AN EVALUATION OF PRODUCTIVITY AND MORTALITY FACTORS INFLUENCING GOOSE POPULATIONS

- a status report of the 1984 waterfowl monitoring effort at Kigigak Island, Alaska.

by

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All data and conclusions presented in this report are preliminary and not for publication or citation.

INTRODUCTION

From April through July 1984, an arctic nesting goose study was conducted on Kigigak Island, Yukon Delta National Wildlife Refuge (NWR), Alaska, as part of a refuge-wide waterfowl monitoring program. The Kigigak Island study was one of eight studies conducted at various sites on the refuge during the 1984 monitoring program. Two goals of this waterfowl monitoring effort are: first, to evaluate waterfowl productivity, particularly of brant (Branta bernicla nigricans), cackling Canada geese (B. canadensis minimus), emperor geese (Anser canagicus) and greater white-fronted geese (A. albifrons frontalis); and second, to determine both qualitatively and quantitatively what mortality factors influence goose nesting populations on the Yukon-Kuskokwim Delta.

Kigigak Island study site was initially established in the spring of 1982 primarily to assess brant productivity and was sampled as a study site in 1983 as part of the initial phase of the Yukon Delta NWR waterfowl monitoring program (Wege and Garrett 1983). It was selected as a study site because it sustains one of the five largest remaining aggregations of nesting brant on the Yukon Delta NWR (Wege and Garrett 1983). On Kigigak Island as well as elsewhere on the refuge, the number of brant nesting colonies and the number of brant utilizing traditional nesting areas appears to be substantially reduced (Jarvis and Bartonek 1979). Information gathered at Kigigak Island might provide baseline data on the population dynamics of geese on the island and serve as a comparative reference to other production areas on the Yukon-Kuskokwim Delta. This report describes the weather conditions; chronology of snow melt; arrival, harvest, production, and habitat utilization of brant, cackling Canada geese, emperor geese, and greater white-fronted geese at Kigigak Island, during the spring and summer of 1984.

STUDY AREA

Kigigak Island (60°50'N, 164°50'W) is a triangular shaped island approximately 20km^2 (8mi^2) in area, located along the coast of western Alaska adjacent to Nelson Island (Figure 1). A 3-person field camp was established on Kigigak Island from 25 April until 15 July 1984 (Julian days 115-196). The field camp was located in the west-central portion of the island 1.7km (1.05 mi) from the west coast and 2.7km (1.7 mi) from the south coast.

METHODS

Preparations

Sampling design, methods, table formats, and all calculations for table values were strictly prescribed by R. L. Garrett, biologist for Yukon Delta National Wildlife Refuge. To attempt to insure consistency in the application of these methods between different field camps, a 5-day training session for most field personnel was held just prior to the field season (16-21 April) at Oregon State University's Hatfield Marine Science Center, Newport, Oregon.

Daily Weather

Temperature ranges were estimated based on reports from Cape Romanzoff weather station, since thermometers at camp were inaccurate. Wind velocity and direction, and cloud cover was estimated daily at 0800 hours and any changes throughout the day that may have occurred were also noted. Type of precipitation (rain, drizzle, snow, sleet) was recorded and a rain gauge was used to determine accumulation. The date of last freeze, last snow fall and number of days with snow/rain or without precipitation was determined during the field season.

Snow Transects

Within the first week of field crew arrival at camp, a total of 9 transects were established each approximately 1.6km (1.0 mi) in length. Transects were flagged at 0.4km intervals. At each interval, two observers estimated the percent coverage of snow, melt-water and bare ground within a 100m x 200m rectangle, perpendicular to and centered on the transect. Melt-water that refroze was still recorded as melt-water but noted as frozen.

Three transects were sampled daily, so that each transect was sampled once every three days unless poor visibility prevented observations. The estimated percentage of each category (snow, melt-water, bare ground) were averaged for intervals of all transects conducted each day to obtain daily estimates of ground cover. The condition of ice and sequence of melt on lakes, ponds and sloughs were descriptively recorded as transects were run.

Chronology of Migration

Spring migration was observed daily at one hour intervals for a total of four hrs/day. Observation periods usually began at 0800 hours until 1200 hours unless inclement weather obscured visibility in which case the observation periods were delayed until later in the day or not conducted.

Observers stationed themselves about 15m north of camp. A 180° arc extending approximately 1/2 mi directly east and west of camp was established. Binoculars and a spotting scope were used to observe birds flying over or into the arc. Species, flock size and direction of flight of birds within the arc were recorded. In addition two ground counts were taken of all birds resting within the arc at 0800 and 1200 hours. Observations of courtship and pre-nesting behavior of paired geese were recorded. Dates of first arrival and peak arrival for each species observed on the study area were noted.

Subsistance Activity

The number of gunshots and vicinity of the shots were recorded daily. Additionally boat/snow machine motors and associated shots were also noted. Efforts were made when possible using a scope and binoculars to count the number of hunters in a party. If contact was made with the party, inquiries were made of their home village and hunting succes (i.e. number of birds, species). Locations of dead

geese and shotgun shells found while conducting plot surveys were recorded.

Observation were made of the number of people (adults, children) in egging groups, length of time spent egging, location of egged area, and number of associated shots fired while egging. Footprints to all nests located on plot surveys after egging incidents were noted.

Sample Plots (Calibration, Validation, Primary)

Sample plots were established utilizing three strategies based on modifications of Mayfield (1975). Plots were designated as either calibration, validation, or primary plots and were studied at different levels of intensity (high = calibration, medium = validation, low = primary). Calibration plots were sampled every three days from nest initiation through hatch to document chronology of reproductive events and occurrence of depredation. Validation plots were searched shortly after onset of incubation and sampled a second time at mid- to late-incubation. All nests that still had eggs on the second survey were rechecked a third time after peak hatch to determine their fate. Primary plots were surveyed once during mid-incubation and nests containing eggs were checked a second time after peak hatch to determine their fate.

Plot boundaries were irregular and usually established along natural physiographic features such as slough banks or pond edges. Plot size varied according to density of nesting birds in the area.

Three calibration plots were delineated in areas with high nesting densities of geese. Boundaries were determined during the initial search when a minimum of 50-100 brant nests and 25-50 cackler nests were located or a period of 24 man-hours of search time elapsed. Three validation and three primary plots were delineated in areas with medium nesting densities of geese. These were searched until a minimum of 20-30 brant and 20 cackler nests were located or 24 man-hours of search time elapsed. All plots were divided into subplots. Subplots were defined as units of the plot covered during 1 man-hour of search time. As search visits varied for each strategy, access routes to each plot were established to avoid intrusion and disturbance to other plots.

During the first three surveys in each calibration plot and the initial surveys in validation and primary plots, thorough nest searches were conducted in which all islands, shorelines, slough banks, and open field were searched. During subsequent visits, only nests previously located were rechecked.

Data Collection

The following information was recorded during each nest visit: plot number, strategy (calibration, validaton, primary), subplot letter, nest number, species, Julian day, male presence in area, female observed flushing from nest, distance from nest of observer when female flushed, number of eggs in nest, nest condition (presence of down, if strewn or intact, egg fragments, etc.), signs and sources of depredation, comments regarding nest status during incubation and hatching stages (i.e. detached membranes, number of goslings, number

of eggs found addled, abandoned, kicked out, etc.) and time spent at nest by observer. This same information was also recorded at each subsequent recheck visit.

Additionally on the initial visit, the nest location (island, shoreline, peninsula, field), island/peninsula size (LXW) and nest distance from water was recorded. The eggs present were numbered with the darkest stained (usually oldest) presumed first laid. A tongue depressor with nest number/species/date/number eggs was placed in ground next to nest rim. A flag or stake marked with the nest number was placed 5-10m from the nest. The nest and nest number was plotted on enlarged aerial photographs of the study area.

Nest Initiation and Onset of Incubation

The onset of the nest initiation period was determined from behavioral observation of pairs of geese. During surveys of calibration plots, nests with 1-3 eggs were considered to be located during initiation. Nests with more than 3 eggs were considered located after initiation. For nests in calibration plots in which egg laying sequence was observed on subsequent visits, back-dating was used to determine the day the nest was initiated.

Laying sequence was determined by numbering the eggs present when the nest was first located and numbering additional eggs on subsequent visits. One day was back-dated for each egg in the nest. For nests with five or more eggs, an extra day was skipped between the fourth and fifth egg (Garrett et al. 1983).

Nest initiation dates were also determined by back-dating from observed hatch dates. The timing of initial searches and frequency of visits in validation and primary plots did not allow for observation of laying sequence, therefore nest initiation dates were not determined unless hatch dates were observed.

The onset of incubation was determined by observed laying sequence, float angles (Westerskov 1950), and back-dating from observed hatch dates.

Determination of Hatch Date

Expected hatch dates were determined using pre-determined incubation periods for each species (brant-23 days, emperor-24 days, cacklers and white-fronts-26 days) (Garrett et al. 1983) and adding these to the date on which incubation began. Exact hatching dates were determined to be the day in which pipped eggs or goslings were observed at or near the nest.

Determination of Egg Loss

Egg loss referred to any egg that for some reason did not survive to hatch. The following situations occurred in which eggs were lost: 1) eggs kicked out of nest by flushing females (observed outside nest rim); 2) eggs that were addled; 3) eggs depredated (i.e. cracked shells, yolk in nest, egg fragments, missing eggs); 4) abandoned eggs

(i.e. cold, buried eggs); and 5) undetermined cause of egg loss.

Determination of Mortality

A nest was thought to be depredated if: 1) it was first located with down but no eggs were present in the bowl (since down is usually deposited with the second or third egg); 2) a larger number of eggs were previously known to be present on earlier visits (partial depredation); 3) nests which had egg fragments or yolk present.

Attempts were made to determine the source of mortality. Animal sign or tracks; eggs with puncture holes indicating gull (Larus sp.) or jaeger (Stercorarius sp.) predation; footprints to nest indicating human predation; storm tides or other environmental sources of mortality; and any instances of investigator caused mortality were recorded.

Brood Counts

On rechecks conducted during hatch, broods observed on the study area were noted; species, number of goslings, and location were recorded. In addition, brood surveys were conducted along the coast of the island (particularly the west coast).

After hatch, several attempts were made to approach areas where large concentrations of brant broods were feeding and resting. A spotting scope was used to record number of adults, number of goslings in a group and their location and age class. Brood counts were continued every 3-5 days until camp break up. This span of time allowed for counts of both class I and class II broods.

RESULTS

Daily Weather

Warm temperatures (38 - 40°F) and precipitation occurred from 26 April (day 116) to 29 April (day 119) resulting in rapid snow-melt. However, below freezing temperatures, intermittent snow and high winds from 30 April (day 120) through 12 May (day 132) caused all melt water to refreeze. From 13 May through 18 May temperatures ranged from 35 to 40°F, the majority of snow/ice melt occurred, and nesting habitat for geese was available. During peak nest initiation (25 May - 27 May, day 145 - 147), the study area experienced cold temperatures, wind and light snow.

The date of last freeze was 22 May (day 142). The date of last snowfall was 27 May (day 147). Between 27 April - 30 May (day 118 - 150), precipitation fell on 20 of 35 days with a total accumulation of 1.21 inches. Maximum temperatures (60 - 65°F) during the study occurred on nine days in June (days 152-156, 167, 171, 172, 175).

Snow Transects

Average percent coverage of snow, melt-water, and bare ground for nine transects is presented in Figure 2. From 26 April (day 117) to 5 May (day 125) snow cover changed to melt-water and subsequently

refroze. After 12 May (day 132) gradual melting occurred so that by 18 May (day 138) frozen melt-water had thawed, most ponds were ice-free, and dry nesting habitat was available.

Chronology of Migration

Small numbers (2-14) of brant, cackling Canada geese, emperor geese, and white-fronted geese were observed on 27-28 April (day 117-118), the day after the field camp was established (Figures 3 and 4). On 30 April (day 120) 26 cacklers/hr were observed flying north. Freezing temperature, high winds, and poor visibility ensued during the next week and few geese were observed. By 5 May (day 125) weather improved and on 6 May a large influx of emperor geese was observed. Small flocks of all four goose species were observed from 6 to 13 May (days 126-133).

Peak migration for emperors (11-13 May, day 131-133) preceded the peak for cacklers, white-fronts, and brant (13-16 May, day 133-136) by two days. During peak arrivals, 127 brant, 69 cacklers, 97 emperors, and 27 white-fronts were observed per hour. After peak arrivals, small flocks of brant, cacklers, and white-fronts continued to arrive through 23 May (day 143).

Subsistence Activity

With the arrival of emperor geese, subsistence activity began in the area. Gunshots and snow machines were heard frequently on 6 - 7 May (day 126-127) on the island and nearby on the frozen Bering Sea. On 8 May (day 128) a hunter who took two emperors was observed on the island. Harvest activity continued as cacklers, white-fronts, and brant arrived in peak numbers.

A party of eight was observed egging a brant colony in the southwest section of the island (calibration plot 3) during nest initiation. Seventy-one gunshots associated with this party were heard and a dead cackler and red-throated loon were later found in that vicinity.

Gunshots were heard infrequently off the island to the south and east during the nesting season (day 152 - 181). No hunters or eggers were observed on the island during this time.

Study Area Search

A total of 1422 nests were located, including 766 brant, 358 cackler, 89 emperor and 10 white-front nests (Tables 1-4). The mean number of nests/km^2 within plots ranged from 60-324 for brant, 36-96 for cacklers, and 4-50 for emperors. No values were determined for white-fronts due to low sample size. Density values, however, do not represent true densities since only nesting colonies or high density nesting areas were sampled.

Nest site preferences were apparent for geese on Kigigak Island (Table 4). Brant appeared to prefer island sites (56%) over peninsulas (15%) or "other" sites (29%) ("Other" sites included pond-shoreline, slough-shoreline, pingo tops, grass-flats, displaced islands and mudflats). Cacklers also selected for island sites (60%)

over peninsulas (18%) and "other" sites (22%). Emperor nests were located most frequently on "other" sites (54%), primarily shorelines. Islands (25%) and peninsulas (21%) were used less frequently by emperors for nest sites. Seven of 10 white-front nests were located on "other" sites, primarily slough-shorelines.

Nest Initiation

Nest initiation dates for 175 nests (86 brant, 68 cacklers, 19 emperors, and 2 white-fronts) were determined from observed laying sequences or back-calculated from observed hatch dates (Table 5). Brant, cackler, and emperor nests were initiated during 20, 21, and 11-day periods, respectively. Nest initiation for brant began as early as 18 May (day 138) and peaked during a six-day span from 24-29 May (day 144-149). Nest initiation for cacklers and emperors peaked during a period (23-27 May) similar to brant.

Nest initiation dates by nest location for geese in calibration plots I-III are presented in Tables 6-8. Sample sizes were small and no trends in initiation date by nest location were apparent in individual calibration plots.

For nests in which the initiation date was determined, the number of nests not located during the first plot search after initiation is displayed in Tables 9-11 for calibration plots I-III. For all three plots, 16% of the nests were not located during the first search after their initiation.

Clutch Size

Modal "complete" clutch size was three for brant, five for cacklers, and five for emperors (Table 12). "Incomplete" clutch sizes were slightly less than "complete" clutch sizes (Tables 13-23). Sample sizes of "complete" clutches by nest location and species were too small when disaggregated by plot to determine if clutch size varied with nest location (Table 24-32). For brant, cacklers, and emperors, larger "complete" clutches generally were initiated earlier than smaller "complete" clutches (Tables 33-35).

Hatch Date

The period of hatch in calibration plots (Table 36) was 10 days for brant (16-25 June, day 167-176), 14 days for cacklers (17-30 June, day 168-181), and 8 days for emperors (16-23 June, day 167-174). Peak hatch for brant occurred earlier (day 168-170) than peaks for emperors (day 170-172) and cacklers (day 172 and day 176). Similarly, in validation and primary plots (Table 37), peak of hatch for cacklers was later than peaks for brant and emperors.

Nest Success

Percent nest success was based on only 438 of 1422 nests for which nest status (fate) was determined. A majority of 954 nests for which fate was undetermined were probably nest scrapes, empty nest bowls from previous years or nests depredated soon after initiation. A

discrimination between these types was not made in the field. As a result, nest success may be grossly overestimated due to the large number of nests that were potentially depredated but included in a category for nest status (fate) undetermined.

Nest success based only on 438 nests in which status was determined is presented in Table 38 for geese at different nest locations.

Nests in calibration plots were visited as many as 10 times during the course of field work (Table 39-47). It was unclear if nest success decreased with an increase in human disturbance as measured by number of pre-hatch visits. For nests in which the fate was determined, the frequency of nests that contained abandoned or unhatched eggs is presented in Table 52.

For brant, cacklers, and emperors in calibration plots, nest success generally increased as clutch size increased (Tables 48-51).

Nest Depredation

Major causes of nest depredation were avian and mammalian predators. Subsistence egging by Eskimos was minimal. The major source of mammalian depredation on the study area was attributed to fox (*Vulpes sp.*). Fox and fox sign were frequently observed in calibration plot I, validation plot I and validation plot II, which were located near an active fox den. Depredation by avian predators occurred, particularly in brant colonies. Gulls and parasitic jaeger were the most common avian predators.

Depredation may be grossly underestimated since fate was undetermined for 954 nests. For those nests in which fate was determined, the percent of nests sustaining "animal" predation (non-egging) for all plots was 14% for brant, 8% for cacklers, and 5% for emperors (Table 54). The percent of nests which were unsuccessful due to spring harvest (egging) in calibration plots was highest for brant (24%) compared to cacklers (4%) and emperors (5%) (Table 53). Average egg loss from nests that lost eggs ranged from 1.0 to 7.0 for calibration, validation, and primary plots (Tables 1-3).

Brood Size

A total of 50 (36 class I, 14 class II) cackler broods, 30 (15 class I, 15 class II) brant broods, 12 (class I) emperor broods and 2 (class I) white-front broods were observed on Kigigak Island (Figure 5) during brood counts. Concentrations of brant broods were observed in the southwest portion of the island near calibration plot III, while broods of emperors and cacklers were observed more frequently on the west coast and on inland ponds and sloughs.

Average brood size for class I goslings was 3.1 for brant, 3.7 for cacklers, and 4.0 for emperors. Class II broods were first observed on 12 July (day 193). Average brood size for class II goslings was 3.1 for brant and 3.3 for cacklers.

DISCUSSION

Nest Initiation

Nest initiation for brant, cacklers, and emperors occurred simultaneously and peaked for all three species between 23 and 27 May (Table 5). This peak occurred 10 to 14 days after peak arrival dates, which occurred between 11 and 16 May for all three species (Figures 3 and 4). Milder weather coincided with peak arrival dates; however, cold temperatures, high wind and light snow accompanied the peak of nest initiation.

The periods of nest initiation for brant and cacklers ranged 21 and 20 days, respectively, while the period for emperors ranged 11 days (Table 5). The smaller range for emperors was probably due to a smaller sample size in comparison to brant and cacklers.

Most nesting habitat was free of snow and melt-water five to seven days prior to the onset of nest initiation and a correlation between availability of habitat and nest initiation was not apparent. Sample sizes for species within plots were too small to detect any trends between nest initiation dates and nest site locations.

Human Disturbance

Impact of nest sampling on depredation of brant nests could not be determined from comparisons of sampling strategies (calibration = high disturbance, primary = low disturbance), because nesting densities decreased between calibration, validation, and primary plots, respectively, and denser plots were likely to be less susceptible to predation due to communal defense behavior exhibited by brant.

Nest Distribution

Cackler and emperor nests were distributed in a scattered pattern throughout the study area in contrast to brant nests, which occurred in small aggregations. Nesting density values for brant represent densities within plots and should not be extrapolated beyond plot boundaries, since plots were located to sample high density areas.

RECOMMENDATIONS

1. Specify and prioritize objectives of the monitoring program so that important information (i.e. production and mortality data) is not lost by the effort to obtain less important information (handling time, egg karma).

2. Design concise data collection formats. Eliminate the data coding system used, which was too confusing, time-consuming, ambiguous, and repetitive. Key punch computer cards could be used for each nest visit and then entered directly into a computer system without transcription and associated errors. A camp log of the status of each nest should be maintained.

3. Pre-season training sessions should be conducted again and required for all field personnel including local native hires. Emphasis should be on clearly defining methods and terminology to be

used (i.e. so definition of nest/nest scrape/last year's bowl will not result in 954 of 1422 nests with status undetermined). A concise written summary of techniques should be distributed to all camps.

4. Subplot searches should be eliminated; the major reason being that searches by several people in one area by subplot disturbs birds for a longer period of time, often flushing and reflushing birds. Also, search methods and search rates vary by individual and with the terrain of the plot. Subplot data did not accurately describe nesting densities of geese or individual search rates (i.e. nests of other species were also located which affected time in subplot and which were not included in analysis).

5. Discontinue use of calibration plots and expand the use of validation plots. This should be done to reduce the amount of disturbance to high density nesting areas, particularly during nest initiation and hatch periods.

6. Permanently-staked snow transects and photo-plots should be established so year-to-year comparisons could be made.

7. More emphasis and effort should be put into brood counts.

8. Reports should be revised to summarize important analyzed data, using concise tables and figures to display pertinent relationships rather than an extensive reiteration of raw data.

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Table 1. Production data for Pacific black brant at Kigigak Island, 1984.

Category	Plot								
	Calibration			Validation			Primary		
	I	II	III	I	II	III	I	II	III
Number of nests located	55	48	172	28	100	78	37	173	90
Number of nests for which status was determined	14	8	53	4	23	5	28	72	7
Number of nests/km^2	100	60	324	57	217	170	97	145	121
Number of nests/mi^2	260	155	834	148	561	442	250	375	313
Average size of "complete" clutch	3.0(6)[a] ±0.6[b]	3.1(12) ±1.1	3.7(28) ±1.1	—	—	—	—	—	—
Average number of eggs/nest at the end of incubation[c]	0.3(34)	0.3(28)	1.2(69)	0.3(4)	1.2(46)	1.1(18)	3.0(30)	2.4(112)	1.2(13)
Average egg loss from nests that lost eggs	2.7(31)	2.5(26)	2.0(51)	2.3(3)	2.4(33)	2.9(13)	2.0(6)	4.2(62)	2.0(9)
Average size of clutch that hatched[d]	2.0(4)	2.7(3)	2.9(28)	1.0(1)	3.0(18)	3.3(4)	3.6(25)	4.0(65)	3.2(5)
Average number of goslings hatched per nest[e]	0.2	0.2	0.5	<0.1	0.5	0.2	2.5	1.6	0.2
Percent of successful nests	28.6	37.5	52.8	25.0	78.3	80.0	89.3	90.3	71.4

[a] Figures in parentheses are sample sizes.

[b] Standard deviation.

[c] This = $(B-C)/N_b$, where B = total number of eggs observed in all nests, C = minimum number of eggs known to have been lost from all nests, and N_b = total number of nests in which eggs were observed. Nests depredated before the first nest visit are not included in this average; nests depredated during early, mid, or late incubation, are included in this average. This equation prescribed by R.L. Garrett (pers. comm.).

[d] This = $(B-C)/N_g$, where B and C are defined above, and N_g = total number of successfull nests. Eggs of undetermined fate (unknown if hatched or predated) are counted as hatched. This equation prescribed by R.L. Garrett (pers. comm.).

[e] This = $(B-C)/N_l$, where B and C are defined above, and N_l = total number of nests (includes nests which were observed with eggs (N_b) and nests which were never observed with eggs). Eggs of undetermined fate are assumed to have hatched. This equation prescribed by R.L. Garrett (pers. comm.).

Table 2. Production data for cackling Canada geese at Kigigak Island, 1984.

Category	Plot								
	Calibration			Validation			Primary		
	I	II	III	I	II	III	I	II	III
Number of nests located	20	46	33	43	44	24	26	76	50
Number of nests for which status was determined	11	29	120	14	18	10	14	36	17
Number of nests/km^2	36	58	62	88	96	52	68	64	68
Number of nests/mi^2	95	149	160	227	247	135	175	165	174
Average size of "complete" clutch	5.3(9)[a] ±1.3[b]	5.0(30) ±1.1	5.0(11) ±1.2	—	—	—	—	—	—
Average number of eggs/nest at the end of incubation[c]	2.6(14)	2.9(40)	3.0(15)	2.2(25)	3.1(23)	2.4(14)	4.9(14)	3.0(43)	3.9(19)
Average egg loss from nests that lost eggs	2.4(10)	2.5(21)	2.4(8)	2.8(12)	1.9(11)	3.9(9)	—	2.4(11)	2.6(7)
Average size of clutch that hatched[d]	4.5(8)	4.6(25)	4.5(10)	3.9(12)	4.4(16)	4.9(7)	5.0(13)	3.5(35)	4.4(17)
Average number of goslings hatched per nest[e]	1.8	2.5	1.4	1.3	1.6	1.4	2.7	1.7	1.5
Percent of successful nests	72.7	86.2	83.3	85.7	88.9	70.0	92.9	97.2	100.0

[a] Figures in parentheses are sample sizes.

[b] Standard deviation.

[c] This = $(B-C)/N_b$, where B = total number of eggs observed in all nests, C = minimum number of eggs known to have been lost from all nests, and N_b = total number of nests in which eggs were observed. Nests depredated before the first nest visit are not included in this average; nests depredated during early, mid, or late incubation, are included in this average. This equation prescribed by R.L. Garrett (pers. comm.).

[d] This = $(B-C)/N_g$, where B and C are defined above, and N_g = total number of successfull nests. Eggs of undetermined fate (unknown if hatched or predated) are counted as hatched. This equation prescribed by R.L. Garrett (pers. comm.).

[e] This = $(B-C)/N_1$, where B and C are defined above, and N_1 = total number of nests (includes nests which were observed with eggs (N_b) and nests which were never observed with eggs). Eggs of undetermined fate are assumed to have hatched. This equation prescribed by R.L. Garrett (pers. comm.).

Table 3. Production data for emperor geese at Kigigak Island, 1984.

Catgory	Plot								
	Calibration			Validation			Primary		
	I	II	III	I	II	III	I	II	III
Number of nests located	14	12	2	7	12	2	19	16	5
Number of nests for which status was determined	7	11	1	4	5	2	17	12	3
Number of nests/km^2	25	15	4	14	26	4	50	13	7
Number of nests/mi^2	66	39	10	37	67	11	128	35	17
Average size of "complete" clutch	5.0(4)[a] ±1.8[b]	6.0(11) 1.9	—	—	—	—	—	—	-
Average number of eggs/nest at the end of incubation[c]	2.4(8)	5.3(12)	0.0(2)	3.3(6)	5.2(6)	4.0(2)	5.1(17)	5.6(15)	4.5(4)
Average egg loss from nests that lost eggs	2.7(6)	1.3(3)	1.0(2)	3.0(3)	2.3(3)	—	1.0(1)	7.0(1)	3.0(2)
Average size of clutch that hatched[d]	4.8(4)	5.8(11)	—	5.0(4)	7.0(4)	4.0(2)	5.1(17)	5.8(12)	6.0(3)
Average number of goslings hatched per nest[e]	1.4	5.3	3.0	2.9	2.9	4.0	4.5	5.3	3.6
Percent of succeasful nests	57.1	100.0	0.0	100.0	80.0	100.0	100.0	100.0	100.0

[a] Figures in parentheses are sample sizes.

[b] Standard deviation.

[c] This = $(B-C)/N_b$, where B = total number of eggs observed in all nests, C = minimum number of eggs known to have been lost from all nests, and N_b = total number of nests in which eggs were observed. Nests depredated before the first nest visit are not included in this average; nests depredated during early, mid, or late incubation, are included in this average. This equation prescribed by R.L. Garrett (pers. comm.).

[d] This = $(B-C)/N_g$, where B and C are defined above, and N_g = total number of successfull nests. Eggs of undetermined fate (unknown if hatched or predated) are counted as hatched. This equation prescribed by R.L. Garrett (pers. comm.).

[e] This = $(B-C)/N_l$, where B and C are defined above, and N_l = total number of nests (includes nests which were observed with eggs (N_b) and nests which were never observed with eggs). Eggs of undetermined fate are assumed to have hatched. This equation prescribed by R.L. Garrett (pers. comm.).

Table 4. Nest site locations for geese at Kigigak Island, 1984.

Species Plot	Nest Location						Total
	Island		Peninsula		Other[a]		
BRANT:							
Calibration I	38	(70)[b]	13	(24)	3	(6)	54
Calibration II	11	(26)	17	(40)	14	(33)	42
Calibration III	43	(26)	24	(14)	99	(60)	166
Validation I	14	(52)	5	(18)	8	(30)	27
Validation II	97	(97)	2	(2)	1	(1)	100
Validation III	24	(31)	18	(23)	36	(46)	78
Primary I	33	(89)	4	(11)	—		37
Primary II	127	(73)	6	(3)	40	(23)	173
Primary III	40	(45)	24	(27)	25	(28)	89
Subtotal	427	(56)	113	(15)	226	(29)	766
CACKLERS:							
Calibration I	16	(84)	2	(11)	1	(5)	19
Calibration II	32	(73)	6	(14)	6	(14)	44
Calibration III	12	(38)	4	(12)	16	(50)	32
Validation I	31	(72)	4	(9)	8	(19)	43
Validation II	26	(59)	10	(23)	8	(18)	44
Validation III	12	(50)	2	(8)	10	(42)	24
Primary I	16	(62)	10	(38)	—		26
Primary II	41	(54)	19	(25)	16	(21)	76
Primary III	30	(60)	6	(12)	14	(28)	50
Subtotal	216	(60)	63	(18)	79	(22)	358
EMPERORS:							
Calibration I	4	(28)	5	(36)	5	(36)	14
Calibration II	5	(42)	1	(8)	6	(50)	12
Calibration III	1	(50)	—		1	(50)	2
Validation I	2	(29)	—		5	(71)	7
Validation II	1	(8)	3	(25)	8	(67)	12
Validation III	1	(50)	—		1	(50)	2
Primary I	6	(32)	6	(32)	7	(37)	19
Primary II	2	(12)	3	(19)	11	(69)	16
Primary III	—		1	(20)	4	(80)	5
Subtotal	22	(25)	19	(21)	48	(54)	89
WHITE-FRONTS:							
Calibration II	—		1	(50)	1	(50)	2
Validation I	1	(100)	—		—		1
Validation II	—		—		3	(100)	3
Primary I	1	(25)	—		3	(75)	4
Subtotal	2	(20)	1	(10)	7	(70)	10
Total	667	(55)	196	(16)	360	(29)	1223

[a] Includes: pond-shoreline; slough-shoreline; pingo top; grass flat; displaced island; and mudflat.

[b] Number in parentheses are percentages.

Table 5. Nest initiation dates for Pacific black brant, cackling Canada geese, emperor geese and Pacific white-fronted geese at Kigigak Island, 1984.

Species	Julian day																												
Plot	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
BRANT:																													
Calibration I	0	0	0	0	0	0	0	0	0	1	1	5	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	13
Calibration II	0	0	0	0	0	0	0	0	0	0	1	0	3	8	2	4	3	1	2	0	0	0	2	0	0	0	0	0	26
Calibration III	0	0	0	0	0	1	0	0	1	2	2	4	5	5	3	6	9	3	1	2	1	1	1	0	0	0	0	0	47
Subtotal	0	0	0	0	0	1	0	0	1	3	4	9	9	14	5	10	12	4	3	2	1	2	3	1	1	0	0	0	86
CACKLERS:																													
Calibration I	0	0	0	0	0	0	0	0	0	0	2	0	0	5	1	3	0	1	1	0	0	0	0	0	0	0	0	0	13
Calibration II	0	0	0	0	0	0	0	2	2	1	5	5	2	5	8	1	3	0	0	1	0	1	0	0	0	0	0	0	36
Calibration III	0	0	0	0	0	0	0	0	0	0	1	3	4	1	0	1	0	2	1	0	2	0	0	0	0	0	0	0	15
Validation IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
Primary I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Subtotal	0	0	0	0	0	0	0	2	2	1	8	9	6	11	9	5	3	3	2	1	2	1	0	0	0	1	1	1	68
EMPERORS:																													
Calibration I	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	7
Calibration II	0	0	0	0	0	0	0	1	1	2	1	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Subtotal	0	0	0	0	0	0	0	2	1	2	3	2	3	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0	19
WHITE-FRONTS:																													
Calibration II	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Subtotal	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	0	0	0	0	0	1	1	4	4	6	15	20	18	28	15	16	15	9	5	3	3	3	3	1	1	0	0	0	175

Table 6. Initiation dates by nest location for Pacific black brant, cackling Canada geese, and emperor geese in calibration plot I at Kigigak Island, 1984.

Species	Julian day																													
Plot	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
BRANT:																														
Island	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	9
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	1	5	1	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0	12
CACKLERS:																														
Island	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5	1	2	0	0	1	0	0	0	0	0	0	0	0	0	11
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5	1	2	0	1	1	0	0	0	0	0	0	0	0	0	12
EMPERORS:																														
Island	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Peninsula	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
Other	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Subtotal	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	7
TOTAL	0	0	0	0	0	0	0	0	1	0	0	5	6	1	6	1	3	0	3	1	0	1	1	0	1	1	0	0	0	31

Table 7. Initiation dates by nest location for Pacific black brant, cackling Canada geese, emperor geese and Pacific white-fronted geese in calibration plot 11 at Kigigak Island, 1984.

Species	Julian day																													
Plot	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
BRANT:																														
Island	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	3	0	0	0	0	0	0	0	0	0	0	0	8
Peninsula	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	2	0	0	0	0	0	0	1	0	0	0	0	0	6
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	0	1	0	0	0	0	0	0	0	0	0	0	8
Subtotal	0	0	0	0	0	0	0	0	0	0	0	1	0	3	7	2	4	3	1	0	0	0	0	1	0	0	0	0	0	22
CACKLERS:																														
Island	0	0	0	0	0	0	0	0	2	2	1	3	3	2	3	7	1	1	0	0	0	0	0	0	0	0	0	0	0	25
Peninsula	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	4
Other	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	6
Subtotal	0	0	0	0	0	0	0	0	2	2	1	5	5	2	5	8	1	2	0	0	1	0	1	0	0	0	0	0	0	35
EMPERORS:																														
Island	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Subtotal	0	0	0	0	0	0	0	0	1	1	2	1	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12
WHITE-FRONTS:																														
Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Subtotal	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	0	0	0	0	0	0	0	1	3	3	3	7	6	8	15	11	5	5	1	0	1	0	1	1	0	0	0	0	0	71

Table 8. Initiation dates by nest location for Pacific black brant and cackling Canada geese in calibration plots III at Kigigak Island, 1984.

Species	Julian day																													
Plot	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
BRANT:																														
Island	0	0	0	0	0	0	0	0	0	1	2	2	1	3	1	0	3	4	0	0	1	0	0	0	0	0	0	0	0	18
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	7
Other	0	0	0	0	0	0	1	0	0	0	0	0	3	1	4	3	2	4	2	1	0	0	0	1	0	0	0	0	0	22
Subtotal	0	0	0	0	0	0	1	0	0	1	2	2	4	5	5	3	6	9	3	1	2	1	1	1	0	0	0	0	0	47
CACKLERS:																														
Island	0	0	0	0	0	0	0	0	0	0	0	1	3	3	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	9
Peninsula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	4
Subtotal	0	0	0	0	0	0	0	0	0	0	0	1	3	4	1	0	1	0	2	1	0	2	0	0	0	0	0	0	0	15
TOTAL	0	0	0	0	0	0	1	0	0	1	2	3	7	9	6	3	7	9	5	2	2	3	1	1	0	0	0	0	0	62

Table 9. The number of goose nests located[a] during successive searches of calibration plot I at Kigigak Island, 1984.

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian Day	Located	Not Located	Total
Brant	1	146	8	1	9
	2	151	0	0	0
	3	154	2	0	2
	4	157	2	0	2
Total			12	1	13
Cackler	1	146	3	1	4
	2	151	6	3	9
	3	154	0	0	0
Total			9	4	13
Emperor	1	146	4	0	4
	2	151	3	0	3
	3	154	0	0	0
Total			7	0	7

[a] Includes only nests for which initiation date was determined.

Table 10. The number of goose nests located[a] during successive searches of calibration plot II at Kigigak Island, 1984.

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian Day	Located	Not Located	Total
Brant	1	149	20	1	21
	2	152	2	1	3
	3	155	2	-	2
Total			24	2	26
Cackler	1	149	30	3	33
	2	152	1	1	2
	3	155	2	0	2
Total			33	4	37
Emperor	1	149	10	1	11
	2	152	0	0	0
	3	155	0	0	0
Total			10	1	11
White-front	1	149	2	1	3
	2	152	0	0	0
	3	155	0	0	0
Total			2	1	3

[a] Includes only nests for which initiation date was determined.

Table 11. The number of goose nests located[a] during successive searches of calibration plot III at Kigigak Island, 1984.

Species	Successive Search		Number of nests initiated since last search		
	Number	Julian Day	Located	Not Located	Total
Brant	1	150	31	10	41
	2	153	1	2	3
	3	156	3	0	3
Total			35	12	47
Cackler	1	150	11	1	12
	2	153	2	0	2
	3	156	1	0	1
Total			14	1	15

[a] Includes only nests for which initiation date was determined.

Table 12. Frequency of clutch size from "complete"[a] clutches for geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch Size U	1	2	3	4	5	6	7	8	9	10	Total
BRANT:												
Calibration I	–	1	4	1	–	–	–	–	–	–		6
Calibration II	1	2	5	3	1	–	–	–	–	–		12
Calibration III	–	4	10	6	7	1	–	–	–	–		28
Subtotal	1	7	19	10	8	1	–	–	–	–		46
CACKLERS:												
Calibration I	–	–	1	1	3	2	2	–	–	–		9
Calibration II	–	–	3	6	12	7	2	–	–	–		30
Calibration III	–	–	1	3	3	3	1	–	–	–		11
Subtotal	–	–	5	10	18	12	5	–	–	–		50
EMPERORS:												
Calibration I	–	–	1	1	–	1	1	–	–	–		4
Calibration II	–	–	–	2	4	2	–	2	–	1		11
Calibration III	–	–	–	–	–	–	–	–	–	–		0
Subtotal	–	–	1	3	4	3	1	2	0	1		15
WHITE-FRONTS:												
Calibration I	–	–	–	–	–	–	–	–	–	–		0
Calibration II	–	–	–	–	–	–	1	–	–	–		1
Calibration III	–	–	–	–	–	–	–	–	–	–		0
Subtotal	–	–	–	–	–	–	1	–	–	–		1
TOTAL	1	7	25	23	30	16	7	2	0	1		112

[a] Clutches which were discovered during the laying sequence, and the number of eggs in the nest increased on at least two successive vists and then remained the same for at least two successive visits.

Table 13. Frequency of clutch size from "incomplete"[a] clutches for Pacific black brant in calibration plots at Kigigak Island, 1984.

	Clutch Size										
Plot	U	1	2	3	4	5	6	7	8	9	Total
Calibration I	1	7	5	9	4	2	1	-	-	-	29
Calibration II	-	5	3	7	1	-	-	-	-	-	16
Calibration III	5	17	12	8	3	1	-	-	-	3	49
Total	6	29	20	24	8	3	1	-	-	3	94

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 14. Frequency of clutch size from "incomplete"[a] clutches for Pacific black brant in validation plots at Kigigak Island, 1984.

Plot	Clutch Size										Total
	U	1	2	3	4	5	6	7	8	9	
Validation I	-	1	2	1	-	-	-	-	-	-	4
Validation II	-	6	10	17	10	2	1	-	-	-	46
Validation III	-	2	3	6	6	-	1	-	-	-	18
Total	-	9	15	24	16	2	2	-	-	-	68

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 15. Frequency of clutch size from "incomplete"[a] clutches for Pacific black brant in primary plots at Kigigak Island, 1984.

	Clutch Size											
Plot	U	1	2	3	4	5	6	7	8	9	<9	Total
Primary I	-	1	5	12	7	2	3	-	-	-	-	30
Primary II	-	7	18	16	17	15	15	9	4	3	8	112
Primary III	-	3	4	2	3	1	-	-	-	-	-	13
Total	-	11	27	30	27	18	18	9	4	3	8	155

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 16. Frequency of clutch size from "incomplete"[a] clutches for cackling Canada geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch Size										
	U	1	2	3	4	5	6	7	8	9	Total
Calibration I	-	3	-	-	1	1	-	-	-	-	5
Calibration II	-	4	5	-	-	1	-	-	-	-	10
Calibration III	-	1	1	2	-	-	-	-	-	-	4
Total	-	8	6	2	1	2	-	-	-	-	19

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 17. Frequency of clutch size from "incomplete"[a] clutches for cackling Canada geese in validation plots at Kigigak Island, 1984.

Plot	Clutch Size										
	U	1	2	3	4	5	6	7	8	9	Total
Validation I	-	3	4	6	5	3	4	-	-	-	25
Validation II	-	3	2	2	7	4	4	1	-	-	23
Validation III	-	-	-	1	4	4	5	-	-	-	14
Total	-	6	6	9	16	11	13	1	-	-	62

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 18. Frequency of clutch size from "incomplete"[a] clutches for cackling Canada geese in primary plots at Kigigak Island, 1984.

	Clutch Size										
Plot	U	1	2	3	4	5	6	7	8	9	Total
Primary I	-	1	1	-	3	3	3	3	-	-	14
Primary II	-	6	5	12	6	8	5	1	-	-	43
Primary III	-	1	-	4	2	7	3	-	1	-	18
Total	-	8	6	16	11	18	11	4	1	-	75

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 19. Frequency of clutch size from "incomplete"[a] clutches for emperor geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch Size										Total
	U	1	2	3	4	5	6	7	8	9	
Calibration I	-	-	1	1	1	-	1	-	-	-	4
Calibration II	-	-	1	-	-	-	-	-	-	-	1
Calibration III	-	2	-	-	-	-	-	-	-	-	2
Total	-	2	2	1	1	-	1	-	-	-	7

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 20. Frequency of clutch size from "incomplete"[a] clutches for emperor geese in validation plots at Kigigak Island, 1984.

	Clutch Size										
Plot	U	1	2	3	4	5	6	7	8	9	Total
Validation I	-	1	-	1	1	-	1	1	1	-	6
Validation II	-	-	-	1	1	1	1	-	1	-	5
Validation III	-	-	-	1	-	1	-	-	-	-	2
Total	-	1	-	3	2	2	2	1	2	-	13

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 21. Frequency of clutch size from "incomplete"[a] clutches for emperor geese in primary plots at Kigigak Island, 1984.

	Clutch Size											
Plot	U	1	2	3	4	5	6	7	8	9	<9	Total
Primary I	-	1	2	-	5	4	1	2	1	-	1	17
Primary II	-	-	1	2	1	1	5	3	-	-	2	15
Primary III	-	-	-	-	2	1	-	-	-	-	1	4
Total	-	1	3	2	8	6	6	5	1	-	4	36

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 22. Frequency of clutch size from "incomplete"[a] clutches for white-fronted geese in validation plots at Kigigak Island, 1984.

	Clutch Size										
Plot	U	1	2	3	4	5	6	7	8	9	Total
Validation I	-	-	-	1	-	-	-	-	-	-	1
Validation II	-	-	1	-	-	1	1	-	-	-	3
Validation III	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	1	1	-	1	1	-	-	-	4

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 23. Frequency of clutch size from "incomplete"[a] clutches for white-fronted geese in primary plots at Kigigak Island, 1984.

	Clutch										
Plot	U	1	2	3	4	5	6	7	8	9	Total
Primary I	-	-	-	1	1	-	1	1	-	-	4
Primary II	-	-	-	-	-	-	-	-	-	-	-
Primary III	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	1	1	-	1	1	-	-	4

[a] "Incomplete" indicates that the number of eggs present during nest revists did not meet the criteria for defining a complete clutch.

Table 24. Frequency of clutch size from "complete" clutches by nest location for Pacific black brant in calibration plot I at Kigigak Island, 1984.

	Nest Location			
Clutch Size	Island	Peninsula	Other[a]	Total
1	0	0	0	0
2	0	1	0	1
3	2	1	0	3
4	1	0	0	1
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	3.3±0.3 (3)[b]	2.5±0.5(2)	0	3.0±0.3 (5)

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

[b] Number in parentheses are sample sizes.

Table 25. Frequency of clutch size from "complete" clutches by nest location for Pacific black brant in calibration plot II at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	1	1
2	1	0	0	1
3	2	0	2	4
4	1	0	2	3
5	0	0	1	1
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	3.0±0.4 (4)[b]	0	3.3±0.6(6)	3.2±0.4 (10)

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

[b] Number in parentheses are sample sizes.

Table 26. Frequency of clutch size from "complete" clutches by nest location for Pacific black brant in calibration plot III at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	0	0
2	0	0	4	4
3	4	3	3	10
4	2	1	3	6
5	5	1	1	7
6	0	0	1	1
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	4.1±0.3(11)[b]	3.6±0.4(5)[b]	3.3±0.4(12)	3.7±0.2(28)

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

[b] Number in parentheses are sample sizes.

Table 27. Frequency of clutch size from "complete" clutches by nest location for cackling Canada geese in calibration plot I at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	0	0
2	0	0	0	0
3	0	1	0	1
4	0	0	0	0
5	3	0	0	3
6	2	0	0	2
7	2	0	0	2
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	5.9±0.3 (7)[b]	-	0	5.5±0.5 (8)

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

[b] Number in parentheses are sample sizes.

Table 28. Frequency of clutch size from "complete" clutches by nest location for cackling Canada geese in calibration plot II at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	0	0
2	0	0	0	0
3	2	0	1	3
4	5	0	1	6
5	9	1	1	11
6	4	1	2	7
7	2	0	0	2
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	5.0±0.2(22)[b]	5.5±0.5 (2)	4.8±0.6 (5)	5.0±0.2 (29)

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

[b] Number in parentheses are sample sizes.

Table 29. Frequency of clutch size from "complete" clutches by nest location for cackling Canada geese in calibration plot III at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	0	0
2	0	0	0	0
3	0	1	0	1
4	1	1	1	3
5	2	0	1	3
6	3	0	0	3
7	1	0	0	1
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	5.6±0.4 (7)[b]	3.5±0.5 (2)	4.5±0.5 (2)	5.0±0.4 (11)

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

[b] Number in parentheses are sample sizes.

Table 30. Frequency of clutch size from "complete" clutches by nest location for emperor geese in calibration plot I at Kigigak Island, 1984.

	Nest Location			
Clutch Size	Island	Peninsula	Other[a]	Total
1	0	0	0	0
2	0	0	0	0
3	0	1	0	1
4	0	0	1	1
5	0	0	0	0
6	0	1	0	1
7	0	1	0	1
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	0	5.3±1.2 (3)[b]	-	5.0±0.9 (4)

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

[b] Number in parentheses are sample sizes.

Table 31. Frequency of clutch size from "complete" clutches by nest location for emperor geese in calibration plot II at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	1	1	0	2
5	3	0	1	4
6	0	0	2	2
7	0	0	0	0
8	1	0	1	2
9	0	0	0	0
Mean ± S.E.	5.4±0.7 (5)[b]	-	6.2±0.6 (4)	5.6±0.5 (10)

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

[b] Number in parentheses are sample sizes.

Table 32. Frequency of clutch size from "complete" clutches by nest location for Pacific white-fronted geese in calibration plot II at Kigigak Island, 1984.

Clutch Size	Nest Location			Total
	Island	Peninsula	Other[a]	
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	1	1
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
Mean ± S.E.	0	0	-	-

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

[b] Number in parentheses are sample sizes.

Table 33. Nest initiation dates by clutch size from "complete" clutches for Pacific black brant at Kigigak Island, 1984.

Clutch Size	Julian day																														
	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	1	0	0	0	1	0	0	0	0	0	7
3	0	0	0	0	0	0	0	0	0	0	1	0	2	3	4	1	2	2	1	0	1	0	1	0	0	0	0	0	0	18
4	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	2	1	0	0	0	1	1	0	0	0	0	0	0	0	10
5	0	0	0	0	0	0	1	0	0	1	2	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8
6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	0	1	3	0	5	7	8	3	3	6	1	1	2	1	1	1	0	0	0	0	0	44

Table 34. Nest initiation dates by clutch size from "complete" clutches for cackling Canada geese at Kigigak Island, 1984.

Clutch Size	Julian day																														
	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	5
4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	1	0	1	0	1	1	0	0	0	0	0	0	0	10
5	0	0	0	0	0	0	0	0	2	1	0	1	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	17
6	0	0	0	0	0	0	0	0	0	0	0	6	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	12
7	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	2	2	1	8	6	6	7	6	3	2	2	1	1	1	1	0	0	0	0	0	0	49

Table 35. Nest initiation dates by clutch size from "complete" clutches for emperor geese at Kigigak Island, 1984.

Clutch Size	Julian day																														
	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
5	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
6	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	1	1	2	2	1	3	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	14

Table 36. Observed hatch dates for Pacific black brant, cackling Canada geese, and emperor geese in calibration plots at Kigigak Island, 1984.

	Julian day																												
Species - Plot	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	Total
BRANT:																													
Calibration I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Calibration II	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Calibration III	0	0	0	0	0	0	0	0	0	3	7	0	5	3	2	1	1	1	3	0	0	0	0	0	0	0	0	0	26
Subtotal	0	0	0	0	0	0	0	0	0	3	7	2	7	3	2	1	1	1	3	0	0	0	0	0	0	0	0	0	30
CACKLERS:																													
Calibration I	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	3	1	0	1	0	0	0	0	0	0	8
Calibration II	0	0	0	0	0	0	0	0	0	0	0	2	5	1	9	0	1	0	2	1	1	0	0	1	0	0	0	0	23
Calibration III	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	0	4	1	0	0	0	0	0	0	0	0	10
Subtotal	0	0	0	0	0	0	0	0	0	0	1	2	5	3	9	1	5	0	9	3	1	1	0	1	0	0	0	0	41
EMPEROR:																													
Calibration I	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Calibration II	0	0	0	0	0	0	0	0	0	1	0	0	2	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	9
Calibration III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	1	0	1	4	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	12
TOTAL	0	0	0	0	0	0	0	0	0	4	8	5	16	7	15	2	7	1	12	3	1	1	0	1	0	0	0	0	83

Table 37. Observed hatch dates for Pacific black brant, cackling Canada geese, emperor geese and Pacific white-fronted geese in validation and primary plots at Kigigak Island, 1984.

	Julian day																													
Species - Plot	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	Total
BRANT:																													
Validation II	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Validation III	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Subtotal	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CACKLERS:																													
Validation I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Validation III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Primary I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Primary III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	5
EMPERORS:																													
Validation II	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Validation III	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Subtotal	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
WHITE-FRONTS:																													
Primary I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Subtotal	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	0	0	0	0	0	0	0	0	0	0	3	3	2	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	13

Table 38. Percent nesting success for Pacific black brant, cackling Canada geese, emperor geese, and Pacific white-fronted geese at different nest locations at Kigigak Island, 1984.

	Brant				Cacklers			
Plot	Island	Peninsula	Other[a]	Total	Island	Peninsula	Other	Total
Calibration I	44 (9)	0 (4)	0 (1)	29 (14)	78 (9)	-	50 (2)	73 (11)
Calibration II	100 (2)	25 (4)	0 (2)	38 (8)	90 (21)	33 (3)	100 (5)	86 (29)
Calibration III	71 (17)	50 (4)	44 (32)	53 (53)	100 (7)	100 (2)	33 (3)	83 (12)
Subtotal	64 (28)	25(12)	40 (35)	47 (75)	89 (37)	60 (5)	40(10)	83 (52)
Validation I	33 (3)	-	-	33 (3)	92 (13)	-	0 (1)	86 (14)
Validation II	82 (22)	0 (1)	-	78 (23)	88 (17)	-	100 (1)	89 (18)
Validation III	100 (4)	-	0 (1)	80 (5)	83 (6)	-	0 (2)	62 (8)
Subtotal	79 (29)	0 (1)	0 (1)	74 (31)	89 (36)	-	25 (4)	82 (40)
Primary I	93 (27)	0 (1)	-	89 (28)	100 (11)	67 (3)	-	93 (14)
Primary II	90 (70)	100 (1)	100 (1)	90 (72)	100 (22)	100 (8)	83 (6)	97 (36)
Primary III	100 (5)	0 (1)	0 (1)	71 (7)	100 (13)	100 (1)	100 (2)	100 (16)
Subtotal	91(102)	33 (3)	50 (2)	89(107)	100 (46)	92(12)	88 (8)	97 (66)
Total	84(159)	25(16)	39 (38)	72(213)	93(119)	82(17)	68(22)	89(158)

Table 38. Continued

Plot	Emperor				White-front				Total
	Island	Peninsula	Other	Total	Island	Peninsula	Other	Total	
Calibration I	0 (1)	100 (1)	33 (3)	40 (5)	-	-	-	-	47 (30)
Calibration II	100 (5)	100 (3)	100 (5)	100(13)	-	-	-	-	82 (50)
Calibration III	-	-	0 (1)	0 (1)	-	-	-	-	58 (66)
Subtotal	83 (6)	100 (4)	67 (9)	79(19)	-	-	-	-	64(146)
Validation I	100 (1)	-	100 (3)	100 (4)	100(1)	-	-	100(1)	82 (22)
Validation II	-	100 (1)	75 (4)	80 (5)	-	-	100(2)	100(2)	83 (48)
Validation III	100 (1)	-	100 (1)	100 (2)	-	-	-	-	73 (15)
Subtotal	100 (2)	100 (1)	88 (8)	91(11)	100(1)	-	100(2)	100(3)	81 (85)
Primary I	100 (6)	100 (4)	100 (6)	100(16)	100(1)	-	100(2)	100(3)	93 (61)
Primary II	100 (2)	100 (2)	100 (8)	100(12)	-	-	-	-	93(120)
Primary III	-	-	100 (3)	100 (3)	-	-	-	-	92 (26)
Subtotal	100 (8)	100 (6)	100(17)	100(31)	100(1)	-	100(2)	100(3)	93(207)
Total	94(16)	100(11)	88(34)	92(61)	100(2)	-	100(4)	100(6)	81(438)

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

[b] Numbers in parentheses are sample sizes.

Table 39. Status of Pacific black brant clutches in relation to the number of prehatch visits in calibration plot I at Kigigak Island, 1984.

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	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
With egg loss	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	1	6	3	0	0	0	0	0	0	0	0	0	0	0	10
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	10	17	10	1	1	1	0	1	0	0	0	0	0	0	41
Total	3	11	23	14	1	1	1	0	1	0	0	0	0	0	0	55

Table 40. Status of Pacific black brant clutches in relation to the number of prehatch visits in calibration plot II at Kigigak Island, 1984.

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	1	1	0	0	0	0	0	0	0	2
With egg loss	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	1	5	5	18	3	8	3	8	0	0	0	0	0	0	40
Total	0	1	5	9	10	3	10	4	8	0	0	0	0	0	0	48

Table 41. Status of Pacific black brant clutches in relation to the number of prehatch visits in calibration plot III at Kigigak Island, 1984.

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	1	0	2	7	5	2	0	0	0	0	0	0	17
With egg loss	0	0	0	0	1	3	2	0	1	0	0	0	0	0	0	7
Partial hatch:																
Without egg loss	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	3
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	1	0	0	3	0	1	0	0	1	0	0	0	0	0	0	6
Harvest (egged)	1	0	8	8	0	0	0	0	0	0	0	0	0	0	0	17
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Unhatched	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Undetermined:	9	16	40	40	5	3	1	3	0	2	0	0	0	0	0	119
Total	11	16	48	53	8	10	10	9	4	2	0	0	0	0	0	172

Table 42. Status of cackling Canada goose clutches in relation to the number of prehatch visits in calibration plot I at Kigigak Island, 1984.

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	1	3	0	0	0	0	0	0	0	4
With egg loss	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	4
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	3
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	2	5	1	1	0	0	0	0	0	0	0	0	0	0	9
Total	0	2	7	1	2	1	3	4	0	0	0	0	0	0	0	20

Table 43. Status of cackling Canada goose clutches in relation to the number of prehatch visits in calibration plot II at Kigigak Island, 1984.

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	1	1	1	3	9	2	0	0	0	0	0	0	17
With egg loss	0	0	0	0	0	1	1	5	0	0	0	0	0	0	0	7
Partial hatch:																
Without egg loss	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Predation -																
(avian & mammalian)	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	3
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	2	1	10	0	2	2	0	0	0	0	0	0	0	0	17
Total	0	2	1	13	1	5	8	14	2	0	0	0	0	0	0	46

Table 44. Status of cackling Canada goose clutches in relation to the number of prehatch visits in calibration plot III at Kigigak Island, 1984.

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	1	0	0	0	1	0	1	2	1	0	0	0	0	0	0	6
With egg loss	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	4
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvest (egged)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	2	5	5	8	1	0	0	0	0	0	0	0	0	0	0	21
Total	4	6	5	9	2	0	1	3	3	0	0	0	0	0	0	33

Table 45. Status of emperor goose clutches in relation to the number of prehatch visits in calibration plot I at Kigigak Island, 1984.

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	1	1	0	0	0	0	0	0	0	2
With egg loss	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	3
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	7
Total	0	2	3	3	0	0	3	2	1	0	0	0	0	0	0	14

Table 46. Status of emperor goose clutches in relation to the number of prehatch visits in calibration plot II at Kigigak Island, 1984.

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	1	2	3	2	1	0	0	0	0	0	0	9
With egg loss	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvest (egged)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	1	0	2	2	3	3	1	0	0	0	0	0	0	12

Table 47. Status of emperor goose clutches in relation to the number of prehatch visits in calibration plot III at Kigigak Island, 1984.

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	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Partial hatch:																
Without egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
With egg loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched:																
Abandoned -																
at initiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
prehatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Predation -																
(avian & mammalian)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvest (egged)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Fail to develop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-predation):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continued (post-harvest):																
Hatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unhatched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined:	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2

Table 48. Hatching success of "complete" clutches for Pacific black brant geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch size									Total
	1	2	3	4	5	6	7	8	9	
Calibration I	-	0[a](1)[b]	25 (4)	0 (1)	-	-	-	-	-	17 (6)
Calibration II	0 (1)	0 (2)	20 (5)	33 (3)	0 (1)	-	-	-	-	17 (12)
Calibration III	-	25 (4)	50 (10)	67 (6)	71 (7)	100 (1)	-	-	-	57 (28)
Total	0 (1)	14 (7)	42 (19)	50 (10)	62 (8)	100 (1)	-	-	-	41 (46)

[a] Numbers are percentages.

[b] Numbers in parentheses are sample sizes.

Table 49. Hatching success of "complete" clutches for cackling Canada geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch size									Total
	1	2	3	4	5	6	7	8	9	
Calibration I	-	-	0[a] (1)[b]	100 (1)	67 (3)	100 (2)	50 (2)	-	-	67 (9)
Calibration II	-	-	67 (3)	67 (6)	67 (12)	86 (7)	100 (2)	-	-	73 (30)
Calibration III	-	-	100 (1)	67 (3)	67 (3)	100 (3)	100 (1)	-	-	82 (11)
Total	-	-	60 (5)	70 (10)	67 (18)	92 (12)	80 (5)	-	-	74 (50)

[a] Numbers are percentages.

[b] Numbers in parentheses are sample sizes.

Table 50. Hatching success of "complete" clutches for emperor geese in calibration plots at Kigigak Island, 1984.

Plot	Clutch size										Total
	1	2	3	4	5	6	7	8	9	10	
Calibration I	-	-	100[a](1)[b]	0 (1)	-	100 (1)	100 (1)	-	-	-	75 (4)
Calibration II	-	-	-	100 (2)	100 (4)	50 (2)	-	100 (2)	-	100 (1)	91 (11)
Calibration III	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	100 (1)	67 (3)	100 (4)	67 (3)	100 (1)	100 (2)	-	100 (1)	87 (15)

[a] Numbers are percentages.

[b] Numbers in parentheses are sample sizes.

Table 51. Hatching success of "complete" clutches for Pacific white-fronted geese in calibration plots at Kigigak Island, 1984.

	Clutch size									
Plot	1	2	3	4	5	6	7	8	9	Total
Calibration I	0	0	0	0	0	0	0	0	0	0
Calibration II	0	0	0	0	0	0[a] (1)[b]	0	0	0	0 (1)
Calibration III	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0 (1)	0	0	0	0 (1)

[a] Numbers are percentages.

[b] Numbers in parentheses are sample sizes.

Table 52. Frequency of nests which were abandoned or contained unhatched eggs for Pacific black brant, cackling Canada geese and emperor geese at Kigigak Island, 1984.

	Species									
	Brant			Cacklers			Emperors			
Plot	Abandoned	Addled	Total	Abandoned	Addled	Total	Abandoned	Addled	Total	Total
Calibration I	14[a](14)[b]	0(14)	14(14)	36(11)	0(11)	36(11)	29 (7)	0 (7)	29 (7)	25 (32)
Calibration II	50 (8)	0 (8)	50 (8)	66(29)	0(29)	66(29)	82(11)	0(11)	82(11)	67 (48)
Calibration III	42 (53)	0(53)	42(53)	50(12)	0(12)	50(12)	0 (1)	0 (1)	0 (1)	43 (66)
Total	37 (75)	0(75)	37(75)	56(52)	0(52)	56(52)	58(19)	0(19)	58(19)	47(146)

[a] Percentages of total number of nests for which status was determined within a plot.

[b] Number in parentheses equal the number of nests for which status was determined wihtin a plot.

Table 53. Percent of nests which were unsuccessful due to spring harvest for geese at Kigigak Island, 1984.

	Brant				Cackler				Emperor				
Plot	Island	Peninsula	Other	Total	Island	Peninsula	Other	Total	Island	Peninsula	Other	Total	Total
Calibration I	0 (9)[a]	0 (4)	0 (1)	0(14)	0 (9)	—	0(2)	0(11)	0(1)	0(3)	0(3)	0 (7)	0 (32)
Calibration II	0 (2)	0 (4)	0 (2)	0 (8)	0(21)	0(3)	0(5)	0(29)	0(5)	0(1)	0(5)	0(11)	0 (48)
Calibration III	29(17)	25 (4)	38(32)	34(53)	0 (7)	0(2)	67 (3)	17(12)	—	—	100(1)	100 (1)	32 (66)
Total	18(28)	8(12)	34(35)	24(75)	0(37)	0(5)	20(10)	4(52)	0(6)	0(4)	11(9)	5(19)	14(146)

[a] Sample size based on nests for which status was determined.

Table 54. Percentage of Pacific black brant, cackling Canada goose, emperor goose and Pacific white-fronted goose nests suffering "animal predation"[a] at different nest locations at Kigigak Island, 1984.

	Brant				Cackler			
Plot	Island	Peninsula	Other[b]	Total	Island	Peninsula	Other	Total
Calibration I	55 (9)[c]	100 (4)	100 (1)	71 (14)	22 (9)	—	50 (2)	27 (23)
Calibration II	0 (2)	50 (4)	50 (2)	38 (8)	5 (21)	67 (3)	0 (5)	10 (29)
Calibration III	0 (17)	25 (4)	16(32)	11 (53)	0 (7)	0 (2)	0 (3)	0 (12)
Subtotal	18 (28)	58(12)	20(35)	25 (75)	8 (37)	40 (5)	10(10)	12 (52)
Validation I	67 (3)	—	—	67 (3)	0 (16)	—	100 (1)	7 (14)
Validation II	9 (22)	100 (1)	—	13 (23)	6 (17)	—	0 (1)	6 (18)
Validation III	0 (4)	—	100 (1)	20 (5)	17 (6)	—	100 (2)	38 (8)
Subtotal	14 (29)	100 (1)	100 (1)	19 (31)	6 (36)	—	75 (4)	12 (40)
Primary I	4 (27)	100 (1)	—	7 (28)	0 (11)	33 (3)	—	7 (14)
Primary II	3 (70)	0 (1)	0 (1)	3 (72)	0 (22)	0 (8)	17 (6)	3 (36)
Primary III	0 (5)	100 (1)	0 (1)	14 (7)	0 (13)	0 (1)	0 (2)	0 (16)
Subtotal	3(102)	67 (3)	0 (2)	5(107)	0 (46)	8(12)	12 (8)	3 (66)
Total	8(159)	62(16)	23(38)	14(213)	4(119)	18(17)	23(22)	8(158)

Table 54. Continued

Plot	Emperor				White-front				Total
	Island	Peninsula	Other	Total	Island	Peninsula	Other	Total	
Calibration I	100 (1)	0 (3)	67 (3)	43 (7)	--	--	--	--	50 (32)
Calibration II	0 (5)	0 (1)	0 (5)	0(11)	--	--	--	--	12 (48)
Calibration III	--	--	0 (1)	0 (1)	--	--	--	--	9 (66)
Subtotal	17 (6)	0 (4)	22 (9)	16(19)	--	--	--	--	19(146)
Validation I	0 (1)	--	0 (3)	0 (4)	0(1)	--	--	0(1)	14 (22)
Validation II	--	0 (1)	0 (4)	0 (5)	--	--	0(2)	0(2)	8 (48)
Validation III	0 (1)	--	0 (1)	0 (2)	--	--	--	--	26 (15)
Subtotal	0 (2)	0 (1)	0 (8)	0(11)	0(1)	--	0(2)	0(3)	13 (85)
Primary I	0 (6)	0 (4)	0 (6)	0(16)	0(1)	--	0(2)	0(3)	5 (61)
Primary II	0 (2)	0 (2)	0 (8)	0(12)	--	--	--	--	2(120)
Primary III	--	--	0 (3)	0 (3)	--	--	--	--	4 (26)
Subtotal	0 (8)	0 (6)	0(17)	0(31)	0(1)	--	0(2)	0(3)	3(207)
Total	6(16)	0(11)	6(34)	5(61)	0(2)	--	0(4)	0(6)	11(438)

[a] Does not include eggs (nests) taken by natives during spring harvest activity.

[b] Nest locations designated as "other" contain six categories: pond-shoreline, slough-shoreline, pingo top, "grass flat", displaced island and mudflat.

[c] Numbers in parentheses are sample sizes.

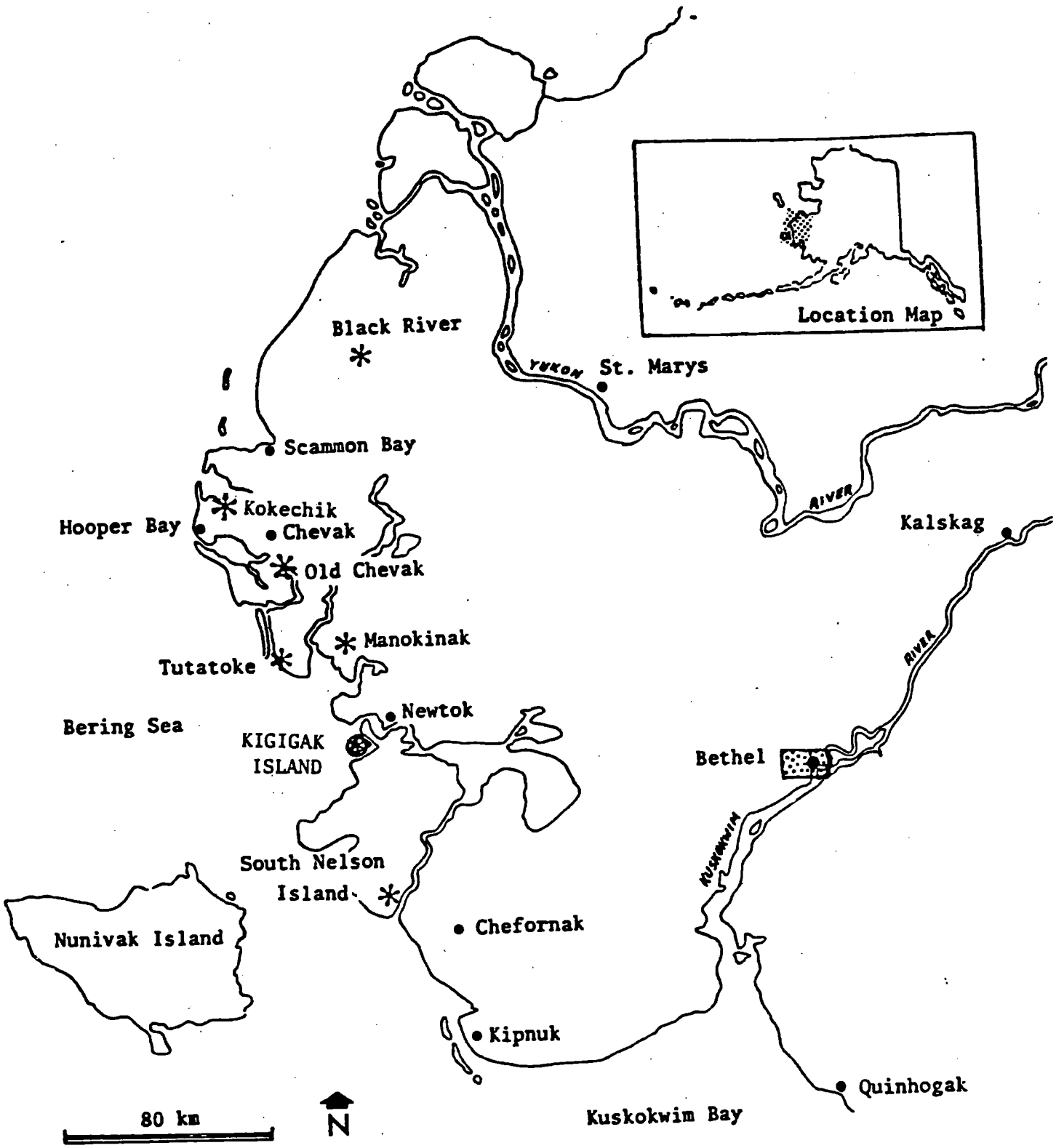

Fig. 1 Location of Kigigak Island field camp in relation to other field camps (*) and to native villages (•) on the Yukon Delta National Wildlife Refuge, 1984.

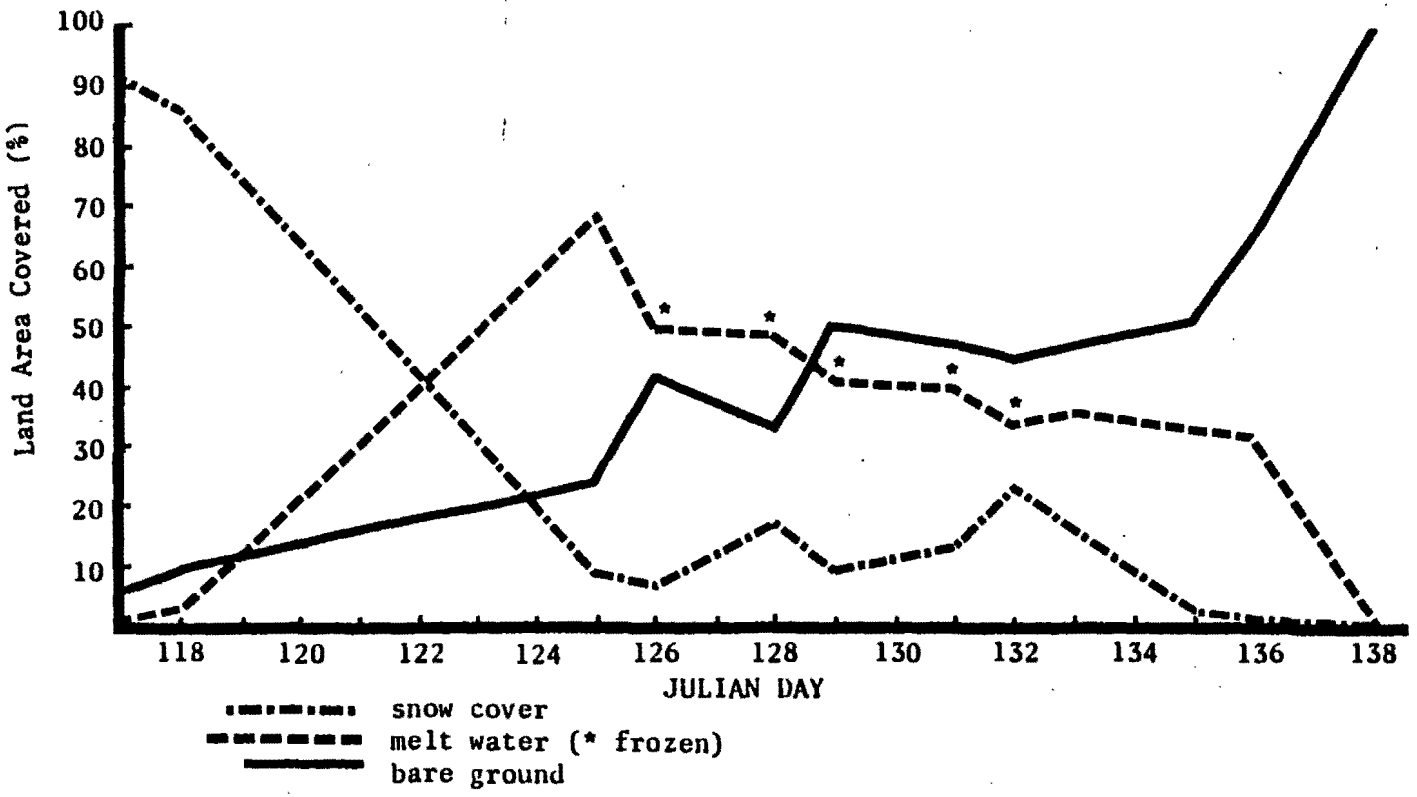

Figure 2. Average percent of land area covered by melt-water, snow and bare ground along nine snow transects at Kigigak Island, 1984.

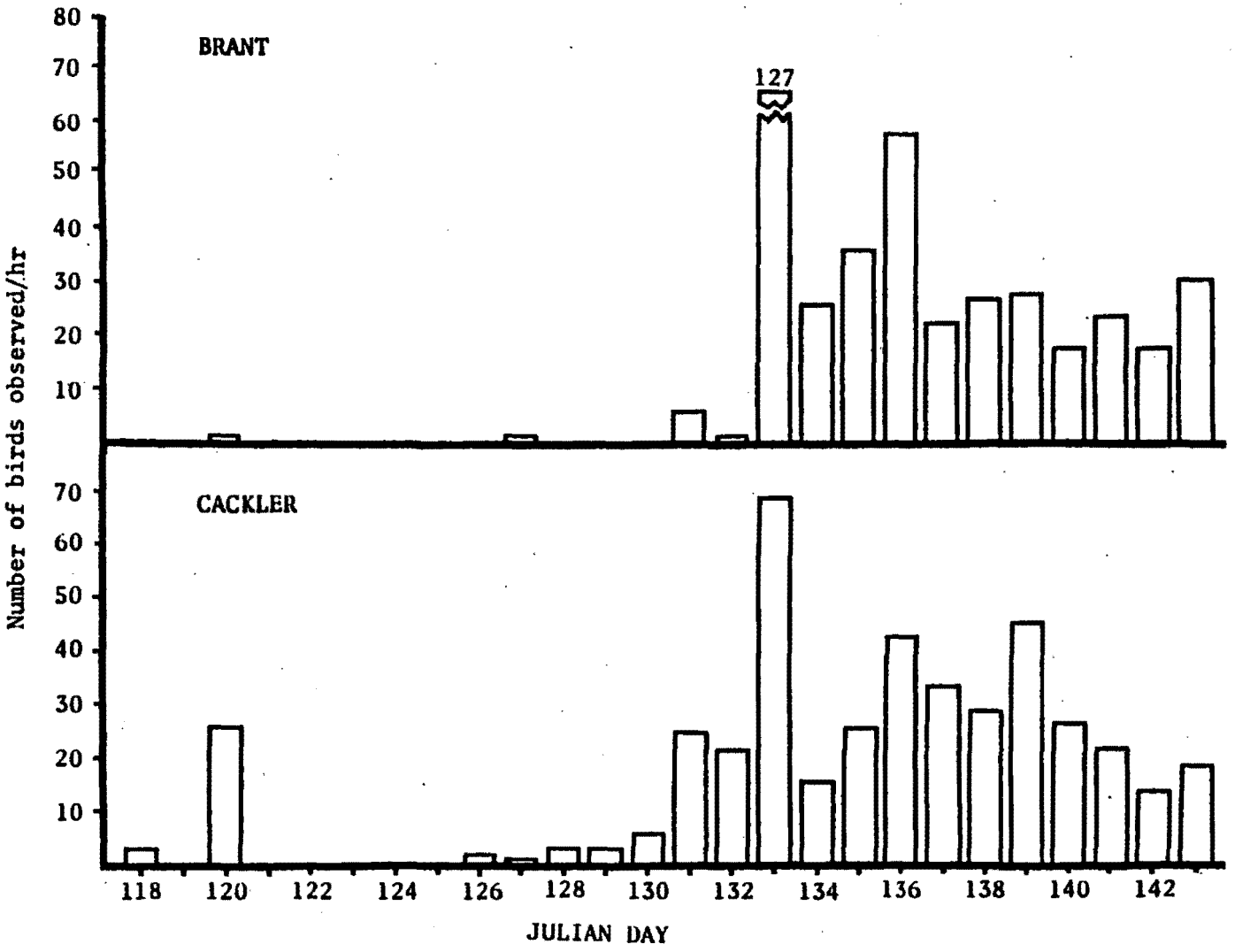

Figure 3. Number of brant and cackling Canada geese observed per hour during migration counts at Kigigak Island, 1984.

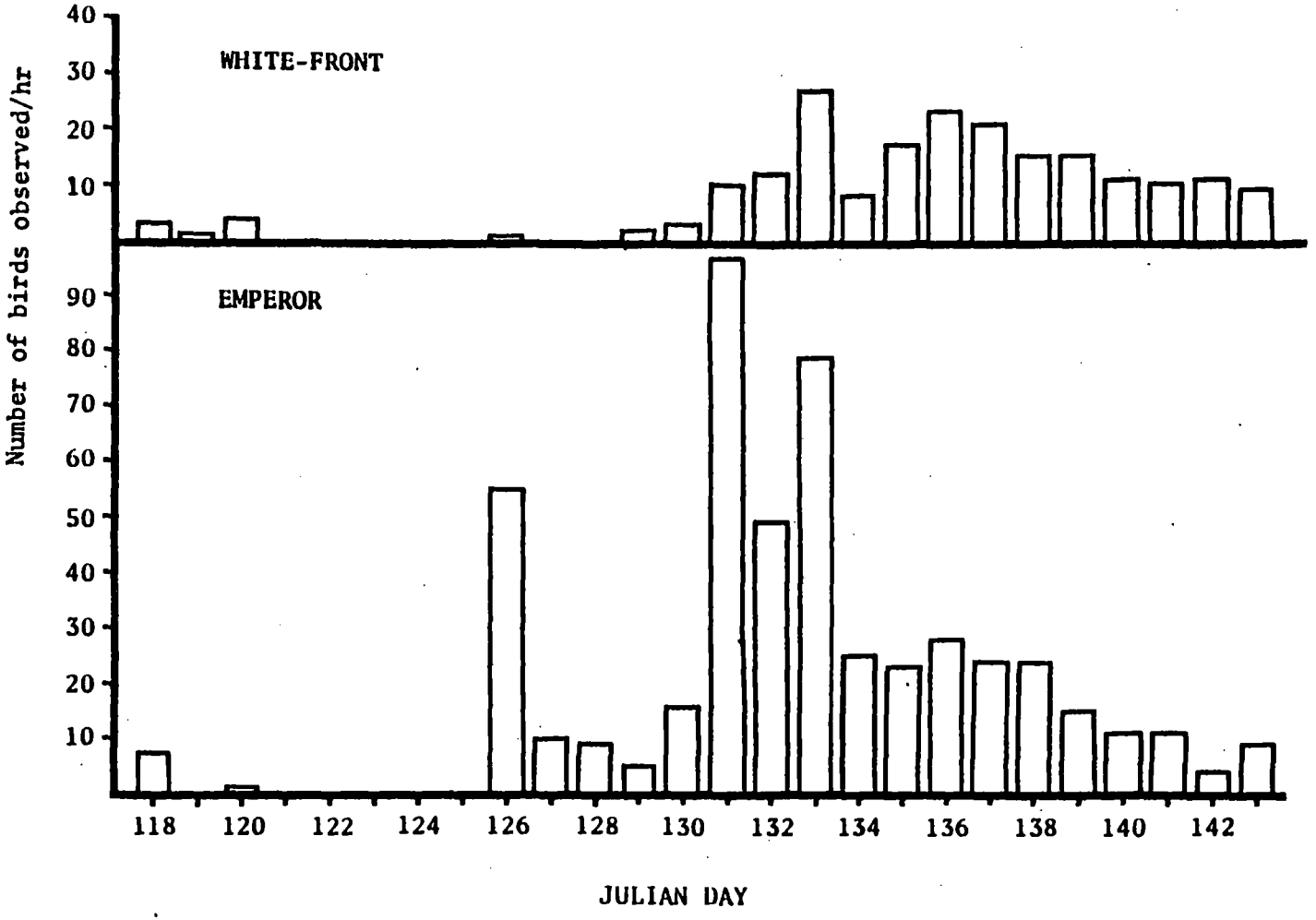

Figure 4. Number of emperor and white-fronted geese observed per hour during migration counts at Kigigak Island, 1984.

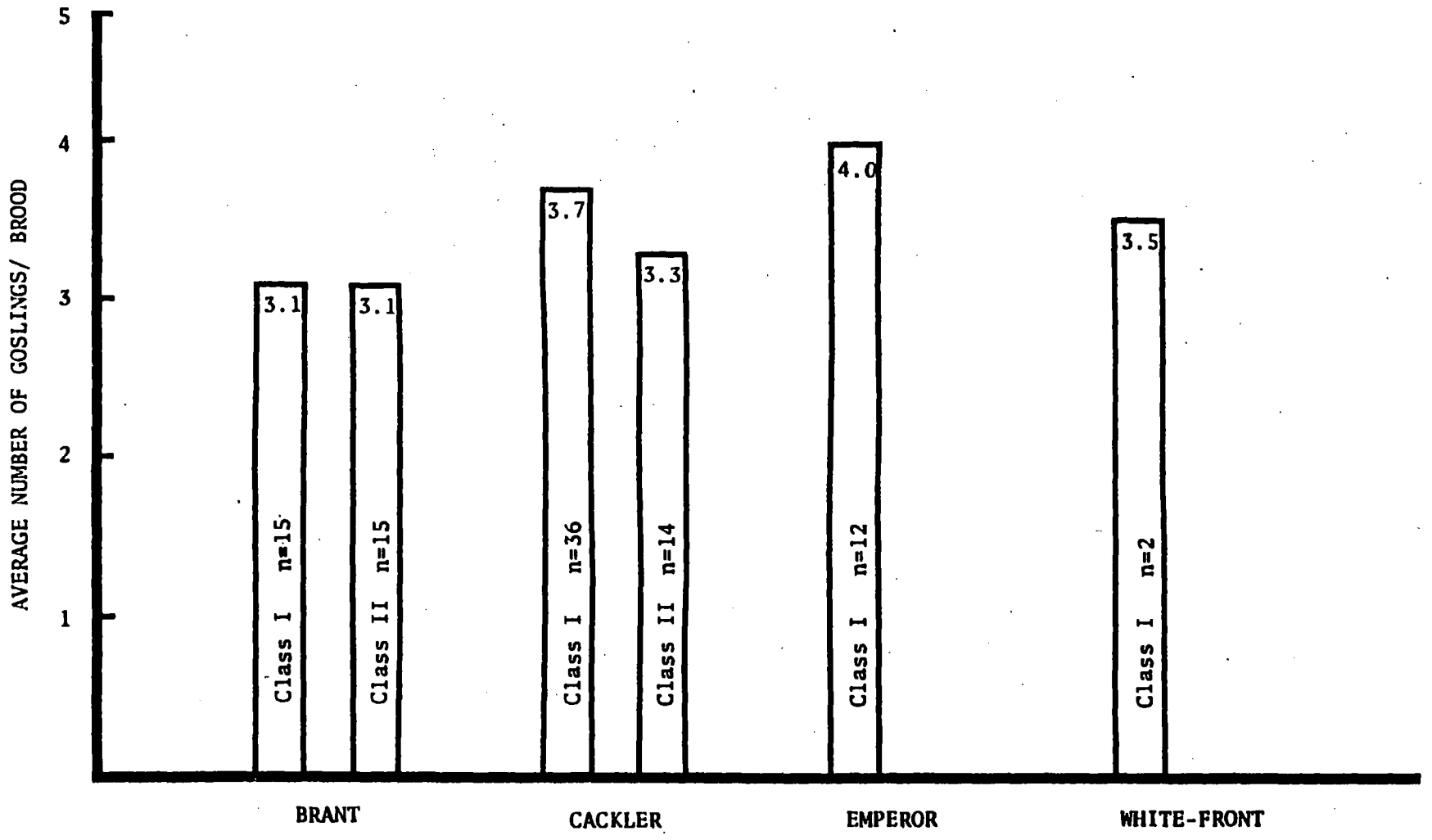

Figure 5. Average brood size by age class for broods observed at Kigigak Island, 1984.