show that nesting loss occurred at a similar level throughout incubation. Nesting loss did not appear to be directly attributable to the field data gathering effort.

#### I. Nest Depredation

Average clutch size in Calibration Plots decreased by about 2.2 eggs by the end of incubation (Tables 2-4). For nests sustaining egg loss, the average loss was 2.8 eggs for cacklers, 3.6 eggs for emperors and 2.3 eggs for white-fronts.

Nest failure was recorded for the various forms of mortality whether predation ("animal" or human), nest abandonment or unhatched eggs. The study design was such that the schedule of nest searches and revisits promoted identification of nest abandonment and the occurrence of unhatched eggs. These kinds of data were accurately determined in Calibration Plots; no nests were abandoned and eight percent contained unhatched eggs out of a total of 25 nests.

The only identified cause of nest depredation was "animal" predation. No spring hunting for eggs was observed and no nests were lost due to environmental factors.

#### J. Waterfowl Harvest

No attempt was made to quantify the number of waterfowl harvested (Table 37). Gun shots were heard on 10 of the 71 days between May 3rd and July 12th, days 123-193. During this period six people were observed in the vicinity of the study area in groups of one to three individuals. Shots were heard on only one occasion (day 193) after birds had left the nesting area.

#### K. Brood Size

Broods were observed mainly on the Kashunuk River and Onumtuk Slough south of camp. Observations of broods on four occasions between June

30th and July 9th, days 181-190, revealed an average of 3.4 Class I goslings per brood for cacklers (n=5), 3.7 for emperors (n=32) and 6.0 for white-fronts (n=1). No brant broods were observed.

#### L. Habitat Description

Plant associations were subjectively determined and mapped for all plots. Categorization was based upon sixteen ecological formations. In addition, percent cover estimates by species and photographs were taken at 7 brant nests, 55 cackler nests, 22 emperor nests and 16 white-front nests.

### V. Discussion

#### A. Nest Initiation

A ten day (8-17 May, days 128-137) warming period resulted in snow melt and "drying" of most of the study area. Despite moderately cool temperatures until May 30th, day 150, nest sites became available and nest initiation proceeded. From a limited number of nests, it did not appear that initiation was delayed or prevented or that nest loss occurred as a result of the cool temperatures.

#### B. Human Disturbance

During the period when the reproductive behavior of the geese indicated that nest initiation was occurring, monitoring activity was stopped for several days before Calibration Plots were searched. Since no eggng and limited spring hunting occurred, the main disturbance to nesting geese was from the monitoring effort. In other study plots (Validation, Primary Census and Secondary Census) searches were conducted at different frequencies. By comparing intraspecific nesting loss for the different strategies, it is possible to get a preliminary estimate of the contribution of the monitoring effort to nesting loss. Nesting success was lowest for cacklers, intermediate for emperors and highest for white-fronts in Calibration, Validation and Primary Census Plots. Data were only available for brant in Validation Plots and the absence of nesting success followed the pattern and was obviously less than the other three species. Except for cacklers, average nesting success was lowest in Calibration Plots. Nevertheless, intraspecific, interplot nesting success values and the timing of depredation within the nesting cycle make it unlikely that the lower nesting success in Calibration Plots was due to disturbance from the nest monitoring effort.

#### C. Nest Distribution

Nest distribution followed the anticipated pattern with brant and cacklers located primarily on islands and white-fronts primarily at sites designated as "others". Unexpectedly, the majority (53%) of emperor goose nests were located on islands. Perhaps the relatively low nest density (see below) for brant and cacklers and a "perceived threat" from the relatively high abundance of foxes resulted in the high proportion of island nest sites.

## VI. Recommendations

### A. Data Gathering:

1. Conduct a pre-season orientation workshop covering camp establishment and maintenance as well as data gathering objectives and procedures.
2. Continue established data gathering procedures, including daily weather conditions, snow cover transects, migration arrival, daily check list of species, spring waterfowl harvest and assessment of goose productivity utilizing the strategies of Calibration, Validation, Primary Census and Secondary Census Plots.
3. Continue to improve and modify habitat description and mapping as well as nest site characterization procedures.

### B. Logistic Supply

1. Continue the once daily (2100 hrs.) radio check.
2. Continue the schedule of supply flights every 10-14 days with "wish lists" relayed to Bethel via radio three to four days in advance of the flight.

## VII. Acknowledgments

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Table 1. Production data for Pacific black brant at ~~Manokinak River~~ <sup>Old Chevak</sup>, 1984.

Category	Plot										
	Calibration			Validation				Primary Census			
	I	II	III	I	II	III	IV	I	II	III	IV
Number of nests located	0	0	0	12	1	1	0	0	0	0	0
Number of nests which status was determined	-	-	-	12	1	1	-	-	-	-	-
Number of nests/km <sup>2</sup>	-	-	-	12	1	1	-	-	-	-	-
Number of nests/mi <sup>2</sup>	-	-	-	31	3	3	-	-	-	-	-
Average size of "complete" clutch	-	-	-	-	-	-	-	-	-	-	-
Average number of eggs per nest at the end of incubation <sup>b</sup>	-	-	-	0	0	0	-	-	-	-	-
Average egg loss from nests that lost eggs	-	-	-	-	-	-	-	-	-	-	-
Average size of clutch that hatched <sup>c</sup>	-	-	-	-	-	-	-	-	-	-	-
Average number of goslings hatched per nest <sup>d</sup>	-	-	-	-	-	-	-	-	-	-	-
Percent of successful nests	-	-	-	0	0	0	-	-	-	-	-

Category	Plot											
	Calibration			Validation				Primary Censuses				Secondary
	I	II	III	I	II	III	IV	I	II	III	IV	I
Number of nests located	3	2	0	12	29	23	1	4	31	2	1	6
Number of nests which status was determined	3	2	-	12	28	23	1	4	31	2	1	6
Number of nests/km <sup>2</sup>	3	1	-	12	30	27	2	1	28	4	2	8
Number of nests/m <sup>2</sup>	7	3	-	31	76	70	4	2	72	10	5	20
Average size of "complete" clutch	-	-	-	-	-	-	-	-	-	-	-	-
Average number of eggs per nest at the end of incubation <sup>a</sup>	0	1.5	-	0.3	1.2(29) <sup>b</sup>	1.2	0	0.2	0.9	0	5.0	-
Average egg loss from nests that lost eggs	3.3	1.0(1)	-	5.0(1)	3.3(3)	1.0(1)	-	-	-	-	-	-
Average size of clutch that hatched <sup>c</sup>	-	3.0(1)	-	4.0(1)	5.2(4)	5.2(5)	-	-	5.2(5)	-	5.0	-
Average number of goslings hatched per nest	-	1.5	-	0.3	0.8	1.1	-	-	0.8	-	5.0	-
Percent of successful nests	0	50.0	-	8.3	14.3	21.7	0	0	16.1	0	100	66.7

<sup>a</sup> This value represents the number of eggs present at the last pre-hatch visit to Calibration Plots, the number of eggs present at the second visit to Validation Plots and the number of eggs present at the pre-hatch visit to Primary Censuses Plots.

<sup>b</sup> Figures in parentheses are sample sizes.

<sup>c</sup> The number of eggs used in this calculation is the same as those for footnote a; only successful nests were used in this calculation.

<sup>d</sup> The number of eggs used in this calculation is the same as those for footnote a; all nests for which productivity status was determined were used in this calculation.

Table 3. <sup>3</sup> Production data for ~~Pacific black brant~~ <sup>emperor geese</sup> ~~at Mandan River~~ <sup>old channel</sup>, 1984.

Category	Plot											
	Calibration			Validation				Primary Census				Secondary
	I	II	III	I	II	III	IV	I	II	III	IV	I
Number of nests located	4	5	1	2	4	-	4	3	1	2	2	2
Number of nests which status was determined	4	5	1	2	4	-	4	3	1	2	2	2
Number of nests/km <sup>2</sup>	4	3	4	2	4	-	6	1	1	4	4	3
Number of nests/mi <sup>2</sup>	10	8	9	5	11	-	16	2	2	10	10	7
Average size of "complete" clutch	5.0(2) <sup>a</sup>	5.5(2)	-	-	-	-	-	-	-	-	-	-
Average number of eggs per <sup>b</sup> nest at the end of incubation	4.5	0	0	4.0	5.5	-	3.5	5.7	4.0	5.0	3.0	-
Average egg loss from nests that lost eggs	1.0(2)	4.2	6.0	-	-	-	-	-	-	-	-	-
Average size of clutch that hatched <sup>c</sup>	4.5	-	-	4.0	5.5	-	7.0(2)	8.5(2)	4.0	6.0(1)	6.0(1)	-
Average number of goslings hatched per nest <sup>d</sup>	4.5	-	-	4.0	5.5	-	3.5	5.7	4.0	3.0	3.0	-
Percent of successful nests	100	0	0	50.0	100	-	50.0	66.7	100	50.0	50.0	50.0

<sup>a</sup> Figures in parentheses are sample sizes.

<sup>b</sup> The value represents the number of eggs present at the last pre-hatch visit to Calibration Plots, the number of eggs present at the second visit to Validation Plots and the number of eggs present at the pre-hatch visit to Primary Census Plots.

<sup>c</sup> The number of eggs used in this calculation is the same as those for footnote b; only successful nests were used in this calculation.

<sup>d</sup> The number of eggs used in this calculation is the same as those for footnote b; all nests for which productivity status was determined were used in this calculation.

Table 4. Production data for Pacific <sup>white-fronted geese</sup> ~~black-brant~~ <sup>Old Chuvak</sup> at ~~Honolua~~ River, 1984.

Category	Plot											
	Calibration			Validation				Primary <i>(Census)</i>				
	I	II	III	I	II	III	IV	I	II	III	IV	
Number of nests located	4	5	1	-	2	4	-	5	1	-	1	
Number of nests which status was determined	4	5	1	-	2	4	-	5	1	-	1	
Number of nests/km <sup>2</sup>	4	3	4	-	2	5	-	1	1	-	2	
Number of nests/mi <sup>2</sup>	10	8	9	-	5	12	-	3	2	-	5	
Average size of "complete" clutch	7.0(2) <sup>a</sup>	4.3(3)	-	-	-	-	-	-	-	-	-	
Average number of eggs per nest at the end of incubation	4.8	2.6	0	-	4.0	5.2	-	4.8	7.0	-	4.0	
Average egg loss from nests that lost eggs	1.0(2)	3.0(4)	2.0	-	2.0(1)	1.0(1)	-	-	-	-	-	
Average size of clutch that hatched <sup>c</sup>	4.8	4.3(3)	-	-	5.0(1)	5.2	-	4.8	7.0	-	4.0	
Average number of goslings hatched per nest	4.8	2.6	-	-	4.0	5.2	-	4.8	7.0	-	4.0	
Percent of successful nests	100	60.0	0	-	50.0	100	0	100	100	-	100	

<sup>a</sup> Figures in parentheses are sample sizes.

<sup>b</sup> The value represents the number of eggs present at the last pre-hatch visit to Calibration Plots, the number of eggs present at the second visit to Validation Plots and the number of eggs present at the pre-hatch visit to Primary Census Plots.

<sup>c</sup> The number of eggs used in this calculation is the same as those for footnote b; only successful nests were used in this calculation.

<sup>d</sup> The number of eggs used in this calculation is the same as those for footnote b; all nests for which productivity status was determined were used in this calculation.

Table 5. Nest site locations for Pacific black brant, cackling Canada geese, emperor geese, and Pacific white-fronted geese at Manokinak River, 1984.

Old Chavak

Species Plot	Nest Location			Total
	Island	Peninsula	Other <sup>a</sup>	
<b>BRANT:</b>				
Validation I	6 (50) <sup>b</sup>	5 (42)	1 (8)	12
<del>Calibration III</del>	1 (100)	0	0	1
<del>Subtotal</del>	1 (100)	0	0	1
Subtotal	8 (57)	5 (36)	1 (7)	14
<b>CACKLERS:</b>				
Calibration I	3 (100)	0	0	3
Calibration II	2 (100)	0	0	2
Calibration III	-	-	-	-
Validation I	8 (73)	2 (18)	1 (9)	11
Validation II	21 (81)	2 (8)	3 (11)	26
Validation III	18 (86)	0	3 (14)	21
Validation IV	1 (100)	0	0	1
Primary I	3 (75)	0	1 (25)	4
Primary II	30 (97)	0	1 (3)	31
<del>Subtotal</del>	2 (100)	0	0	2
<del>Primary IV</del>	1 (100)	0	0	1
<del>Secondary I</del>	6 (100)	0	0	6
Subtotal	95 (88)	4 (4)	9 (8)	108
<b>EMPERORS:</b>				
Calibration I	3 (75)	0	1 (25)	4
Calibration II	2 (40)	0	3 (60)	5
Calibration III	1 (100)	0	0	1
Validation I	1 (50)	0	1 (50)	2
Validation II	2 (50)	1 (25)	1 (25)	4
Validation III	-	-	-	-
Validation IV	3 (75)	0	1 (25)	4
Primary I	0	1 (33)	2 (67)	3
Primary II	0	1 (100)	0	1
<del>Primary IV</del>	0	0	2 (100)	2
<del>Subtotal</del>	2 (100)	0	0	2
<del>Secondary I</del>	2 (100)	0	0	2
Subtotal	16 (53)	3 (10)	11 (37)	30
<b>WHITE-FRONT:</b>				
Calibration I	1 (25)	1 (25)	2 (50)	4
Calibration II	0	0	5 (100)	5
<del>Calibration III</del>	0	0	1 (100)	1
<del>Calibration III</del>	0	0	2 (100)	2
Validation IV	0	1 (25)	3 (75)	4
Primary I	0	0	5 (100)	5
Primary II	0	0	1 (100)	1
<del>Subtotal</del>	0	0	1 (100)	1
Subtotal	1 (4)	2 (9)	20 (87)	23
Total	120 (69)	14 (8)	41 (23)	175

<sup>a</sup> Includes: pond-shoreline; slough-shoreline; pingo top; grass flat; displaced island; and mudflat.

<sup>b</sup> Number in parentheses are percentages.

Imperial Glass  
Co., and Pacific

Old Church

[illegible]

Table 7. Nest initiation dates by nest location for ~~Pacific black bronz~~, ~~ackling Canada geese~~, emperor geese, and Pacific white-fronted geese in calibration plot I at ~~Humboldt River~~, 1984.

old chevak

[illegible]

~~NO DELETED~~





10  
Table 11. The number of goose nests located<sup>a</sup> during successive searches of calibration plot I at ~~Manokinak River~~, 1984.  
*Old Chuvak*

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian day	Located	Not Located	Total
Cackling Canada geese	1	144	0	1	1
	2	148	0	0	0
	3				
	4				
	Total		0	1	1
Emperor geese	1	144	1	1	2
	2	148	0	0	0
	3	151	1	0	1
	4	154	0	1	1
	Total		2	2	4
Pacific white-fronted geese	1	144	1	2	3
	2	148	0	0	0
	3	151	0	1	1
	4	154	0	0	0
	Total		1	3	4

<sup>a</sup> ~~Includes only nests for~~

Table 11. The number of goose nests located<sup>a</sup> during successive searches of calibration plot II at ~~Manokinec River~~, 1984.

*old Chevak*

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian day	Located	Not Located	Total
Cackling Canada geese	1	145	0	0	0
	2	149	0	1	1
	3	152	0	0	0
	4				
	Total		0	1	1
Emperor geese	1	145	2	0	2
	2	149	0	1	1
	3	152	0	0	0
	4				
	Total		2	1	3
Pacific white-fronted geese	1	145	3	1	4
	2	149	1	0	1
	3	152	0	0	0
	4				
	Total		4	1	5

<sup>a</sup> ~~Includes only nests for~~

12  
Table 11. The number of goose nests located<sup>a</sup> during successive searches of calibration plot III at ~~Manokinak River~~, 1984.

*Old Chuvok*

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian day	Located	Not Located	Total
<del>Cackling</del>	1				
<del>Canada geese</del>	2				
	3				
	4				
	Total				
Emperor geese	1	150	1	0	1
	2	153	1	0	1
	3				
	4				
	Total		2	0	2
Pacific white-fronted geese	1	150	1	0	1
	2	153	1	0	1
	3				
	4				
	Total		2	0	2

<sup>a</sup> ~~Includes only nests for~~

Table 14. Frequency of clutch sizes from "complete" clutches for ~~ackling Canada geese~~, emperor geese, and Pacific white-fronted geese in calibration plots at ~~Manokinak River~~, 1984.

Old Cherek

Plot	Clutch									Total
	1	2	3	4	5	6	7	8	9	
<del>CACKLERS:</del>										
<del>Calibration I</del>										
<del>Calibration II</del>										
<del>Calibration III</del>										
<del>Subtotal</del>										
EMPERORS:										
Calibration I	0	0	0	1	0	1	0	0	0	2
Calibration II	0	0	0	1	0	0	1	0	0	2
<del>Calibration III</del>										
Subtotal	0	0	0	2	0	1	1	0	0	4
WHITE-FRONTES:										
Calibration I	0	0	0	0	0	0	2	0	0	2
Calibration II	0	0	1	1	0	1	0	0	0	3
<del>Calibration III</del>										
Subtotal	0	0	1	1	0	1	2	0	0	5
TOTAL	0	0	1	3	0	2	3	0	0	9

\* ~~Does not include~~

Table <sup>14</sup>19. Frequency of clutch size from "complete" clutches by nest location for ~~cackling~~ <sup>imperial</sup> Canada geese in calibration plot I at Manekinak River, 1984.

Old Chevak

Clutch Size	Nest Location			Total
	Island	Peninsula	Other <sup>a</sup>	
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	1	0	0	1
5	0	0	0	0
6	1	0	0	1
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean <del>± S.E.</del>	5.0	—	—	5.0

<sup>a</sup> Nest site locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island, and mudflat.

15  
 Table 19. Frequency of clutch size from "complete" clutches by nest location for ~~Pacific white-fronted~~ <sup>Pacific white-fronted</sup> Canada geese in calibration plot I at ~~Manikook River~~, 1984.  
 Old Chevak

Clutch Size	Nest Location			Total
	Island	Peninsula	Other <sup>a</sup>	
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	1	1	0	2
8	0	0	0	0
9	0	0	0	0
Mean <del>± S.E.</del>	-	-	-	7.0

<sup>a</sup> Nest site locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island, and mudflat.

Table <sup>16</sup> 19. Frequency of clutch size from "complete" clutches by nest location for ~~nesting~~ <sup>imperial</sup> Canada geese in calibration plot II at ~~Manokinaak River~~, 1984.  
Old Cheval

Clutch Size	Nest Location			Total
	Island	Peninsula	Other <sup>a</sup>	
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	1	1
5	0	0	0	0
6	0	0	0	0
7	1	0	0	1
8	0	0	0	0
9	0	0	0	0
Mean <del>± S.E.</del>	—	—	—	5.5

<sup>a</sup> Nest site locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island, and mudflat.

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Table 19. Frequency of clutch size from "complete" clutches by nest location for ~~Eastern White-fronted~~ <sup>Pacific White-fronted</sup> Canada geese in calibration plot II at ~~Manokinak River~~, 1984.

Old Cheval

Clutch Size	Nest Location			Total
	Island	Peninsula	Other <sup>a</sup>	
1	0	0	0	0
2	0	0	0	0
3	0	0	1	1
4	0	0	1	1
5	0	0	0	0
6	0	0	1	1
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean <del>± S.E.</del>	-	-	4.3	4.3

<sup>a</sup> Nest site locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island, and mudflat.

Table 25. Nest initiation dates by clutch size from "complete" clutches for ~~suckling~~ Canada geese at ~~Hamokinah~~ River, 1984.

[illegible]

19 Pacific white-fronted Old chavak  
Table 25. Nest initiation dates by clutch size from "complete" clutches for ~~nesting~~ <sup>nesting</sup> Canada geese at ~~Hennrichs~~ <sup>Hennrichs</sup> Marsh, 1984.

[illegible]

20  
Table 15. Frequency of clutch size from "incomplete"<sup>a</sup> clutches for Pacific black brant at ~~Hanokialak River~~, 1984.  
*Old Chevak*

Plot	Clutch										Total
	U	1	2	3	4	5	6	7	8	9	
<del>Calibration I</del>											
<del>Calibration II</del>											
<del>Calibration III</del>											
<del>Subtotal</del>											
Validation <del>a I</del>	12	0	0	0	0	0	0	0	0	0	12
Validation <del>b II</del>	1	0	0	0	0	0	0	0	0	0	1
Validation <del>c III</del>	1	0	0	0	0	0	0	0	0	0	1
<del>Validation d</del>											
Subtotal	14	0	0	0	0	0	0	0	0	0	14
<del>Primary 1</del>											
<del>Primary 2</del>											
<del>Primary 3</del>											
<del>Primary 4</del>											
<del>Subtotal</del>											
Total											

<sup>a</sup> "Incomplete" indicates that the number of eggs present during nest revisits did not meet the criteria for defining a complete clutch.

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 Table 13. Frequency of clutch size from "incomplete"<sup>a</sup> clutches for  
~~Pacific black brant~~ at ~~Manokinak River~~, 1984.  
*cackling Canada geese* *Old Chertak*

Plot	Clutch										Total
	U	1	2	3	4	5	6	7	8	9	
Calibration I	0	0	0	2	1	0	0	0	0	0	3
Calibration II	0	1	0	1	0	0	0	0	0	0	2
<del>Calibration III</del>											
Subtotal	0	1	0	3	1	0	0	0	0	0	5
Validation <del>I</del>	10	0	0	0	1	1	0	0	0	0	12
Validation <del>II</del>	19	1	1	1	2	2	1	2	0	0	29
Validation <del>III</del>	17	0	1	1	1	0	1	2	0	0	23
Validation <del>IV</del>	1	0	0	0	0	0	0	0	0	0	1
Subtotal	47	1	2	2	4	3	2	4	0	0	65
Primary I	3	1	0	0	0	0	0	0	0	0	4
Primary <del>II</del>	25	1	0	1	0	2	1	1	0	0	31
Primary <del>III</del>	2	0	0	0	0	0	0	0	0	0	2
Primary <del>IV</del>	0	0	0	0	0	1	0	0	0	0	1
Subtotal	30	2	0	1	0	3	1	1	0	0	38
Total	77	4	2	6	5	6	3	5	0	0	108

<sup>a</sup> "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

22  
Table 15. Frequency of clutch size from "incomplete"<sup>a</sup> clutches for  
~~Pacific black brant~~ *emperor geese* at ~~Manokinak River~~ *Old Chevak*, 1984.

Plot	Clutch										Total
	U	1	2	3	4	5	6	7	8	9	
Calibration I	0	0	0	0	1	0	1	0	0	0	2
Calibration II	0	0	0	2	1	0	0	0	0	0	3
Calibration III	0	0	0	0	0	0	1	0	0	0	1
Subtotal	0	0	0	2	2	0	2	0	0	0	6
Validation <del>I</del>	0	0	0	1	0	1	0	0	0	0	2
Validation <del>II</del>	0	0	0	1	0	1	0	2	0	0	4
Validation <del>IV</del>	2	0	0	0	0	0	0	2	0	0	4
<del>Validation d</del>											
Subtotal	2	0	0	2	0	2	0	4	0	0	10
Primary I	1	0	0	0	0	0	0	1	0	0	2
Primary <del>II</del>	0	0	0	0	1	0	0	0	0	0	1
Primary <del>III</del>	0	0	0	0	1	0	1	0	0	0	2
Primary <del>IV</del>	1	0	0	0	0	0	1	0	0	0	2
Subtotal	2	0	0	0	2	0	2	1	0	0	7
Total	4	0	0	4	4	2	4	5	0	0	23

<sup>a</sup> "Incomplete" indicates that the number of eggs present during nest revisits did not meet the criteria for defining a complete clutch.

Table 15. Frequency of clutch size from "incomplete"<sup>a</sup> clutches for  
~~Pacific black brant~~ at ~~Hankinck River~~, 1984.  
*Pacific white-fronted geese*      *Old Chuvats*

Plot	Clutch										Total
	U	1	2	3	4	5	6	7	8	9	
Calibration I	0	0	0	1	1	0	0	0	0	0	2
Calibration II	0	0	0	0	0	0	2	0	0	0	2
Calibration III	0	0	1	0	0	0	0	0	0	0	1
Subtotal	0	0	1	1	1	0	2	0	0	0	5
Validation <del>a</del> II	0	0	0	0	0	2	0	0	0	0	2
Validation <del>b</del> III	0	0	0	1	0	0	2	1	0	0	4
<del>Validation c</del>											
<del>Validation d</del>											
Subtotal	0	0	0	1	0	2	2	1	0	0	6
Primary I	0	0	0	0	2	2	1	0	0	0	5
Primary <del>2</del> II	0	0	0	0	0	0	0	1	0	0	1
Primary <del>3</del> IV	0	0	0	0	1	0	0	0	0	0	1
<del>Primary 4</del>											
Subtotal	0	0	0	0	3	2	1	1	0	0	7
Total	0	0	1	2	4	4	5	2	0	0	18

<sup>a</sup> "Incomplete" indicates that the number of eggs present during nest revisits did not meet the criteria for defining a complete clutch.



Table 30. Percent nesting success for Pacific black brant, cackling Canada geese, emperor geese, and Pacific white-fronted geese at different nest locations at ~~Manokinak River~~, 1984.

Old Chevak

Plot	Brant				Cacklers			
	Island	Peninsula	Other <sup>a</sup>	Total	Island	Peninsula	Other	Total
Calibration I	-	-	-	-	0(3) <sup>b</sup>	-	-	0(3)
Calibration II	-	-	-	-	50(2)	-	-	50(2)
Calibration III	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	20(5)	-	-	20(5)
Validation I	0(6)	0(5)	0(1)	0(12)	12(8)	0(2)	0(1)	9(11)
Validation II	0(1)	-	-	0(1)	19(21)	0(2)	0(3)	15(26)
Validation III	0(1)	-	-	0(1)	28(18)	-	0(3)	24(21)
Validation IV	0(8)	0(5)	0(1)	0(14)	0(1)	-	-	0(1)
Subtotal	0(8)	0(5)	0(1)	0(14)	21(48)	0(4)	0(7)	17(59)
Primary I	-	-	-	-	0(3)	-	0(1)	0(4)
Primary II	-	-	-	-	17(30)	-	0(1)	16(31)
Primary III	-	-	-	-	0(2)	-	-	0(2)
Primary IV	-	-	-	-	100(1)	-	-	100(1)
Subtotal	-	-	-	-	17(36)	-	0(2)	16(38)
Total Secondary	-	-	-	-	67(6)	-	-	67(6)
Total	0(8)	0(5)	0(1)	0(14)	22(95)	0(4)	0(9)	19(108)

<sup>a</sup> Nest locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pierce top, "grass flat", displaced island and mudflat.

<sup>b</sup> Figures in parentheses are sample size.

Table 30. Percent nesting success for Pacific black brant, cackling Canada geese, emperor geese, and Pacific white-fronted geese at different nest locations at ~~Manokinak River~~, 1984.

Old Chivak

Plot	Emperor Brant				White-fronted Cacklers			
	Island	Peninsula	Other <sup>a</sup>	Total	Island	Peninsula	Other	Total
Calibration I	100(3) <sup>b</sup>	—	100(1)	100(4)	100(1)	100(1)	100(2)	100(4)
Calibration II	0(2)	—	0(3)	0(5)	—	—	60(5)	60(5)
Calibration III	0(1)	—	—	0(1)	—	—	0(1)	0(1)
Subtotal	50(6)	—	25(4)	40(10)	100(1)	100(1)	62(8)	70(10)
Validation I	100(1)	—	100(1)	100(2)	—	—	—	—
Validation II	100(2)	100(1)	100(1)	100(4)	—	—	100(2)	100(2)
Validation III	—	—	—	—	—	100(1)	100(3)	100(4)
Validation IV	33(3)	—	100(1)	50(4)	—	—	—	—
Subtotal	67(6)	100(1)	100(3)	80(10)	—	100(1)	100(5)	100(6)
Primary I	—	100(1)	50(2)	67(3)	—	—	100(5)	100(5)
Primary II	—	100(1)	—	100(1)	—	—	100(1)	100(1)
Primary III	—	—	50(2)	50(2)	—	—	—	—
Subtotal	50(2)	—	—	50(2)	—	—	100(1)	100(1)
Secondary I	50(2)	100(2)	50(4)	62(8)	—	—	100(7)	100(7)
Subtotal	50(2)	—	—	50(2)	—	—	—	—
Total	56(16)	100(3)	55(11)	60(30)	100(1)	100(2)	85(20)	87(23)

<sup>a</sup> Nest locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island and mudflat.

<sup>b</sup> Figures in parentheses are sample sizes.

27  
 Table 41. Hatching success of "complete" clutches for ~~cackling Canada~~ <sup>emperor</sup> geese at ~~Manokink River~~ <sup>old Chevre</sup>, 1984.

Plot	Clutch size									Total
	1	2	3	4	5	6	7	8	9	
Calibration I	-	-	-	100 <sup>a</sup> (1) <sup>b</sup>	-	100(1)	-	-	-	100(2)
Calibration II	-	-	-	0(1)	-	-	0(1)	-	-	0(2)
<del>Calibration III</del>										
Total	-	-	-	50(2)	-	100(1)	0(1)	-	-	50(4)

<sup>a</sup> Numbers are percentages.

<sup>b</sup> Numbers in parentheses are sample sizes.

Table 41. Hatching success of "complete" clutches for ~~cooking Canada~~ *Pacific white-fronted* geese at ~~Manokinak River~~ *Old Chernik*, 1984.

Plot	Clutch size									Total
	1	2	3	4	5	6	7	8	9	
Calibration I	-	-	-	-	-	-	100 <sup>a</sup> (2) <sup>b</sup>	-	-	100(2)
Calibration II	-	-	100(1)	0(1)	100(1)	-	-	-	-	67(3)
<del>Calibration III</del>										
Total	-	-	100(1)	0(1)	100(1)	-	100(2)	-	-	80(5)

<sup>a</sup> Numbers are percentages.

<sup>b</sup> Numbers in parentheses are sample sizes.

[illegible]

30  
 Table M. Status of <sup>emperor</sup> ~~eckling~~ Canada goose clutches in relation to the number of pre-hatch visits in calibration plot I at ~~Manokinak River~~, 1984.  
 Old Chenaik

Clutch status*	Number of visits															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Hatched:																
Without egg loss	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3
With egg loss	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Partial hatch:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched:																
Abandoned -																
at initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pre-hatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Predation -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(avian & mammalian)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Harvest (egged)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fail to develop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-predation):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-harvest):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	4

Table 31. Status of ~~egg-laying~~ <sup>Pacific white-fronted</sup> Canada goose clutches in relation to the number of pre-hatch visits in calibration plot I at ~~Manokinak River~~ <sup>Old Chevak</sup>, 1984.

Clutch status <sup>a</sup>	Number of visits															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Hatched:																
Without egg loss	0	0	0	0	0	0	0	/	0	0	/	0	0	0	0	2
With egg loss	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	2
Partial hatch:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched:																
Abandoned -																
at initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
prehatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Predation -																
(avian & mammalian)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Harvest (egged)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fail to develop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-predation):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-harvest):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined:																
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	/	/	/	/	0	0	0	0	4

Table 31. Status of cackling Canada goose clutches in relation to the number of prehatch visits in calibration plot II at ~~Manokinak River~~, 1984.

Old Chuvak

Clutch status <sup>a</sup>	Number of visits															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Hatched:																
Without egg loss	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Partial hatch:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched:																
Abandoned -																
at initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
prehatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Predation -																
(avian & mammalian)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Harvest (egged)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fail to develop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-predation):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-harvest):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2

Table 31. Status of ~~eaching~~ <sup>emperor</sup> Canada goose clutches in relation to the number of prehatch visits in calibration plot II at ~~Manokinak River~~, 1984.

*Old Chevak*

Clutch status <sup>a</sup>	Number of visits															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Hatched:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Partial hatch:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched:																
Abandoned -																
at initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
prehatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Predation -																
(avian & mammalian)	0	2	1	0	0	0	0	1	1	0	0	0	0	0	0	5
Harvest (egged)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fail to develop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-predation):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-harvest):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	2	1	0	0	0	0	1	1	0	0	0	0	0	0	5

34 *Pacific white-fronted*  
 Table 31. Status of ~~sackling~~ Canada goose clutches in relation to the number of pre-hatch visits in calibration plot II at ~~Manokinak River~~, 1984.  
*Old Chevak*

Clutch status*	Number of visits															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Hatched:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Partial hatch:																
Without egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
With egg loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched:																
Abandoned -																
at initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pre-hatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Predation -																
(avian & mammalian)	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2
Harvest (egged)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fail to develop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-predation):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Continued (post-harvest):																
Hatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unhatched	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined:																
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	1	0	0	1	0	3	0	0	0	0	0	0	0	5

Old Cheval

[illegible]

Old Chunks

[illegible]

Table 37a. The chronology of spring harvest at Old Chevak, 1984.

Julian day	Chronology of arrival and nesting	Number in Party	Remarks
120	White-fronts, emperors, and cranes present		
121			
122			
123		1	Snow machine observed traveling from SW to NE, west of camp
124			
125			4 shots heard toward NW in afternoon
126		2	2 men, each on a snow machine, approached camp from S and passed just west of camp heading N, 5 shots (at cranes) heard, nothing harvested
127	Cacklers arrived		2 shots heard toward NW in 2 hours
128			A snow machine was heard along with 6 shots in 2 hours toward NNW, 2 more shots were heard later in a.m.
129			
130			
131			10 shots heard toward NW in 2 hours
132			
133		2	Nothing harvested
134		1	1 unidentified goose observed with hunter
135			Snow cover decreased dramatically
136	Brant arrived		
137			
138	White-front nest initiation		
139	Cackler nest initiation		13 shots heard toward N in 2 hours 4 shots heard in 45 minutes
140			4 shots heard toward N in 0.5 hours

Table 37b. The chronology of spring harvest at Old Chevak, 1984.

Julian day	Chronology of arrival and nesting	Number in Party	Remarks
141			3 shots heard toward N in 1 hour
142			2 shots heard toward N 9 shots heard toward N in 1.5 hours 3 shots heard toward N in 1 hour
143			
144	White-front incubation initiation		
145	Emperor incubation initiation		
146			
147			
148	Cackler nest initiation		
...			
169	Emperor hatch		
170	White-front hatch		
...			
176	Cackler hatch		
...			
193		2 adults 1 child	Boat observed and 6 shots heard near Onumtuk II plot

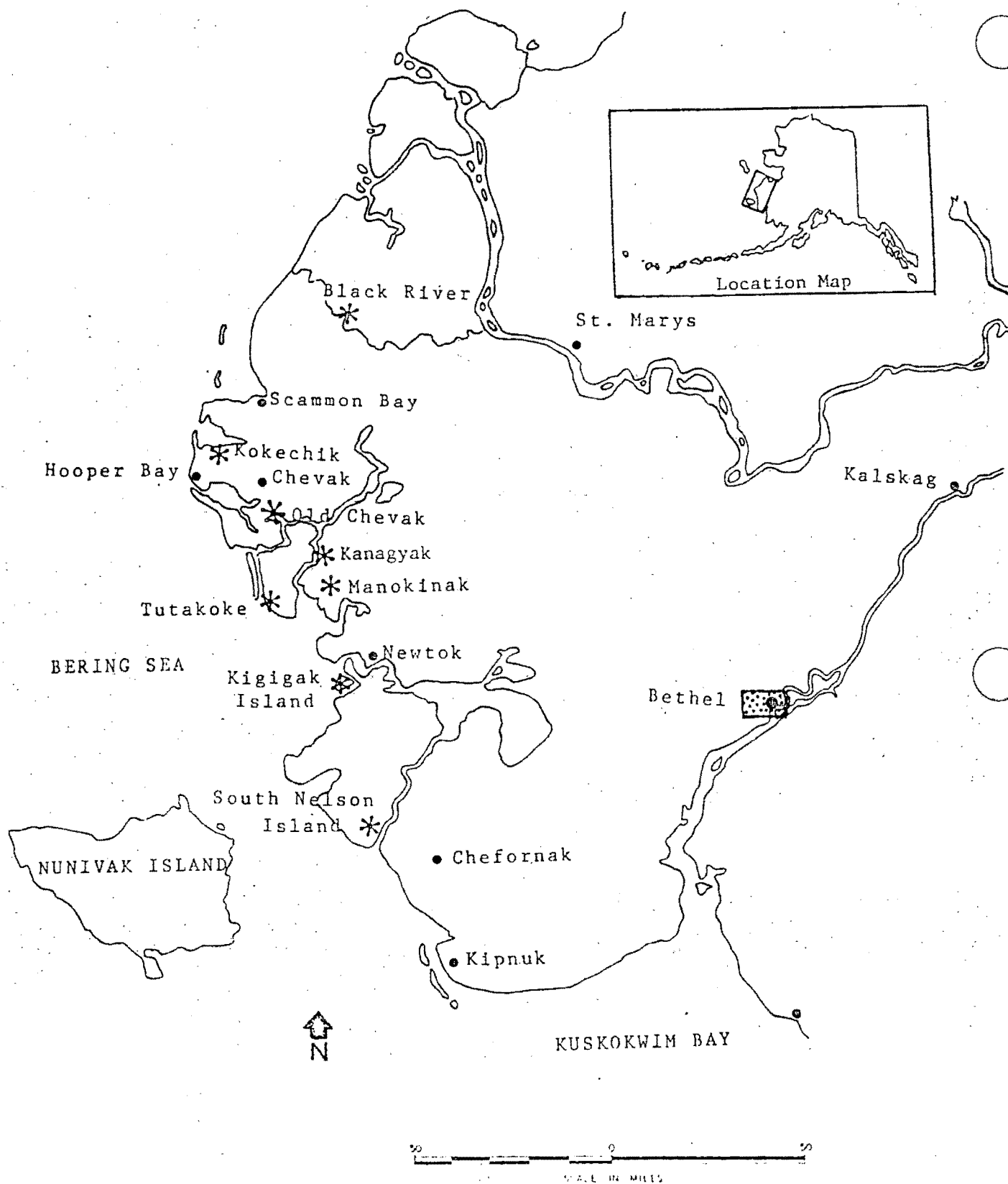


Figure 2. Distribution of field camps throughout the principal goose nesting area of the Yukon Delta NWR. Camps designated by the symbol \*.

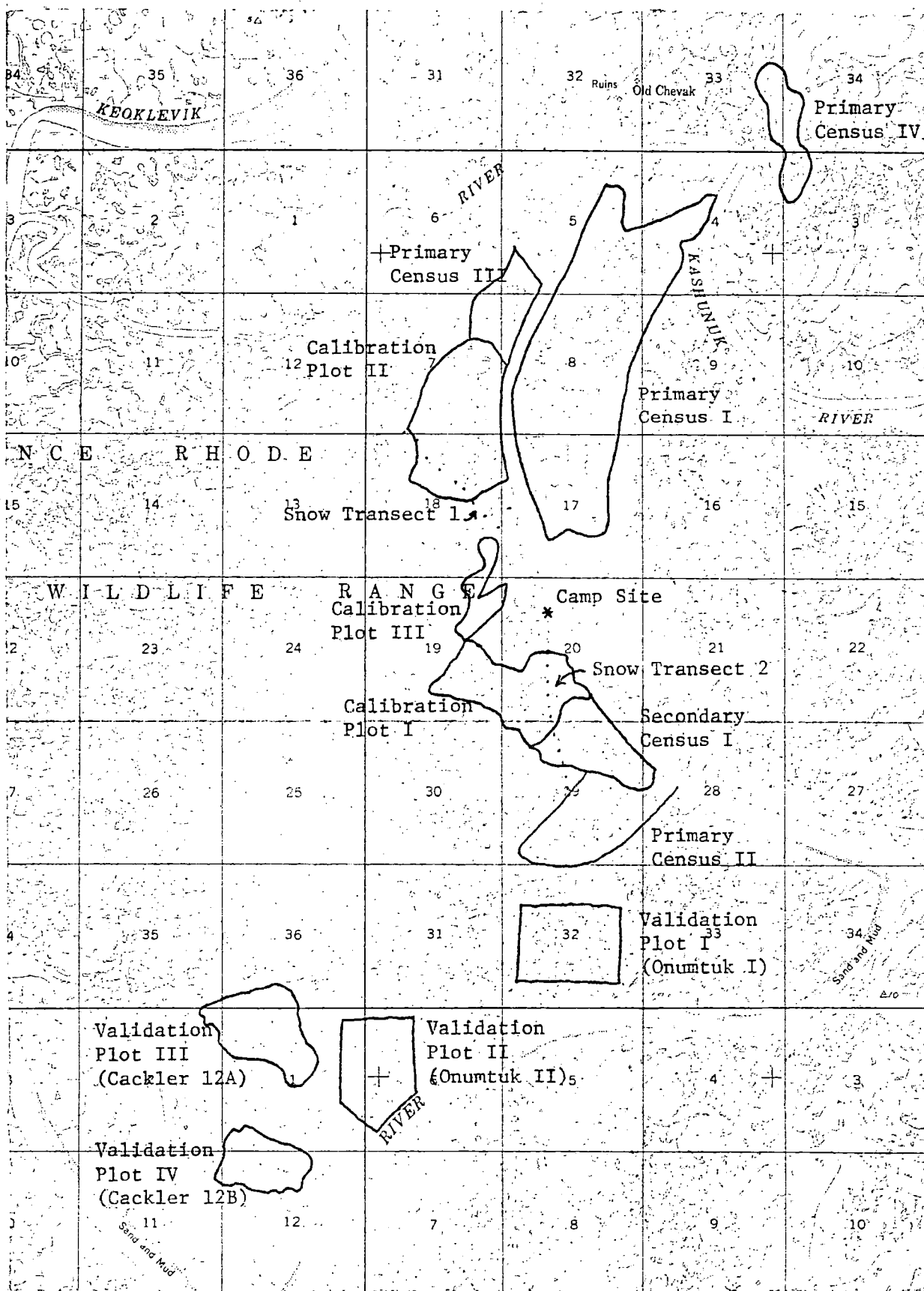


Figure 2. Location of snow cover transects and Calibration, Validation, Primary Census and Secondary Census Plots at Old Chevak field camp, 1984.

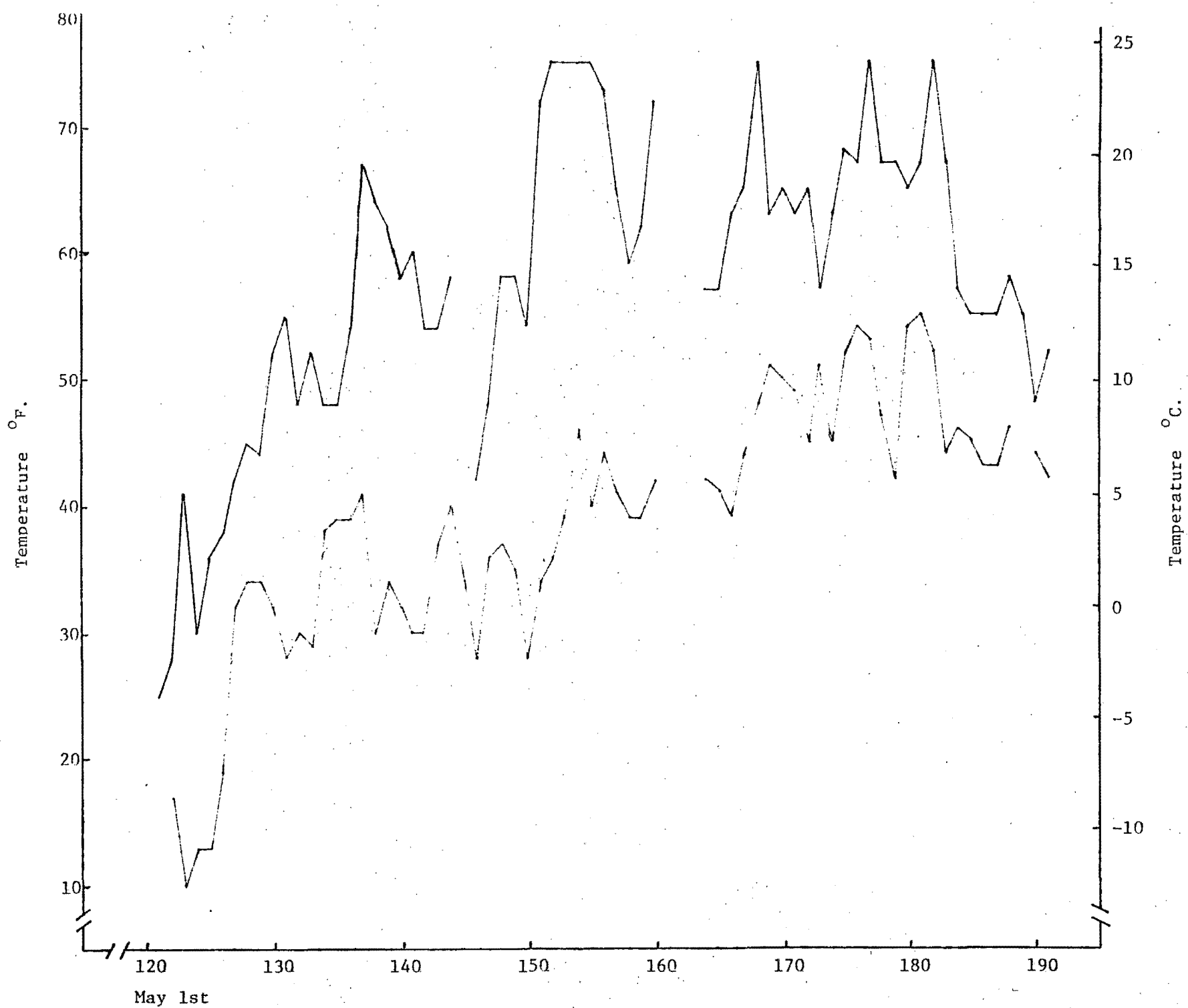


Figure 3. Daily maximum and minimum temperature at Old Chevak field camp, 1984.

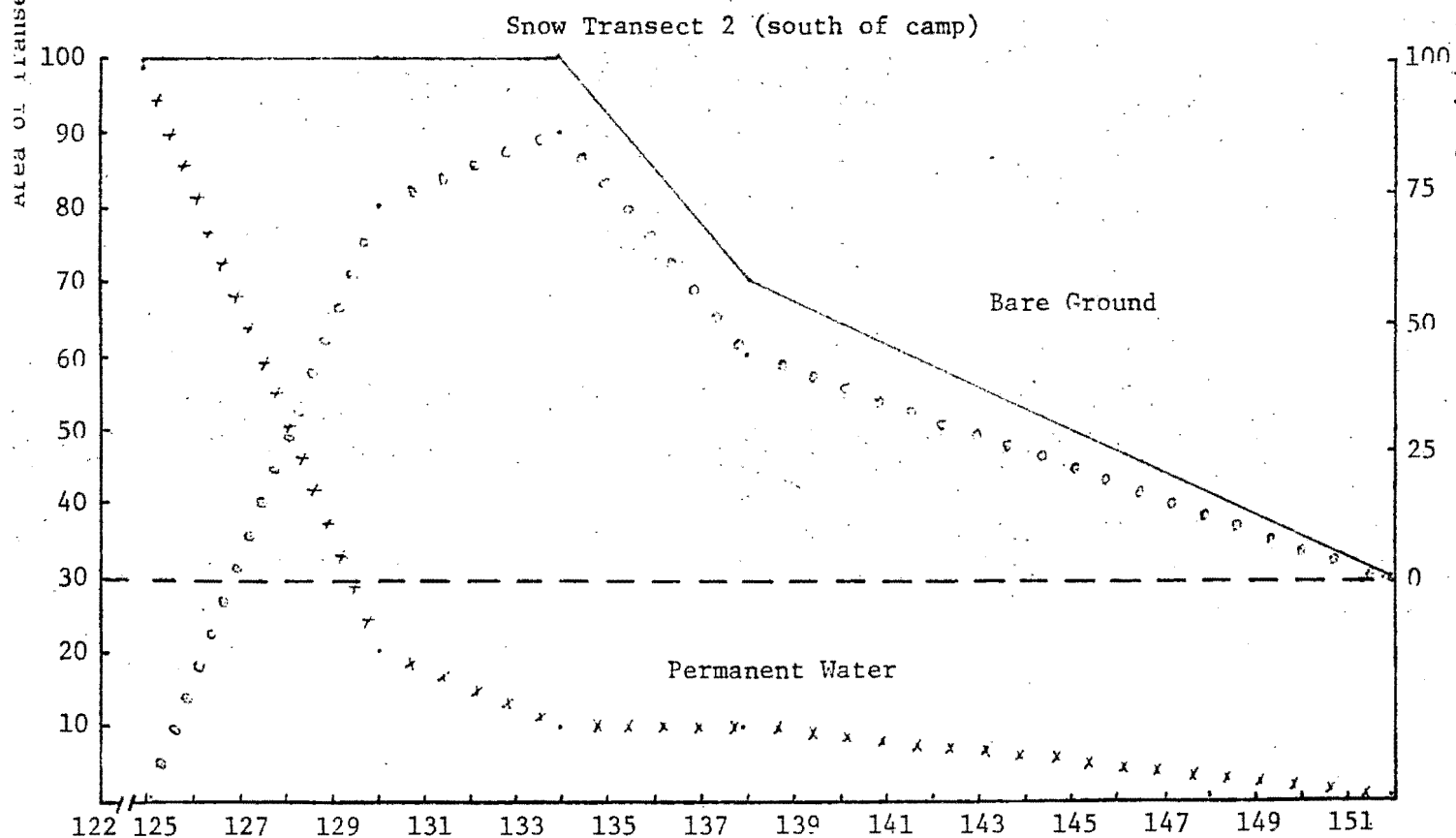
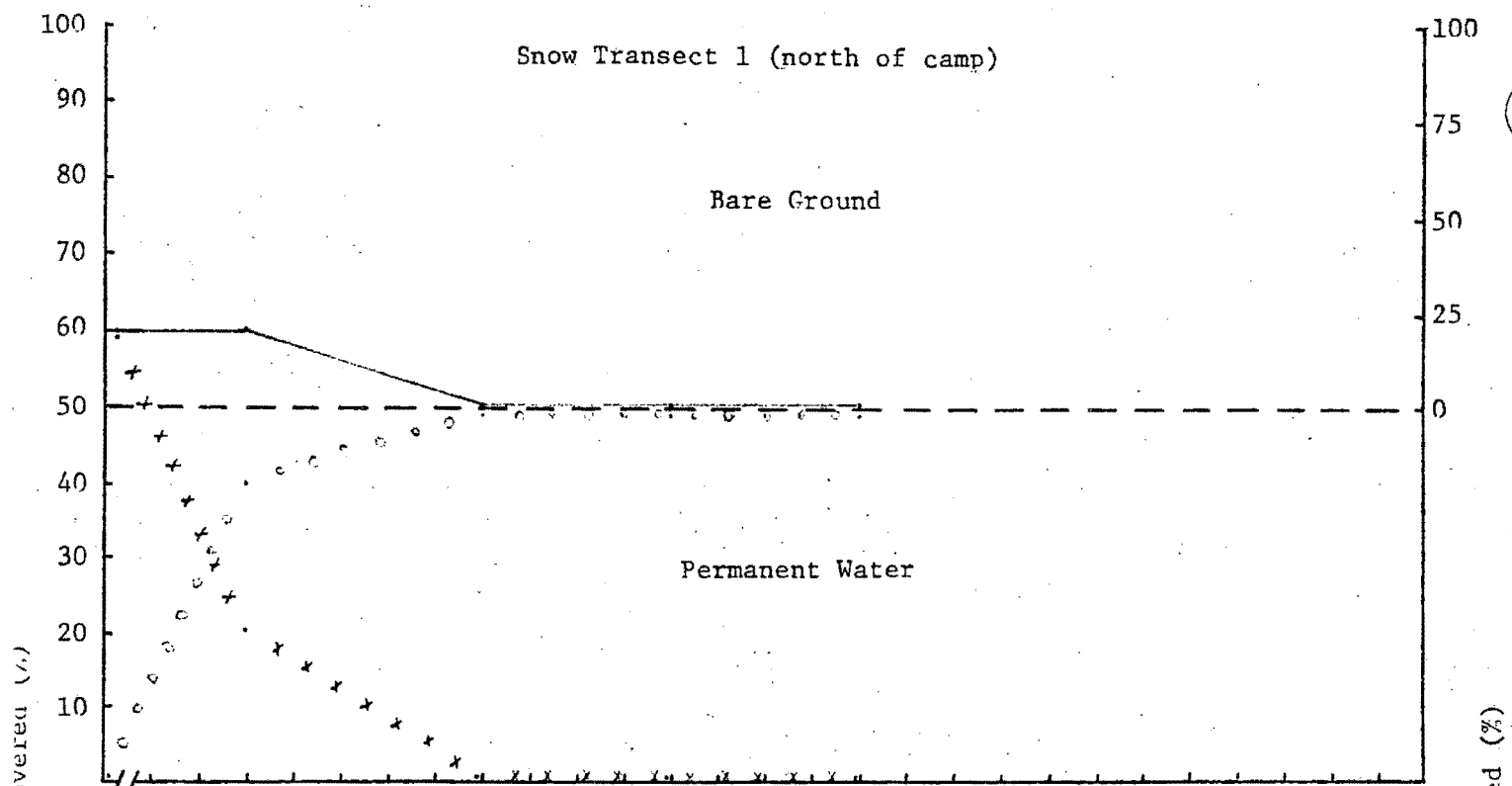


Figure 4. Snow cover transects at Old Chevak, 1984. Covered ground ———, snow covered ground xxxxxx, ground covered by meltwater ooooooooo.

## Appendix I. SUGGESTED FIELD DATA RECORDING PROCEDURE

1. First entry in rite-in-rain notebook: Date, Strategy, Plot Number
2. Record beginning search time for the Subplot and assign Subplot letter
3. Searching for or approaching a nest:
  - Observation of female leaving the nest - yes or no
  - If "yes" above, then estimate distance (m) between observer and nest
  - Observation of male at or near nest - yes or no
  - If "yes" above, then estimate distance (m) between male and nest
4. Nest handling time:
  - Record arrival time at nest or start stopwatch
  - Record:

species	number of addled eggs
nest status	number of pipping eggs
nest stage	number of detached membranes
number of eggs present	number of goslings
egg "karma"	number of eggs sustaining depredation
float angle (if requested)	source of mortality
number of unhatched eggs	
  - Number eggs: darkest (1) to lightest (n)
  - Record: nest site ecological formation (when you can determine it)
    - nest site location
    - nest site dimension and area (if an island or peninsula)
    - distance (m) of nest from nearest water
  - Place labeled tongue depressor at rim of nest bowl
  - Locate nest on field map
  - Record departure time from nest or stop stopwatch
5. Place nest marker (stake or flag) 5m from nest
6. Repeat steps 3-5 until Subplot search time (1 hour) expires
7. Record search ending time for Subplot
8. Delineate and codify Subplot on field map
9. Repeat steps 2-9 until plot is completed (50-100 brant nests located, 25-50 cackler nests located, or 8 hours have elapsed)
10. Delineate plot on field map
11. Appropriate changes in data recording are required during nest rechecks as opposed to complete searches of a plot

Appendix II. ECOLOGICAL COMMUNITY FORMATIONS\*



1) Coastal Mudflat -	<u>Carex subspathacea</u> <u>Puccinellia phryganodes</u>	
2) Riparian Mudflat -	<u>Limosella acauatica</u> <u>Callitriche hermaphroditica</u> <u>Ranunculus hyperboreus</u> <u>Hippuris tetraphylla</u>	
3) Sedge Meadow -	<u>Carex ramenskii</u> <u>Potentilla egedii</u> <u>Poa eminens</u>	<u>Calamagrostis spp.</u> <u>Stellaria spp.</u> <u>Carex glareosa</u>
4) Sedge Grass -	<u>Carex ramenskii</u> <u>Carex rariflora</u> <u>Carex glareosa</u>	<u>Calamagrostis spp.</u> <u>Festuca rubra</u> <u>Potentilla egedii</u>
5) Pond Edge -	<u>Carex mackenziei</u> <u>Hippuris tetraphylla</u>	
6) Grass Sedge -	<u>Carex rariflora</u> <u>Calamagrostis spp.</u> <u>Festuca rubra</u> <u>Potentilla egedii</u>	<u>Elymus arenarius</u> <u>Poa eminens</u> <u>Carex glareosa</u>
7) Sedge Willow -	<u>Salix fuscenscens</u> <u>Salix ovalifolia</u>	<u>Carex rariflora</u> <u>Empetrum nigrum</u>
8) Willow Grass -	<u>Salix ovalifolia</u> <u>Salix fuscenscens</u> <u>Calamagrostis spp.</u> <u>Festuca rubra</u> <u>Petasites frigidus</u>	<u>Pedicularis spp.</u> <u>Parnassia palustris</u> <u>Carex glareosa</u> <u>Carex rariflora</u> <u>Triglochin palustris</u> <u>Empetrum nigrum</u>
9) Willow Graminoid	<u>Salix ovalifolia</u> <u>Salix fuscenscens</u> <u>Carex rariflora</u>	<u>Carex ramenskii</u> <u>Festuca rubra</u> <u>Calamagrostis spp.</u>
10) Crowberry Willow	<u>Empetrum nigrum</u> <u>Carex rariflora</u> <u>Calamagrostis spp.</u> <u>Carex glareosa</u> <u>Lathyrus maritimus</u>	<u>Salix ovalifolia</u> <u>Salix fuscenscens</u> <u>Festuca rubra</u> <u>Valeriana capitata</u> <u>Sedum roseum</u>
11) Coastal Crowberry	<u>Empetrum nigrum</u> <u>Lathyrum maritimus</u> <u>Carex rariflora</u> mosses	<u>Salix spp.</u> <u>Betula nana</u> <u>Petasites frigidus</u>
12) Inland Crowberry	<u>Betula nana</u> <u>Rubus chamaemoris</u> <u>Empetrum nigrum</u>	mosses lichens liverwort
13) Elymus Meadow	<u>Elymus arenarius</u> <u>Potentilla egedii</u> <u>Carex ramenskii</u>	<u>Poa eminens</u> <u>Calamagrostis spp.</u>
14) Sedge Sphagnum bog	<u>Sphagnum moss</u> <u>Carex spp.</u>	<u>Salix spp.</u> <u>Eriophorum spp.</u>
15) Tall Sedge Marsh	<u>Carex lyngbyaei</u>	

~~16) Grass/Sedge/Salix~~  
~~For more detailed descriptions see plant collection, unpublished~~  
~~refuge reports attached, species descriptions from "Hulten"~~