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PROGRESS REPORT
ON
STUDY OF ALEUTIAN CANADA GEESE
AT BULDIR ISLAND, ALASKA

by
Fred G. Deines and Tom J. Early

Restrictions: Internal Document, not for publication

Key Words: Aleutian Canada Geese
Aleutians
Abundance

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☐ Non-refereed publication
☐ Unpublished presentation to
conference or workshop
☐ Internal administrative report
☐ Other (see remarks)

TITLE 1982 Progress Report on nesting study of Aleutian Canada
geese at Buldir Island, Alaska

DATE Nov. 10, 1982
I.D. NO.

AUTHOR(S) Fred Deines
Tom Early

CITATION

OBJECTIVE Nesting study of the Endangered Aleutian Canada Goose to develop estimate of
nesting pairs, egg production, gosling production and fall population.

METHOD OF STUDY

Nest search in twenty-eight 200 meter X 200 meter plots. These are permanent plots
which provide a stratified random sample of the goose nesting habitat on Buldir.

MAIN FINDINGS A total of 65 nests were located with 36 nests found inside the sample
plots. The number of nests was double that found in 1979. The mean clutch size was
5.52. It was calculated that 287 ± 145 pairs attempted nesting on Buldir. These birds
produced an estimated 1065 goslings. The 574 breeding geese + 2126 non-breeders + 1065
fledged goslings - 6.3% assumed mortality (237 birds) = 3528 fall population before
migration.

CONCLUSIONS

The Aleutian Canada goose population has increased dramatically since 1979, probably due
mostly to an earlier closure of hunting in wintering areas. The increasing population
on Buldir provides a strong nucleus for recovery of the species and subsequent removal
from the endangered species list.

MANAGEMENT IMPLICATIONS

Use the Buldir goose population for transplanting of birds to other fox free islands
in the western portion of the chain to establish nesting populations on islands where
the geese previously nested.

ADDITIONAL REMARKS

UPDATES OR SUPERSEDES I.D. NO.

PROGRAM

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INVESTIGATORS

Dana Bradley ----- Volunteer Biologist, Adak
Don Dragoo ----- Volunteer Biologist, Adak
Fred Deines ----- Refuge Biologist, Aleutian Islands Unit, AMNWR, Adak
Tom Early ----- Assistant Refuge Manager, Alaska Maritime NWR, Homer
Van Klett ----- Assistant Refuge Manager, Aleutian Islands, AMNWR, Adak
Mark Ostwald ----- Volunteer Biologist, Adak

SPECIAL THANKS

Special thanks must be given to Dana Bradley, Don Dragoo, and Mark Ostwald for their help in the 1982 Aleutian Canada goose nesting survey. It was only through their enthusiastic and professional participation as volunteer biologists that the study was successfully completed in a timely manner under difficult working conditions.

INTRODUCTION

Investigation of the endangered Aleutian Canada goose (Branta canadensis leucopareia) was initially conducted from 1974 to 1976, again in 1977 and in 1979. During the initial three summers, biologists from the Aleutian Islands N.W.R. studied the basic breeding biology of this Canada goose subspecies. The data obtained, plus extensive vegetative mapping of Buldir, led to the development of a stratified random sampling technique to estimate the size of the breeding population. This technique utilized the examination of randomly selected plots within four strata of potential goose nesting habitat on the island. This technique was employed in 1977, 1979, and again in 1982, when researchers from the refuge worked on the island (see Progress Report of Aleutian Canada Geese on Buldir Island by D. Woolington & Tom Early, 1977, and same title by W. Henry and T. Early, 1979).

During the 1982 breeding season a six person team of refuge personnel returned to Buldir to conduct the nesting study using the random sampling technique. The investigators stayed on Buldir 31 days from 29 May to 28 June. The completion of the goose nesting study was the sole objective of this team.

METHODS

Sampling Technique

A stratified random sampling technique was used to estimate the breeding population of Aleutian Canada geese on Buldir Island. This technique was based on the knowledge that the geese differentially select the best nest sites among habitat types (Woolington and Early 1977). Based on the 1974 to 1976 field work, four basic goose nesting habitat types have been identified and delineated. These habitat types were stratified into: 1) South Facing Slopes, 2) North Facing Slopes, 3) Inland Tall Plant Slopes, and 4) Mossy-Willow Uplands (Figure 1).

Previously selected random plots 200 meters by 200 meters were used in each stratum to sample goose plots in each habitat type. The allocation of plots was weighted to reflect the variance of goose nests per stratum, due to nest site habitat selectivity. The south facing sea slope stratum was most variable and a higher percentage of sample plots were therefore allocated. The mossy-willow upland stratum had the least preferred habitat and therefore the lowest percentage sampled (Table 1).

TABLE 1
NUMBER OF PLOTS AND SAMPLES FOR EACH STRATUM

<u>Stratum Type</u>	<u>Total Possible Plots</u>	<u>Number Sample Plots</u>	<u>% Sampled</u>
South Facing slopes	140	20	14.3
North Facing slopes	40	3	8.0
Inland Tall plant slopes	93	5	5.4
Mossy-willow uplands	<u>128</u>	<u>2</u>	<u>1.0</u>
Totals	401	30	

Areas known not to be utilized as nest sites, such as large slide areas and North marsh, were excluded from consideration in the sample plot selection.

A small area on the northwestern sea slope of the island (Gull slide area) was excluded from plot selection. It had been a site of extremely high nest density and was deemed inappropriate for the normal sampling. This area was censused completely for a total count of nests and added to the total. Also, in late 1977 it was discovered that a portion of the Northwest Point area was inadvertently omitted from plot selection. Therefore, the mean number of nests found during the period from 1974 through 1976 for that area has been added to the total plus an increment of increase based on the percentage of increase observed in other sample plot areas during that period.

Field Activities

Investigators arrived on Buldir Island on 28 May at 0600 hours via the 94 ft. charter vessel "Sea Spray". The seas and weather conditions would not permit unloading until the following day. Unloading began on 29 May using two Zodiac inflatable boats to carry gear and personnel ashore. Surf conditions were still somewhat high, so it was necessary to land on the far NW corner of the beach instead of directly in front of the cabin. This meant an additional 275 meter walk with all gear. The large amount of gear and increasing wind and rain late in the afternoon slowed the operation considerably. The cabin was opened, personnel and gear taken in, stove installed and radio set up that day. The remaining gear was stacked on the beach and covered with plastic and canvas. For the next two days the remaining gear was brought up from the beach, unpacked and the cook tent was set up.

All work originated from the main camp and no spike camps were used this season. Nest searching began on 1 June and ended on 27 June. A total of 10 working days were required to complete the 28 sample nest plots and gull slide census area. It was decided not to sample the two Upland plots (U2 and U3) because of weather limitations and the fact that no nests had been

found in the plots previously. Based on prior experience, nest searching should not begin prior to 1 June in order to lessen the chance of disturbance to the geese and nest abandonment. Our experience this year seemed to strengthen that assumption. Work was delayed twice for two days during the first week of June due to the lack of early nesting activity by the geese (i.e. finding incomplected nest cups and incomplected goose and gull clutches in nests).

Weather restricted work in the field in two ways: 1) fog which made searching for nests very difficult and dangerous, and 2) days with more than 15-20 knot winds and/or rain were avoided to lessen the danger of damage to the egg embryos. Safety for the geese and personnel was the primary consideration. No specific weather data was collected this season, however, a brief general description of weather conditions that were encountered is given in Appendix A.

An attempt was initiated in 1977 to permanently mark one corner of each plot with a 1 1/2 meter piece of galvanized electrical conduit with the tip painted orange. The effort was continued in 1979 and was expanded to mark all plot corners and number the poles. By marking all the corners permanently, the need to measure and temporarily mark the corners each time was eliminated. This helped to improve the efficiency of nest searching. In 1982 the remaining plot corners were permanently marked with conduit and the tips of the majority were repainted with blaze orange. Also, those poles not previously identified with a number were marked with an aluminum tag stating the plot number and corner orientation. These tags were bent around the poles and attached with copper wire.

Assistant Manager Tom Early of the Alaska Maritime NWR, Homer office, participated in the 1977, 1979, and 1982 nest searches providing continuity to the study. Nest searching was done in a similar manner all three years. This basically involved walking abreast approximately 10 meters apart and actively searching for goose nests. Distance between individual searchers varied sometimes due to weather (fog & rain), vegetation, and terrain. In all cases the spacing was close enough to accomplish a thorough search for goose nests. One quarter inch dowels 1 meter in length with colored flagging attached were utilized this season to help maintain a straight line search across the interior of the plots. The dowelling was used to mark a return path while systematically searching for geese. This allowed investigators to concentrate more on searching for goose nests than maintaining a compass line. This technique was especially helpful in the fog.

Whenever a goose was flushed by a researcher, a thorough search effort was made to find the nest. When the nest was found, its location and the number of eggs it contained were recorded on the census plot data forms (Appendix B). Observations or notes on each plot were also recorded on the forms. All nests, both inside and outside of the plots, were recorded. The eggs were then covered with the down from the nest and researchers quickly left the nest area to allow geese to return, thus minimizing impacts. For the same reason no eggs were floated or candled this season. It was felt that the chronology of the peak of laying and peak of hatch was adequately described in previous reports.

No broods found inside the plots were counted unless a nest could be found. As in the past, all broods inside the gull census area were counted even if a nest couldn't be found because of the isolation of the area and young age of the goslings.

There were no observations made of collared or banded geese this season due to weather limitations. A blue neck collared bird was observed, but researchers could not get close enough to read the numbers. Observations were made with 10 X 40 Leitz binoculars. Occasionally, a 25 power spotting scope and a Questar 6, 80 and 130 power scope were used for observations. Their use was limited by weather conditions and terrain and the emphasis to efficiently complete the nesting survey with minimal impact.

RESULTS AND DISCUSSION

Nesting

Researchers found a total of 65 nests in 1982 (Figure 2). This compares with 36 nests found in 1977 and 45 nests found in 1979. A total of 36 nests were found inside the sample plots. This doubles the number found in 1979. Only three nests were found in the gull slide census area this year. It should be noted, however, that almost half of the census area slid down the mountain since 1979 and no longer provides suitable nesting habitat. Also, researchers sampled the area on 27 June instead of the desired mid-June date due to weather limitations. Twenty-eight additional nests were found outside the sample plots. Data collected from all nests found is shown in Tables 2 and 3. The nests and broods found outside the plots were used to calculate the egg production estimate but were not included in calculating the population estimate. A few photos illustrating results and working conditions are contained in Appendix C.

Although no specific measurements, such as candling or floating of eggs, were done this year, it was felt that the nesting activity was slightly later in 1982 than previously based on observations of nesting activity and the hatch. The first pipped and hatched eggs were found in plot S2 on 20 June. The first goslings were found on 22 June. It is estimated that the peak of egg laying occurred on 4 June and the peak of hatch on 3 July.

Clutch sizes ranged from a low of three eggs to a high of eight. The mean clutch size was 5.52 eggs as shown in Table 4. This represents a slight increase from 1979 when the mean clutch size was 5.4.

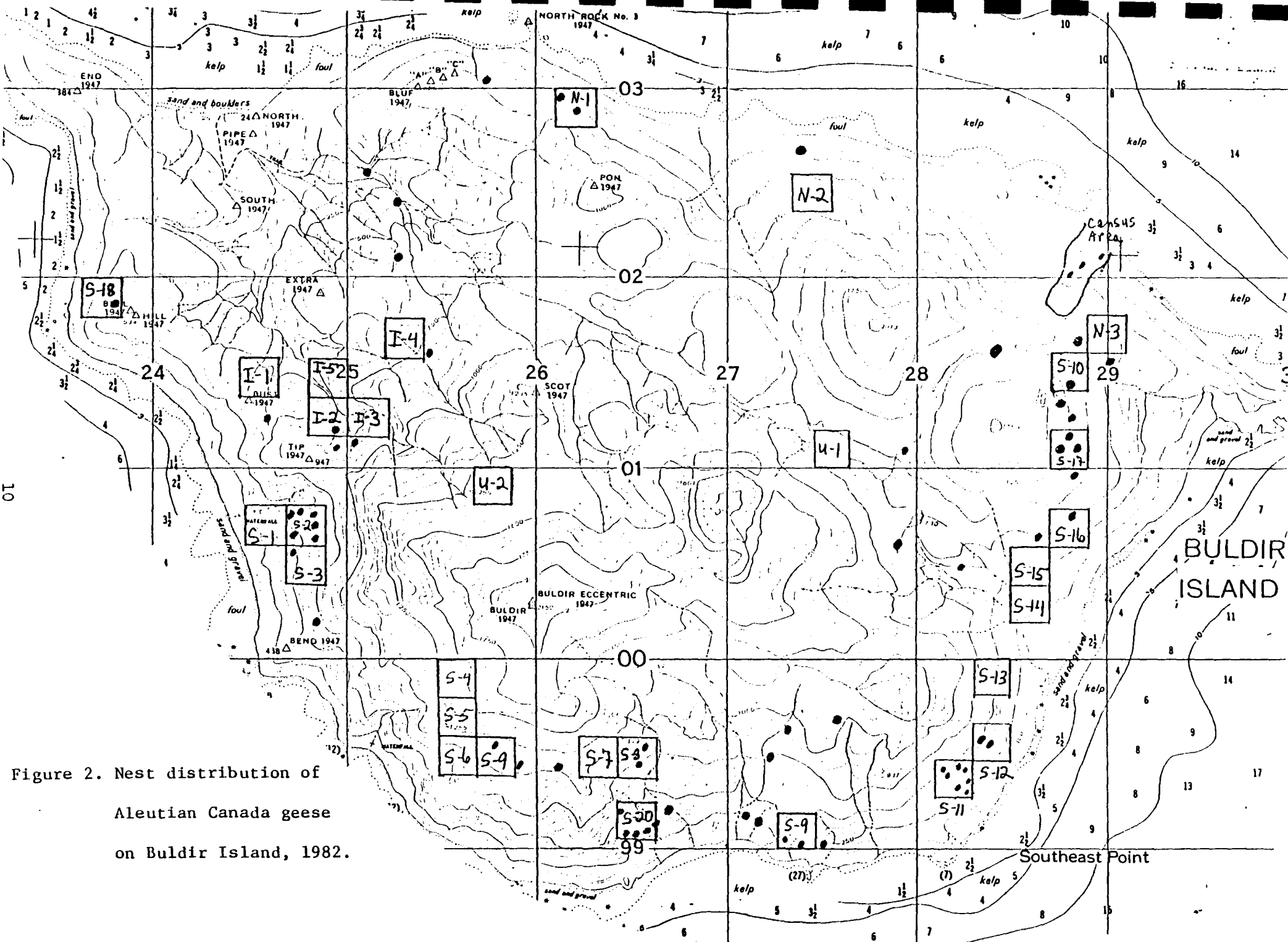


Figure 2. Nest distribution of Aleutian Canada geese on Buldir Island, 1982.

TABLE 2
NESTS AND BROODS LOCATED INSIDE SAMPLE PLOTS
BULDIR ISLAND, 1982

<u>Plots*</u>	<u>Date Worked</u>	<u>No. Clutch Nests & Size</u>	<u>Comments</u>
I1	6-07	No nests -----	No nest in 1979
I2	6-04	One nest, 4 -----	No nest in 1979
I3	6-04	No nests -----	One nest in 1979
I4**	6-10	No nests -----	One nest just outside plot in 1982
I5***	6-04	No nests -----	No nest in 1979
U1		NOT EVALUATED IN 1982	
U2		NOT EVALUATED IN 1982	
N1	6-11	Two nests, 7, 7 -----	Two nests just outside plot in 1982, None in 1979
N2	6-10	No nests -----	No nest in 1979
N3	6-17	No nests -----	Two nests just outside plot in 1982, None in 1979
S1	6-13	-----	One nest in 1979
S2	6-13	Six nests 8,5,4,7,5,4 -	Two nests in 1979
S3	6-13	One nest, 6 -----	Two nests in 1979
S4	6-18	No nests -----	No nests in 1979
S5	6-18	No nests -----	No nests in 1979
S6	6-18	No nests -----	No nests in 1979
S7	6-20	No nests -----	No nests in 1979
S8	6-20	No nests -----	No nests in 1979
S9	6-20	Two nests, 6,6 -----	One nest just outside plot in 1982, two nests in 1979
S10	6-17	One nest, 5 -----	No nest in 1979
S11	6-22	Seven nests, 4,5,5,6,5, 5,5	Five goslings in one nest in 1982, two nests in 1979
S12	6-22	Two nests, 7,7 -----	One of 1982 nests had four dead eggs, one dead gosling, two live goslings, two nests in 1979
S13****	6-22	No nests -----	No nests in 1979
S14****	6-23	No nests -----	No nests in 1979
S15****	6-23	No nests -----	No nests in 1979

TABLE 2. NESTS AND BROODS LOCATED INSIDE SAMPLE PLOTS AT BULDIR ISLAND, (cont.)

<u>Plots</u>	<u>Date Worked</u>	<u>No. Clutch Nests & Size</u>	<u>Comments</u>
S16	6-23	Two nests, 6,6 -----	Two nests in 1979
S17	6-17	Three nests 7,5,6 -----	Three nests just outside plot in 1982, no nest in 1979
S18	6-07	One nest, 5 -----	One nest in 1979
S19	6-18	One nest, 6 -----	Two nests just outside plot in 1982, No nest in 1979
S20	6-11	Five nests 4,4,6,6,7 ---	One nest found outside plot in 1982, three nests in 1979

*Strata Classification of Plots

I = Inland tall plant slopes

U = Mossy-willow uplands

N = North facing slopes

S = South facing slopes

**Surveyed for glaucous-winged gull nests = 44

***Surveyed for glaucous-winged gull nests = 51

****Eagle aeries in near vicinity may have effected goose nesting

TABLE 3

NESTS AND BROODS LOCATED OUTSIDE SAMPLE PLOTS
BULDIR ISLAND, 1982

<u>Date Found</u>	<u>Clutch Size</u>	<u>Comments</u>
1 June	Cup Only	S. of plot I3
1 June	3	Glissade Valley
4 June	5	Gentle Valley
10 June	7	E. of plot I4
10 June	7	Petrel Valley
11 June	8	W. of Bluff
11 June	4	S. of plot N1
13 June	5	S. of plot I2
13 June	6	Ruby-throat Cr.
17 June	4	Icy Valley
18 June	6	SW Point
20 June	6	SW Point
20 June	6	Steep Creek
20 June	4	Steep Creek
17 June	5	Sharp Ridge
17 June	6	Sharp Ridge
17 June	5	S. of plot S10
17 June	5	N. of plot S17
17 June	6	S. of plot S17
17 June	3	Glissade Valley
18 June	6	E. of plot S19
20 June	5	SW of plot S7
20 June	6	E. of plot S9
20 June	5	Steep Creek
20 June	6	Steep Creek
22 June	6	Dry Lake
23 June	6	Glissade Valley
23 June	5	SW of Dip Camp
23 June	6	SE of Dip Camp
23 June	5	E of plot S16

4

TABLE 4
CLUTCH SIZE FREQUENCY OF ALEUTIAN CANADA GEESE
BULDIR ISLAND, 1982

<u>Clutch Size</u>	<u>Number of Nests</u>	<u>Percent Frequency</u>
3	2	2
4	8	9
5	22	31
6	22	37
7	9	17
<u>8</u>	<u>2</u>	<u>4</u>
Mean 5.5	Total 65	Total 100

Observed Production

Table 5 shows the production that was observed while doing the 1982 nesting study.

TABLE 5
OBSERVED PRODUCTION OF ALEUTIAN CANADA GEESE
BULDIR Island, 1982

<u>Date</u>	<u>Location</u>	<u>Comments</u>
6-20	Plot S20	Nest clutch of 6, 2 eggs pipped
6-20	Plot S20	Nest clutch of 4, 3 hatched, 1 dead
6-20	Plot S9	Nest clutch of 6, 2 pipped
6-22	Plot S7	Nest clutch of 5, 5 goslings
6-22	Plot S12	Nest clutch of 7, 7 goslings
6-22	Plot S12	Nest clutch of 7, 2 goslings, 4 dead eggs, 1 dead gosling
6-27	Gull Slide Census Area	Nest clutch of 1, 1 pipped
6-27	Gull Slide Census Area	Nest clutch ?, 3 goslings +?

Breeding Population Estimate

It was calculated that 287 ± 145 pairs attempted nesting on Buldir in 1982 (Table 6). This almost doubles the number of pairs (150 ± 69) determined for 1979. Since the nesting census plot technique was based on the premise that assigned plots were accurately located from map references and that all nests inside the plot were located, any deviation from these could result in an inaccurate estimate of the breeding population. Several factors were encountered during nest searching activities that could have impaired the accuracy of the estimate (Appendix C).

TABLE 6
BREEDING POPULATION ESTIMATE FOR ALEUTIAN CANADA GEESE ON
BULDIR ISLAND, 1982

<u>Habitat*</u>	<u>Total # Plots in Stratum</u>	<u># Plots Sampled</u>	<u># Nests Located</u>	<u>Variance of Sampled Plots</u>	<u>Total Est. # of Nests*</u>
I	93	5	1	0.20	19 ± 36
U	128	---	Not sampled in 1982		---
N	40	3	2	1.34	27 ± 50
S	140	20	33	5.31	231 ± 131
Census areas***	--	--	10	--	10 ± 0
Total					$287 \pm 145^{***}$

* I = Interior Tall Plant Community

U = Mossy-willow Upland Community

N = North Facing Slope Community

S = South Facing Slope Community

** 95% Confidence Interval (Rounded to whole numbers)

*** The gull slide census plot (3 nests) and the 1974-76 mean number of nests at Northwest Point area (4 nests + a 3 nest estimated increase based on approximate percent increase in all the sample plots)

**** See Appendix E for computation method

Gosling Production Estimate

An estimated 1065 goslings fledged was projected for 1982, as compared with 559 in 1979. This estimate was made using production rates from previous years. Nesting success averaged 93 percent in 1975 and 1976. In 1977, it was calculated that 3.99 goslings were raised per successful pair. Since production rates remained similar in 1975 and 1976 and there was no apparent gross difference in adverse weather conditions or other factors in 1982 from other years, it was assumed that the 1982 production was similar to that of previous years of study.

The estimate was calculated as follows:

Nesting pair estimate	287
Successful pairs (287 X .93)	267
Goslings raised (3.99 X 267)	1065

Fall Population Estimate

Based on counts in April 1982 in the Central Valley area of California, 2700 Aleutian Canada geese were in the population prior to the spring migration. The estimated gosling production added 1065 to the population. At this time, the adult and subadult mortality rates during spring migration and on the breeding ground are unknown. Investigators of other Canada goose populations have indicated that this loss is minimal. By assuming a liberal loss of 6.3 percent on 237 adults, subadults and fledged goslings, the fall population is estimated to be 3528 birds. The percentage figure used is the same as that used in 1977 and 1979. The estimate was calculated as follows:

Breeding geese (287 X 2)	574
Non-breeders (2700 - 574)	2126
Gosling Fledged	<u>1065</u>
	3765
Assumed mortality (6.3%)	237
Population Estimate	3528

RECOMMENDATIONS

1. Nest searching activities should begin on or about 1 June and be completed 20 June. Based on 1977 and 1979 hatching dates, it appears the average hatch date for geese may be earlier than originally suspected.
2. Plots S14 and S15 should be thoroughly searched and extra time allotted due to the numerous visual barriers creating more nesting habitat.
3. The Gull Slide Census Area should be surveyed about 15 June.
4. If time is limited, the plots in the Mossy-willow uplands should be eliminated.
5. Evaluate the Northwest Point area and, if possible, census every 3 years.
6. Continue using dowelling and flagging for temporarily marking interior transect lines while searching for goose nests. Increase the dowelling size to 3/8" diameter.
7. Give consideration to eliminating plots S4, S5 and S7 from evaluation of south facing plots. The habitat is more representative of mossy-willow uplands than the south facing plots.
8. Consider using a spike camp for censusing south facing plots.
9. Utilize field notes to develop a specific plan of attack to most efficiently work sample plots.
10. Attach empty clear plastic dish soap bottles painted blaze orange on their insides to the ends of all plot corner poles. This will help distinguish the poles from old Heraculum stalks at a distance and aid in locating plot corners.

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APPENDIX A
GENERAL WEATHER CONDITIONS ENCOUNTERED IN
1982 NEST SURVEY ON BULDIR ISLAND

<u>Date</u>	<u>Comments</u>
6-4	Partly cloudy, winds NW at about 15 knots
6-5	Partly cloudy, winds S at 15 knots
6-6	Partly cloudy, ceiling about 700 ft., winds S at about 10 knots
6-7	Partly cloudy, ceiling about 300 ft., winds S at about 15 knots
6-8	----
6-9	Partly cloudy, rain, ceiling about 200 ft., winds N at about 35 knots
6-10	Ceiling 500 ft., winds NW at about 15-25 knots
6-11	Partly cloudy, ceiling about 400 ft., winds SW at about 15 knots
6-12	Ceiling 200 ft.
6-13	Partly cloudy, ceiling about 800 ft., winds NE at about 15 knots
6-14	Light rain, ceiling < 200 ft.
6-15	Heavy rain, winds at about 50 knots +
6-16	Ceiling variable 2-300 ft., winds at about 30 knots and dropping
6-17	Ceiling variable 2-300 ft.
6-18	Ceiling low on S side, high on north, no winds
6-19	Partly cloudy
6-20	Partly cloudy, ceiling variable
6-21	Partly cloudy with light rain
6-22	Ceiling about 500 ft., winds at about 25 knots
6-23	Partly cloudy, ceiling about 500 ft., no wind
6-24	Partly cloudy
6-25	Gale warnings and rain, winds SE at about 35 knots
6-26	Rain plus low ceiling
6-27	Partly sunny with some rain in AM

APPENDIX B
ALEUTIAN CANADA GOOSE NEST CENSUS
PLOT DATA FORM
BULDIR ISLAND
1982

(Included in the Original and Field Copy Only.)

APPENDIX C
ALEUTIAN CANADA GEESE NESTING
STUDY PHOTOS, BULDIR, 1982

(Included in the Original and Field Copy Only)

APPENDIX D

POSSIBLE SOURCES FOR INACCURACY FOR BULDIR GOOSE BREEDING POPULATION ESTIMATE

Human Failure: In working 200 meter square plots, there is a possibility of simply overlooking a nest during searches. This was kept to a minimum by thorough systematic examination of the entire plot. Despite the confidence of the investigators, the possibility of overlooking an unknown number of nests does exist. Hatched nests are the most difficult to locate, primarily because the goose does not flush from the nest and higher vegetation. Also, during the peak of incubation, females on nests held very tightly allowing investigators to approach within 1 meter before flushing.

Eagle Aeries: There are several eagle aeries located near plot S15 and one is actually inside plot S14. These aeries also existed in 1979 and one nest was present on S15 in 1977. There is a strong possibility that these eagles discourage goose nesting in these plots.

Habitat Changes: Slide areas in the nest-plots were encountered frequently. The presence of slides did not seem to significantly affect the nesting population except for reducing nesting habitat. However, blocking human access to nesting habitat may have caused the overlooking of some nests in the north facing plots #2 and #3 although habitat there was marginal.

Erosion of the gull slide census area heavily occurred since the 1979 nesting study. This reduced the amount of useable nesting habitat by approximately one-half. This type of erosion is occurring island-wide to at least some degree.

Also it may be possible that the geese tend to utilize different slopes annually as a result of yearly climatic variations. This may not be reflected entirely in the sampling methods.

APPENDIX E

CALCULATIONS USED FOR BREEDING POPULATION ESTIMATE OF GEESE ON BULDIR ISLAND, 1982

Equations taken from Giles, F.H., ed., 1971, Wildlife Management Techniques, 3rd ed., The Wildlife Society, Washington, D.C. p.408.

Normal approximation for confidence intervals based on % tables.

1. Total Nests in a Stratum

$$N = \left(\frac{P}{p}\right)n \quad \text{e.g. } N_I = \left(\frac{93}{5}\right) \times 1 = 18.6 \approx 19$$

N = total nests in stratum

n = number nests located in sampled plot

P = total possible plots in stratum

p = number sampled plots in stratum

2. Confidence Interval (95%) for Total Nests in a Stratum

$$V = P \left(\frac{P-p}{p}\right) S^2 \quad \text{e.g. } V_I = 93 \left(\frac{93-5}{5}\right) 0.20 = 327.4$$

Confidence Interval = $N \pm 1.96 \sqrt{V}$

$$\text{e.g. Conf. Int.}_I = 18.6 \pm 1.96 \sqrt{327.4} = 18.6 \pm 35.5 \approx 19 \pm 36$$

V = variance for total nests in a stratum

S^2 = variance for sampled plots in a stratum

3. Total Nests on Island

$$\text{Total } N = N_I + N_U + N_N + N_S + \text{Census Areas}$$

$$\text{e.g. } 287 = 19 + 0 + 27 + 231 + 10$$

N_I = nests found in Interior tall plant stratum

N_U = nests found in Mossy-willow uplands stratum

N_N = nests found in North Facing slope stratum

N_S = nests found in South Facing slope stratum

4. Confidence Interval for Total Nests on the Island

$$\text{Confidence Interval} = \text{Total} \pm 1.96 \sqrt{V}$$

$$V = V_I + V_U + V_N + V_S + V \text{ census area}$$

$$\text{e.g. } V = 327 + 661 + 4460 + 0 = 5448$$

$$\text{e.g. Confidence Interval} = 287 \pm 1.96 \sqrt{5448} = 287 \pm 144.6 \approx 287 \pm 145$$

V = variance of total nests on the island

