Abundance, Age Composition and Observations of Emperor Geese in Cinder Lagoon, Alaska Peninsula 17 September - 10 October 1986

by

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ABSTRACT

Abundance and age composition ground counts of emperor geese **Chen canagica** were conducted in Cinder Lagoon, Alaska Peninsula between 17 September and 10 October 1986. In the study viewing area - comprising approximately 37.4% of the lagoon, a gradual build-up of geese was observed, which peaked on 4 October with an estimated 13,800 emperors. Geese departed quickly thereafter, and by 10 October, 5,250 geese were counted. No emperor geese were seen in the lagoon during a reconaissance conducted by staff members on 22 October. Shifting winds from the north, with dropping temperatures was associated with departures of geese from the study area.

The proportion of young in the population sampled suggested higher production for emperor geese than in recent years, with 90% of 41 counts (with samples $\geq$297 geese) having proportions of young > 30%. The median proportion was 41.8%, with a 95% CI of 37.6% - 45.6% young.

Preliminary data for counts conducted during different times relative to the daily stage of the tide showed that a higher proportion of young occurred in the lagoon sand flats prior to low tide than for some time after (X^2=34.4, df=2, P<0.001 for 24 September; X^2=81.3, df=2, P<0.001 for 28 September), suggesting that family groups arrived to feeding areas earlier than groups without young. Further study is recommended.

The relatively high proportion of young observed was supported by comparatively high numbers of young in groups with 1 or 2 adults (probable family groups). For daily samples of > 20 groups, mean number of young ranged between 3.11 (SE=0.18) and 3.88 (SE=0.21) for birds on-ground, and 3.30 (SE=0.22) - 4.38 (SE=0.41) for groups on the wing. There was no difference between grand means in each category (3.45 (SE=0.06) vs. 3.74 (SE=0.09), t=0.68, df=854, P>0.50). Individual group sizes of young ranged from 1 - 8 for ground counts and 1 - 10 for flying geese.

Codes for 5 neckcollared adult geese were read 28 different times on 13 days. Additionally, 2 collars were found in a hunter's cabin from emperors apparently harvested in fall, 1984. Of the 5 neckcollared geese, resightings ranged from 2 - 10 times per individual. Three of the individuals were observed with young at least 5 times each, but the number of young was not always the same. When young were seen with collared geese, the other adult was seen 88% of the time. The regularity of observation of these marked birds suggested an affinity to the same feeding areas, and a generally low or undetected "turnover" until perhaps, late in the study period.

Low flying aircraft and bald eagles **Haliaeetus leucocephalus** were significant disturbance factors on geese.

It is feasible to capture emperor geese in the study area, especially in roosting areas during high tide, provided geese are lured to rocket nets, perhaps by using commercial decoys.

Ground studies of emperor geese in Cinder Lagoon should continue, to include spring and fall migration periods. Recommendations are presented.

Annotated accounts for 68 other bird and 9 mammal species observed during the study are included.

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INTRODUCTION

The current status of the emperor goose **Chen canagica** in Alaska is tenuous, in light of the species apparent declining numbers, determined by recent aerial surveys during migration (see Dau and King 1986, Petersen 1985, U. S. Fish and Wildlife Service 1986). In an attempt to aid in the study and management of the species, the Alaska Peninsula/Becharof National Wildlife Refuges assisted the Migratory Bird Management Office (U. S. Fish and Wildlife Service, Anchorage, Alaska) by obtaining data on abundance and age composition of geese occurring in Cinder Lagoon, Alaska Peninsula, during fall migration (Fig. 1). Specific data requests were:

1. Report all incidental observations.
2. Record all groups in bays, young and adults.
3. Record collars sighted with dates; record same collars if on successive days for turnover information.
4. Select $\geq$ 4 15-minute time blocks throughout the day to record all observations.
5. Include weather data.

(from copy of memo to Togiak NWR refuge manager received in King Salmon on 2 September 1986). Additionally, we were asked to observe the reaction of geese (if possible) to the presence of unloaded rocket net sets placed in roosting sites, and to appraise the feasibility of capturing the birds for banding and marking.

STUDY AREA

The study area included Cinder Lagoon and environs, especially the north central portion adjacent to the field camp (Fig. 2). Based on data from U. S. Geological Survey map Bristol Bay (B-1), Alaska (1963), scale 1:63360 (Fig. 2), (using a dot grid) we estimated the area of the lagoon to be 32.9 km^2. Within the lagoon, we estimated our area of observation to be 12.3 km^2 or about 37.4% of the total surface area (outlined, in part, by bold line in Fig. 2). The viewing or observation (used synonymously hereafter) area is characterized by a tidal flat of sand, cinder, and mud, which is perhaps 90% exposed during most low tides. No emergent vegetation occurred in this zone. The NW spit is a vegetated sand dune dominated by a plant community of beach rye grass **Elymus arenarius, Senecio pseudo-Arnica** and oysterleaf **Mertensia maritima. Angelica spp.** (primarily **A. genuflexa**) and beach pea **Lathyrus maritima** are also present. Patches of crowberry **Empetrum nigrum** are widespread, especially in the uplands, and were most common on the spit in the trough between low ridges. We observed an exceptionally abundant crop of berries, which apparently extended to areas west of Hook Lagoon (R. E. Gill, pers. comm.). Alkali grass **Puccinellia spp.** also occurred in low patches especially west of camp and along the SW creek. Noteworthy of the study area was the occurrence of what appeared to be the scattered remnants of old hunting blinds which we found in upland crowberry.

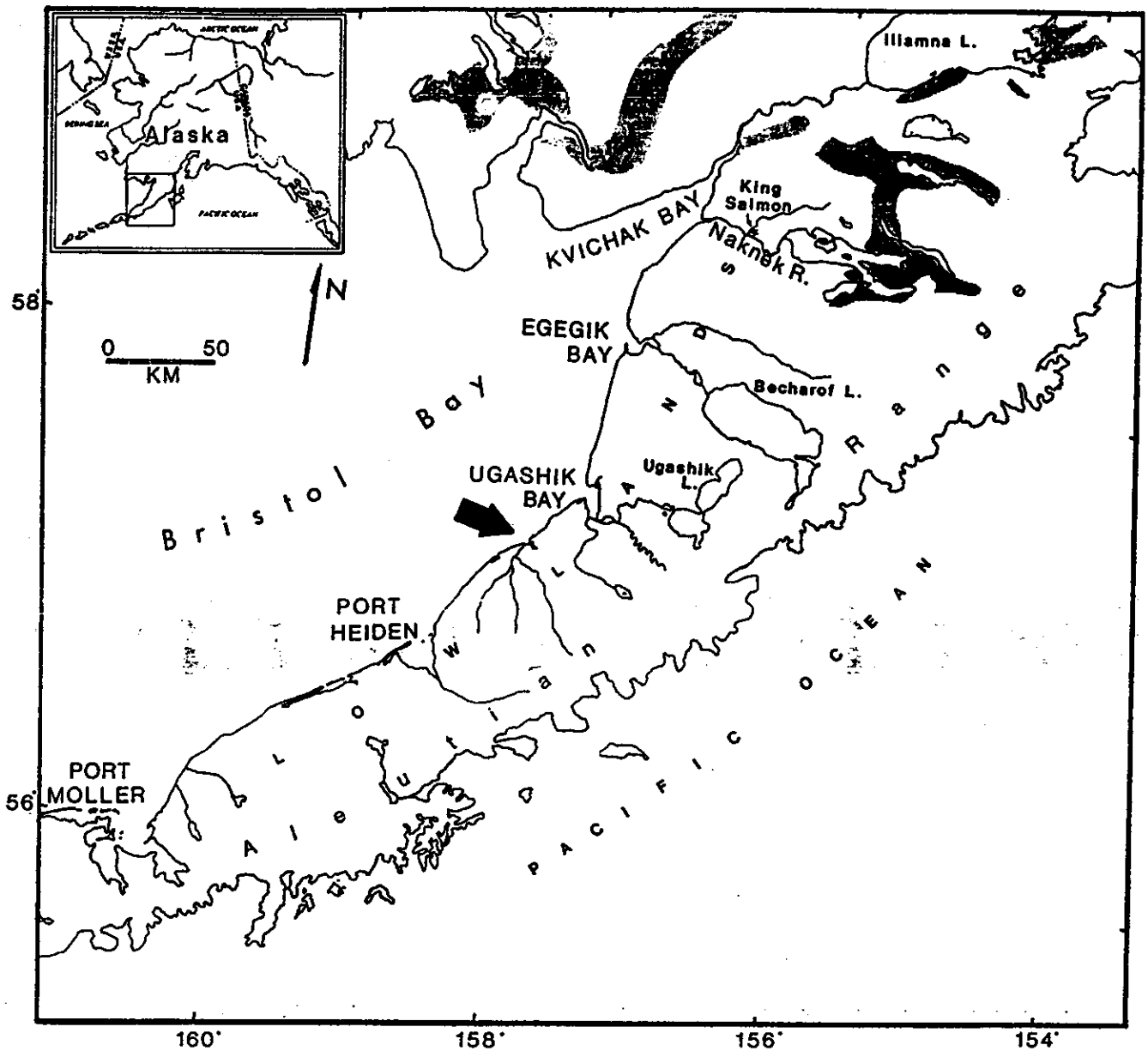

Fig. 1. Location of Cinder Lagoon (arrow) in the Alaska Peninsula.

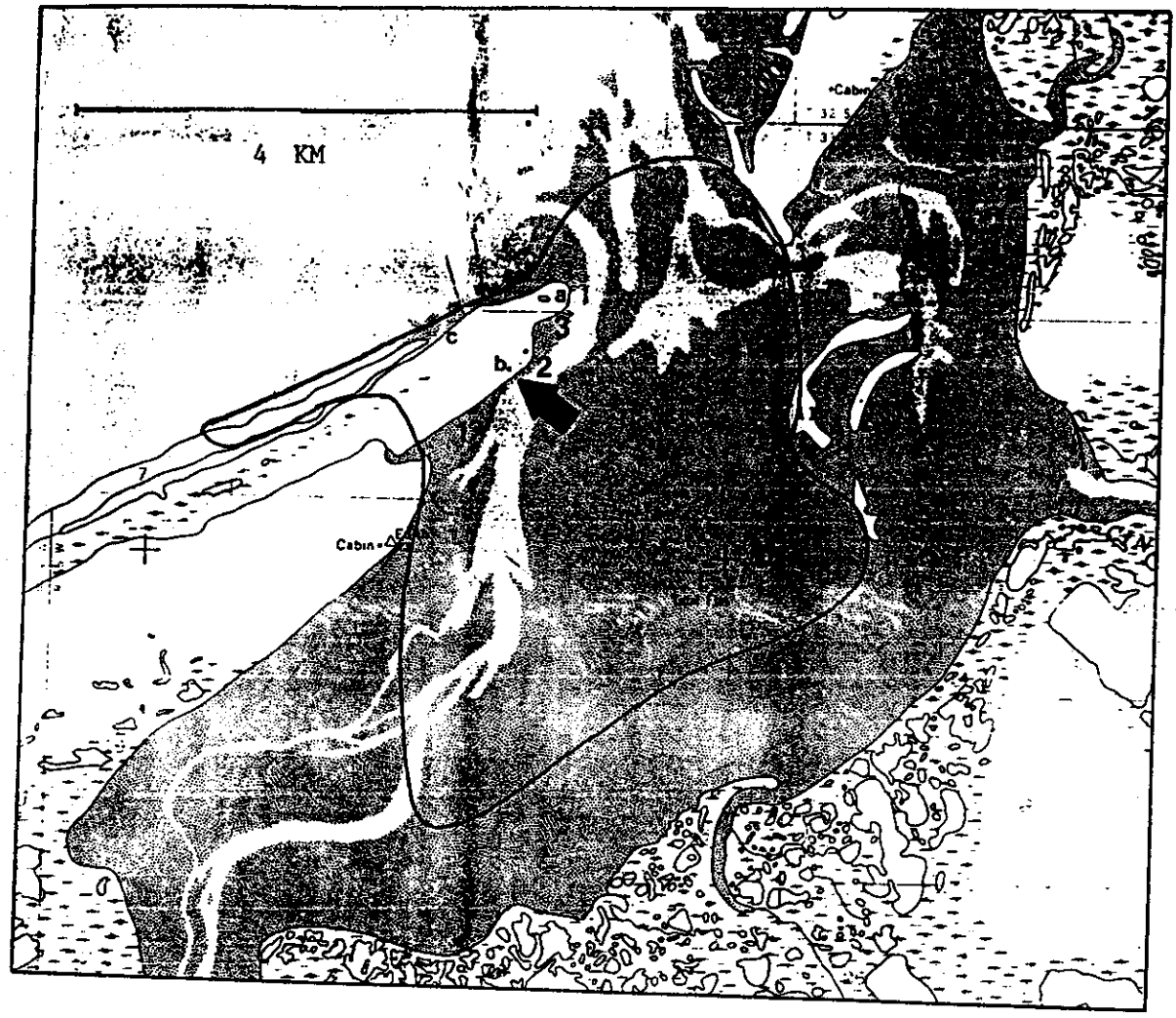

Fig. 2. Cinder Lagoon study area, Alaska Peninsula. Arrow shows field cabin. Bold line is approximate observation area. Letters are counting stations. Numbers are keyed to Appendix 1.

METHODS

Weather

Weather data were recorded each day, as close as possible to sunrise and sunset. These data included time, current, maximum, and minimum ambient air temperature, estimated percent cloud cover, wind direction and velocity, barometric pressure, dew point, and relative humidity. Whenever possible "midday" wind data were recorded (generally between 1130 h and 1600 h).

Daily Counts - General

We established a camp in a field cabin on the south side of the NW spit near the outlet of Cinder Lagoon (Fig. 2). Between 20 September and 7 October, 4 daily counts of emperor geese (and incidental species, when possible) were conducted with the following time schedule:

20 - 30 September 0900, 1200, 1500, and 1900

01 - 07 October 1000, 1300, 1600, and 1900

Times were changed in October to accomodate diminishing diurnal light conditions with the shortening days. The approximate location of each counting station is lettered in Figure 2. We also used a small camouflage tent W of the field cabin (b) to observe geese more closely. On occasion, we changed the location of the count stations to enhance counting, but the area of observation was generally the same (e.g., some counts scheduled for site a were made from the cabin near viewing area 2 (Fig. 2), when it was known that all geese could be seen from that location). Counts were conducted using 10 x 40 binoculars and 25 - 45x and 15 - 60x variable power spotting scopes. Counts were conducted from sites a and b during all count days, and a migration watch site was established (location c) beginning 28 September, for observing geese occurring along the Bristol Bay (Bering Sea) coast. We also started group counts while conducting the abundance and composition counts on the 28th. The following daily schedule was established for the study period:

17-19 September: incidental observations

20-22 September: standard counts (4 times/day)

23 September: 1 low tide count and 1 composition count (sites a & b)

24-25 September: standard counts

26 September: 1 low tide count and 1 composition count (sites a & b)

27-29 September: standard counts (migration watch and group counts begun on the 28th)

30 September: 1 low tide count and 1 composition and group count (sites a & b)

01-02 October: standard and group counts with migration watch

03 October: 1 low tide count and 1 composition and group count (sites a & b)

04-06 October: standard and group counts with migration watch

07-10 October: 1 low tide count and 1 composition and group count (sites a & b)

The counting schedules of observers were rotated on standard count days. On days when 1 count was conducted, usually 1, or 2 observers working together enumerated geese.

We first attempted to estimate total number of emperor geese, by partitioning viewing areas so birds were not counted in duplicate. Next, we conducted composition counts (tallies of adults and young among groups and flocks of geese), sampling from numbers of birds located along the south side of the spit, and into the open water zone where birds fed and/or loafed on shoals. While conducting these counts, we searched for neckcollared geese and recorded each one, along with the date, time, location, associated birds and activity. The duration of each set of counts ranged from about 0.33 h to $\geq$ 1.5 h. These intervals corresponded to the time required to conduct a lagoon or migration watch at high tide to a low tide lagoon count (especially when large numbers of geese were present), respectively. We recorded aircraft overflights, estimating altitude of the aircraft, reaction of geese, and other data.

Composition and Group Counts

We conducted daily composition ground counts for as many geese as possible within the viewing area, while geese were feeding in large numbers. The number of birds present, weather, visibility, observer eye fatigue, individual motivation and disturbance factors on geese all contributed to the number of birds sampled for any single count. All birds counted generally occurred in the viewing area shown in Fig. 2 (general locations of feeding geese along shoreline depicted by numbers, which are keyed to Appendix 1), and within approximately 0.2 - 0.4 km of the shoreline. On clear, well-lighted days, the effective viewing area of these counts was probably extended. We classified geese as either adult or young. If counts were conducted simultaneously from more than 1 site, we made every effort to avoid duplication. All classified geese were then combined for the estimated composition total for the period.

In addition to composition counts, "incidental observations" - geese observed flying over or foraging in nearby uplands - were also recorded. Incidental observations were pooled daily and were treated separate from other counts.

We also attempted to count numbers of young in groups accompanied by 1-2 adults that were presumed to be parent(s). We counted only those groups on the ground or water, or others just landing (Raveling and Lumsden 1977:58) or taking off together (Prevett and MacInnes 1980:42). When large flocks occurred together during feeding, as was the norm, only those "groups" that were obviously separate from others and consistently behaved as a unit, or those occasionally observed in Triumph Ceremony (head and neck waving with raucous honking; Raveling 1969:308) were tallied in our group size data.

Other Wildlife

Finally, we recorded other wildlife observations associated with the standard counts, and from casual observations made during the study period.

Statistical Calculations

Calculations used in statistical analyses were from Zar (1984) and Hewlett-Packard (1984).

RESULTS AND DISCUSSION

Weather

Weather conditions were generally mild during the study period. Weather data are summarized in Table 1, in time blocks of noticeably different weather (temperature) patterns, suggested by Figure 3. Fifty-four percent of the days reached temperatures $\geq$ 12.7° C (55° F), with a high 17.2° C (63° F) on 28 September. A low of 0° C (32° F) occurred on 5 October, and coincided with an apparent exodus of geese from the lagoon (Fig. 3). Only 3 nights had temperatures < 4.4° C (40° F).

Winds were variable, but were lightest in the morning, shifting from E to SE by mid-afternoon. Peak gusts in excess of 96 km/hr (60 m/hr) were recorded at 1540h on 9 October. The greatest rainfall for a 24-hr period was 20.7mm (0.82 in) for 25-26 September. The relationship of weather to goose abundance is discussed later.

General Daily Distribution, Activity Pattern, and Disturbance Factors

While we assembled camp on 17 Septmber, geese were regularly observed nearby (usually $\geq$ 75m away) in the crowberry uplands. By 20 September, geese were seldom observed foraging near camp, as they became aware of our presence. By that time, we became familiar with their daily activity cycle which evolved around the tides in the lagoon.

The first geese would leave their high tide roosting areas (feeding flights) as early as 5 hrs prior to low tide, with a gradual build-up of birds, peaking by low tide. On 30 September, RJW tallied the arrival of geese to the lagoon feeding areas, for a low tide estimated to occur at 1702. During the 0.5 hr count (1248-1318) at least 181 geese were observed (6 geese/min). As the tide ebbed, greater and greater numbers migrated to the feeding areas (feeding flights; at times, hundreds of geese). Geese fed for hours, with large numbers present generally between 3 hrs prior to low tide, to 3 hrs after. Northern pintails **Anas acuta** and mallards **A. platyrhynchos** were the most common dabbling ducks feeding with emperors. With the early incoming tide some geese began shifting within the lagoon, and moving to upland resting and feeding areas (roosting flights). Later, geese moved swiftly, and "mass migrations" to the uplands were immediate and much less protracted than the feeding flights. From our viewpoint, most of the geese migrated to the uplands west and SW of camp. By the time all flats and sandbars were inundated by the incoming tide, virtually all geese had left the lagoon for the uplands, and the vanguard of various seaducks rolled in. We noted that this cycle was generally unaffected by daylight or weather, at least for feeding flights occurring after sunset, or prior to sunrise. The tide cycle was more important to feeding geese than daylight.

Table 1. Weather summary for Cinder Lagoon study area, Alaska Peninsula, 17 September - 10 October 1986. Data in time segments characterized by changing temperatures and weather patterns suggested in Figure 3.[a]

	17-19 Sept.	20-24 Sept.	25 Sept.- 01 Oct.	02-04 Oct.	05-10 Oct.	Range	Totals or means
Temperature (°C)							
Maximum (mean/SD)	16.1 (1.0)	12.2 (2.6)	13.4 (2.5)	9.8 (2.2)	12.6 (2.8)	7.8-17.2	12.8 (2.8)
Minimum (mean/SD)	9.7 (0.4)	6.5 (1.8)	6.7 (2.6)	5.0 (0.6)	5.5 (3.6)	0.0-10.0	6.4 (2.6)
Cloud cover (%)							
Mean (SD)	83.8 (23.6)	71.0 (33.8)	87.9 (19.8)	80.0 (23.5)	67.7 (41.7)	0.0-100	77.8 (30.0)
Relative humidity (%) (mean/SD)	88.5 (3.9)	80.6 (5.1)	88.9 (6.4)	85.0 (4.5)	91.3 (4.1)	70-100	87.1 (6.4)
Barometric pressure (mbar) (mean/SD)	1020 (8)	1025 (4)	1018 (15)	1013 (8)	1010 (7)	998-1067	1017 (12)
Precipitation (mm) (mean/SD) daytime	3.1 (0.2)	0.1 (0.3)	1.0 (1.3)	1.5 (2 3)	0.9 (1.2)	0.0-6.1	1.0 (1.7)
nighttime	1.4 (0.1)	0.0	2.9 (6.4)	1.4 (0.9)	0.2 (0.4)	0.0-17.4	1.3 (3.7)
Wind velocity (km/h) (mean/SD) am	14.5 (0)	14.0 (6.5)	13.6 (6.9)	10.7 (10.1)	12.7 (14.0)	0-27.4	13.2 (8.7)
midday	36.2 (14.8)	16.9 (9.8)	17.6 (8.6)	18.1 (11.9)	20.0 (9.5)	0-80.5	20.3 (13.7)
pm	20.4 (8.7)	16.3 (15.1)	13.5 (7.4)	13.8 (6.8)	16.1 (22.7)	0-40.2	16.1 (10.5)
Wind direction[b] (% of readings)							
am calm			14	33	33		17.4
N		20	14				8.7
NE							0
E			43		50		26.1
SE	50		14		17		13.0
S	50	40					13.0
SW			14				4.3
W		40		67			17.4
NW							0

Table 1. Continued.

		17-19 Sept.	20-24 Sept.	25 Sept.-01 Oct.	02-04 Oct.	05-10 Oct.	Range	Totals or means
Wind direction[b] (% of readings)								
midday	calm			17				5.0
	N							0
	NE					20		5.0
	E							0
	SE	50	25	50		60		40.0
	S	50						5.0
	SW							5.0
	W		50	33	33	20		25.0
	NW		25		67			15.0
pm	calm		20			20		9.1
	N		20					4.5
	NE					20		4.5
	E					20		4.5
	SE	100		71		40		40.1
	S							0
	SW			14				4.5
	W		60	14	33			22.7
	NW				67			9.1

[a]Data for 17 September include max./min. temperatures only; only am data for 10 October included.
[b]N=338°-22°; NE=23°-67°; E=68°-112°; SE=113°-157°; S=158°-202°; SW=203°-247°; W=248°-292°; NW=293°-337°.

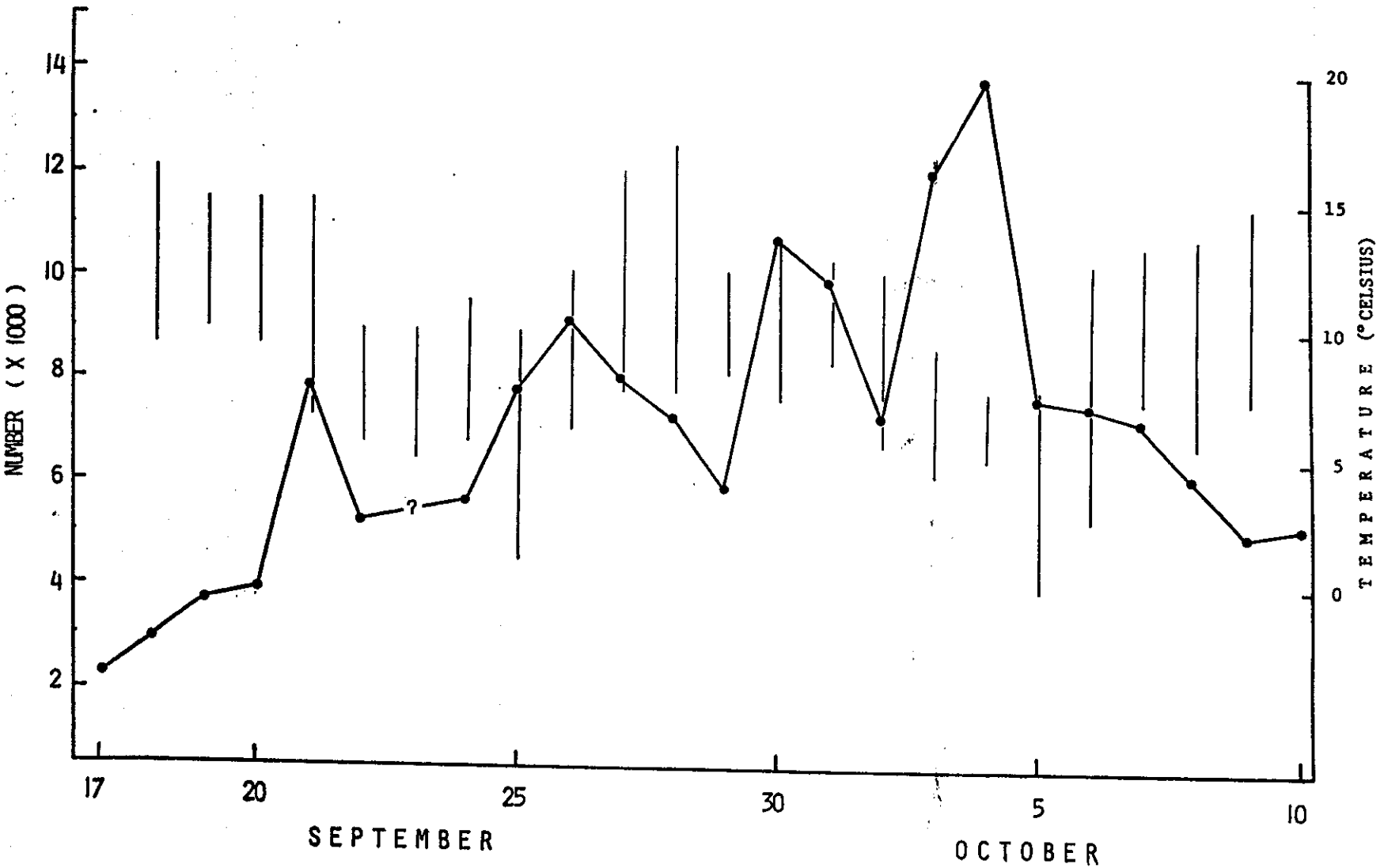

Fig. 3. Daily ambient air temperature extremes (vertical lines), and highest counts (connected points) of emperor geese in viewing area in Cinder Lagoon study area, 17 September - 10 October 1986. Note the two scales on vertical axes.

Among the various lesser numbers of waterbirds associated with feeding geese, we observed familial defense of young by adults only towards glaucous-winged gulls **Larus glaucescens**, and only when the gulls were within perhaps 0.5m of young. Occasionally we observed threat displays toward other adult geese. We also observed aggressive behavior of gulls toward young geese. On the Yukon Delta, the larger glaucous gull **Larus hyperboreus** has the greatest effect among the avian predators on emperor goose brood mortality (Eisenhauer and Kirkpatrick 1977:48). In defense of young, an adult would dip its head either parallel to the water or ground, or lower, in a slight inverted arc, then utter a raspy, nasal sound with its head and neck extended toward the intruder. On a few occasions, we observed geese chasing gulls, but no physical contact was noticed.

Geese were observed foraging on blue mussel **Mytilus edulis** and other mollusks (we regularly observed goose droppings containing mussel/mollusk shell fragments in the upland roosting areas and tidal flat feeding area). Crowberry and alkali grass communities appeared to be heavily grazed by geese while used as "high tide" roosting areas. On the Yukon Delta, Eisenhauer and Kirkpatrick (1977:51) found that emperors with broods along the Kokechik Bay edge frequently fed on mollusks and crustaceans on tidal mudflats. Along the Kokechik River, plant matter comprised the diet. Our observations in Cinder Lagoon suggested a similarly varied diet.

In addition to the geese roosting in the vegetated uplands, we noted that some occurred on the beach along the Bristol Bay coast during high tide. Initially, we observed perhaps 70 - 150 geese among other birds (primarily glaucous-winged gulls). By 4 October, we had estimated perhaps 2000 geese roosting in a loose flock on the beach. Large numbers of geese were observed in the same reach about 3 or 4 days earlier by W. I. Butler and M. R. Petersen (pers. comm.) during an aerial survey. RJW and KIW estimated 3000 - 4000 geese spread out along the beach after sunset (high tide) at 2115 h on 8 October directly north and extending west of the cabin.

Low-flying aircraft and bald eagles **Haliaeetus leucocephalus**, were the most common disturbances which affected feeding geese and their local distribution within the lagoon. Early in the study period, sporadic gunshots were heard, but diminished markedly over time. We suspect that the knowledge of our presence in the study area may have biased hunter distribuion and activity. Aircraft and eagles raised thousands of birds on several occasions. The bald eagle is among the important natural enemies of the emperor goose (Murie 1959:73), especially on their wintering grounds (Eisenhauer and Kirkpatrick 1977:52). Our observations showed an acute sensitivity of geese to the presence of eagles. We did not observe any eagles attempting to capture geese, but adult and subadult eagles commonly flew over large flocks of geese, disrupting feeding activities. One adult was seen SW of the field cabin feeding upon an unidentified waterfowl. Harbor seals **Phoca vitulina**, red foxes **Vulpes vulpes**, common ravens **Corvus corax**, peregrine falcons **Falco peregrinus**, and gyrfalcons **F. rusticolus** were all observed in close proximity to geese during lagoon feeding, with the latter 3 causing minimal disturbance, but at times eliciting a clamor of wariness from geese. On one occasion we observed an adult fox approach to within 2m of a large number of feeding geese, without incident. On the nesting grounds, emperors apparently defend their nests better against foxes than other waterfowl (Eisenhauer and Kirkpatrick 1977:53). On another occasion, an immature peregrine was seen actively pursuing shorebirds along the lagoon shore, moving swiftly to within 10m of feeding geese. The falcon landed (with unidentified prey in its talons) - within 5m of a large flock of geese. Initially disturbed by the bird's

approach, the geese went back to feeding. Some wary adults, however, kept watch of the bird.

Prevett and MacInnes (1980:23) listed bald eagles and aircraft, along with humans, as the major disturbance factors of snow geese in fall staging areas, and stated that the daily disturbance of geese could cause variability in family structure and composition.

We tallied an average of 7.8 aircraft overflights per day of which 4.9 were below 152m (500ft.). These data do not include the disturbances caused from our arrival or departure, or from more than 1 overflight from survey aircraft working the lagoon on a given day (and the 1/2 day for the 17th was not adjusted) (Table 2). At least 27% of all recorded overflights, and 42% of all those flights $\leq$ 152m above ground level (AGL) disturbed geese. Over the study period, 2.1 overflights/day raised geese. This mean includes days of extremely poor weather when no overflights were recorded for the lagoon. Some overflights raised perhaps all the birds observed in the lagoon, which, at times was in excess of 10,000 geese. Sellers (1981) reported daytime (sunrise to sunset) air traffic ($\leq$ 152m AGL) over Cinder River at a rate of 0.4 - 0.5 flights/hr for 1979 and 1980. Our results show an overall rate for overflights $\leq$ 152m AGL of 0.41 flights/hr, or 1 overflight/2.4hrs. These data also include days of inclement weather. The daily range for the study period was 0 - 0.95 overflights/hr; the daily range for overflights that raised geese was 0.09 - 0.57 overfights/hr or 1 disturbance overflight per 1.7 - 11.1 hrs).

Abundance

On 3 September, D. D. Mumma (pers. comm.) estimated that 600 emperor geese occurred in the outlet of Cinder Lagoon during an overflight. On 8 September, during a flight to the study area, RJW and C. R. Arment tallied 880 emperors observed on the shoals and along the spits near the outlet of the lagoon at low tide. When we arrived in the morning of 17 September, we estimated that perhaps 2,300 emperor geese were in the entire Cinder Lagoon. This estimate was determined from a brief aerial reconaissance of the lagoon in a Cherokee 6 aircraft.

Figure 3 depicts daily weather extremes in relation to goose abundance. Most certainly, numerous other factors play a role in the migration of geese, however, the figure suggests a cyclic temperature pattern from which certain migrational events could be associated. This pattern was characterized by periods of shifting winds, with significant drops in overnite temperatures. Temperatures gradually lowered during he first week, and dropped to an overnite low of 1.1° C (34° F) on the morning of 25 September. Our weather notes show that a "major low pressure system" from the W moved in on 22 September; on the 24th, the W winds diminished to calm by evening, then shifted to the NE by morning. Concurrent with and subsequent to these conditions was a marked increase in the number of geese tallied for the 25th and 26th. After a peak temperature of 17.2° C (63° F) on the 28th and following a period of "stability in temperatures", winds shifted from the W by 3 October, with temperatures again dropping and the wind shifting from the NW on the 4th. On the morning of 5 October, a low of 0° C (32° F) was recorded. A significant decrease of geese recorded on subsequent days.

R. E. Gill (pers. comm.) first reported noticeable goose activity on 5 October, when he observed between 1,500 and 2,000 emperors SE of his Hook Lagoon camp (about 10-14km SW of our cabin). On the 6th, we noted a build-up of geese on the seacoast during high tide, estimating about 2,000 - 3,000 geese in areas we had previously recorded a maximum of only a few hundred. On 8

Table 2. Aircraft disturbance of emperor geese in Cinder Lagoon and surrounding area, 17 September - 07 October 1986.[a]

	Number of overflights		Number of times geese were raised			
	Total	≤152m[b]	Total	≤152m overflights	% of all overflights	% of ≤152m overflights
September						
17[c]	12		3		25	
18[c]	18		4		22	
19[c]	8		1		13	
20	13	9	4	4	31	44
21	12	12	7	7	58	58
22	9	7	2	2	22	29
23	11	9	3	3	27	33
24	5	4	2	2	40	50
25	6	4	0			
26	6	3	0			
27	13	9	5	5	38	56
28	5	4	2	2	40	50
29	6	3	0			
30	12	7	2	2	17	29
October						
01	4	4	1	1	25	25
02	7	6	4	4	57	67
03	1	0	0			

Table 2. Continued

	Number of overflights		Number of times geese were raised			
	Total	≤152m[b]	Total	≤152m overflights	% of all overflights	% of ≤152m overflights
04	2	2	1	1	50	50
05	1	0	0			
06	7	1	1	1	14	100
07	6	4	3	3	50	75
Totals or means	164 ($\bar{x}$=7.8)	88 (54)[d] ($\bar{x}$=4.9)	45 ($\bar{x}$=2.1)	37 (100)[d] ($\bar{x}$=2.8)	27.4[e]	42.0[e]

[a]Number of birds disturbed (raised) ranged from a few hundred to greater than 10,000, depending on the magnitude of disturbance, and the number of geese present.
[b]Altitude estimated.
[c]Altitude of overflights not estimated.
[d]Percentage.
[e]From applicable column totals.

October, Gill reported an estimated 3,000 - 4,000 geese near Hook Lagoon, and on the dunes west in some crowberry flats. It is uncertain whether these geese were "spill overs" from Cinder Lagoon, during an apparent period of "active" goose movement, or were new arrivals.

Some of the daily abundance estimates in Figure 3 are low because of inherent problems with visibility due to weather, and estimation variability among observers. The dip in the line for 29 September is an example of a daily high count conducted with poor visibility.

A high count of 13,800 geese in the viewing area was tallied on 4 October (Fig. 3). Perhaps > 10,000 geese were present between 30 September and the peak. When the aircraft of the primary survey team passed over the lagoon, surveying between 1225h and 1309h on 7 October, 10,226 emperors were tallied (memorandum from R. J. King to Chief, Migratory Bird Management, Anchorage, October 1986). Our ground count in the observation area, conducted about 1 hr previous to the aerial survey tallied 7,250 geese, suggesting that 71% of the emperor geese recorded by the survey crew were in the viewing area.

Gill (pers. comm.) reported an estimated 7,000 emperor geese along the Bering Sea beach between Hook Lagoon and Cinder Lagoon on 20 October, when departing the area. On the 22nd, no geese were seen in the lagoon during an aerial reconaissance (C. R. Arment, D. D. Mumma, pers. comm.). Arment reported the tide was low and winds were from the NE at 22 km/hr at the time of the survey.

Age Composition and Group Size

The number of juvenile emperor geese observed in the study area varied, but the proportion of young was generally high when compared to estimates from previous years (see U. S. Fish and Wildlife Service 1986). Table 3 lists the age composition of geese from sample sizes $\geq$ 297 geese. During the study, 33 other counts were conducted but are not reported here because of the "small" sample sizes (range = no geese seen - 192). Ninety percent of the 41 counts listed in Table 3 had proportions of young > 30%. These percentages are among the highest reported for emperor geese during the fall on the Alaska Peninsula. Prior to this study, there has been little on-ground work of this nature conducted in Cinder Lagoon, therefore, direct comparative data are lacking.

It is uncertain whether the data show an excellent production year, or reflect the poor production (low numbers of subadults in adult plumage) from recent years. Differential migration and staging of geese (Prevett and MacInnes 1980:44, Newton 1982) is also a factor that could confound production estimates. Additionally, we are not certain that the area we sampled was representative of the population occurring in the lagoon during the study period. However, we are fairly certain that some of the highest concentrations of geese generally occurred within the viewing area.

In other studies of geese, yearlings tended to associate in groups of family size or larger (Lebret 1956, Lynch and Singleton 1964, both cited in Raveling 1969:315), and family parties and adults without young tended to form more or less distinct aggregates within a flock (Boyd 1956, in Raveling). We observed "aggregates" of as many as several hundred "adult-plumaged" geese. These birds were sampled along with the others and account for some of the variability (lower percentages) in the composition counts (Tables 3-4). These aggregates were not always observed or were not always distinctive. They usually occurred on the periphery of the count area, and probably eluded tally in some counts. At times the numbers of geese were so large and widely distributed that these "aggregates" might have been counted while "lost in the masses".

Table 3. Estimates of percent young of the year of emperor geese classified from ground counts in Cinder Lagoon study area, Alaska Peninsula, 17 September - 10 October 1986[a].

	Stage in tide cycle[b]					
	4-6 hrs. before low	2-4 hrs. before low	Low tide (± 2 hrs.)	2-4 hrs. after low	4-6 hrs. after low	Incidental observations
September						
17						52.0 (304)
18						45.5 (297)
19						45.0 (924)
20			49.0 (655)A	30.5 (704)A		55.4 (556)
21			52.3 (327)A			
22			29.6 (1000)A			
23			41.8 (937)A			47.6 (965)
24		51.6 (1230)P	42.5 (894)P	40.1 (1075)P		
25		52.8 (958)P	41.5 (982)P			
26			27.7 (1660)P 42.8 (1021)P			
27		39.3 (862)P	37.6 (841)P			
28		45.6 (1517)P	32.2 (1392)P	28.9 (419)P		
29	47.9 (503)P		37.0 (1437)P	59.7 (585)P		
30			48.5 (1596)P			

Table 3. Continued.

	Stage in tide cycle[b]					
	4-6 hrs. before low	2-4 hrs. before low	Low tide (± 2 hrs.)	2-4 hrs. after low	4-6 hrs. after low	Incidental observations
October						
01			46.7 (1358)P 41.5 (417)P			
02		52.0 (1040)	33.7 (1518)P			
03			49.7 (1377)P			
04	14.9 (1582)P[c]		41.6 (1440)A 48.5 (1252)P		32.4 (457)A[c]	
05			31.0 (1119)A			
06			35.1 (1855)A			
07			32.9 (842)A			
08			30.2 (1260)A			
09			44.0 (402)P			
10			40.6 (488)P			

[a]Sample size in parentheses.
[b]A=relative to morning low tide; P=relative to afternoon or evening low tide.
[c]Counts conducted of geese in "high tide" beach roost on Bering Sea side.

Table 4. Summary statistics for daily age ratios of emperor geese from 41 counts in Cinder Lagoon, Alaska Peninsula, 17 September - 10 October 1986.

	Sample size			
	297-503	504-1000	1001-1855	Totals
Counts (N)	9	14	18	41
Total sample	3614	11705	24729	40048
Mean sample size	401.6	836.1	1373.8	976.8
SD	77.0	150.2	229.5	422.8
Immature geese (%)	42.1	42.6	38.8	40.2
Mean %	42.8	43.2	39.4	41.4
Median %	44.0	42.5	38.6	41.8
95% CI (median %)				37.6 - 45.6
Range (%)				14.9 - 59.7

The slightly lower percent young for count samples > 1,000 in Table 4 may include these aggregates, but may not have been counted in some of the "smaller" samples.

Raveling (1966) used age ratios in winter from Canada geese captured in cannon-nets (over a 3-month period) to estimate productivity. The author was critical of using capture ratios because of various uncontrolled factors that biased estimates. He stated that the best estimate of the confidence interval (CI) was for the median. We used Raveling's (1966:684) method of presenting summarized composition data (Table 4). The 95% CI of the median % immature geese is 37.6% - 45.6%. Despite the wide range in count estimates, the interval is relatively narrow, and the sample size percentages of young geese (Table 4) are different by only a few percent. These data are only a way of summarizing count results, and are not necessarily valid for predicting future populations.

The 14.9% young observed during a count of beach roosting geese on 4 October is noteworthy because it was conducted at a period of noticeable goose movement (Fig. 3). These birds could have been new arrivals, or perhaps were staging on the beach prior to departure from the area. Since we have little information about proportions of birds in "high tide" roosting areas, this difference could merely reflect a separation of families from other groups when not in the lagoon feeding areas. It is interesting to note the comparative drop in percent young (Table 3) after 4 October, which appears to follow an exodus of geese (Fig. 3).

In comparison to our data, preliminary classification and family group counts conducted in Izembek Lagoon - concurrent with this study - showed that 8.1% (N=198 and 28.9% (N=1300) of the birds sampled from aerial photographs (taken on 2 October) were juveniles (Izembek NWR monthly activities report - September, memorandum to refuge supervisor (S), dated 14 October 1986). In Izembek, 24 broods counted averaged 3.4 young in the same study.

The high proportions of young in Cinder Lagoon are supported by the large number of young in groups (Table 5). The problems associated with group counts (probable family or other social groups) of fall-staging geese have been aptly described for snow geese **Chen caerulescens** by Prevett and MacInnes (1980). The authors showed how the day-to-day continuity (family integrity) of individual family groups (identified with neckcollars) was regularly disrupted during fall migration, and attributed most of the sampling problem to the greater densities of geese in staging areas, larger average flock size, and higher rates of disturbance which caused frequent temporary splitting of families. Although it was learned that separated family members consistently regrouped, the authors suggested that, as a general rule, counts of flying geese should not be used for group counts. Although these dynamics have not been studied in emperor geese, sampling problems are probably similar.

We treated groups counted "on ground" and flying (incidental observations) as independent samples (Table 5). We are fairly certain that a high percentage of those young recorded in individual groups were siblings, no matter where they were observed. Virtually all of our tallies of adults with young were of birds seen during feeding or roosting flights, or were already in the lagoon feeding. We believe that disturbance was a negligible bias in group counts, and the data are representative of the "group sizes" observed in Cinder Lagoon.

For daily samples of > 20 groups observed, mean number of young with 1 or 2 adults ranged from 3.11 to 3.88 goslings. Groups tallied from "incidental observations" (samples > 20) ranged from 3.30 to 4.38 young. The grand mean for groups of young observed flying (3.74) was somewhat larger (vs. 3.45), but was not statistically different ($t=0.69$, $df=854$, $P>0.50$). Modal group size in

Table 5. Group sizes of emperor geese young with 1-2 adults observed from ground counts and incidental sightings in Cinder Lagoon, Alaska Peninsula, 17 September - 10 October 1986. Means are for number of young.

	Ground counts					Incidental observations				
	Number	Mean	SE	Mode	Range	Number	Mean	SE	Mode	Range
September										
17						25	3.96	0.47	3	1 - 10
18						21	3.57	0.33	3	1 - 7
19						40	3.30	0.22	3	1 - 6
20						92	3.60	0.17	3	1 - 8
21	12	4.00	0.48	5	1 - 7	21	4.38	0.41	2	1 - 8
22						15	3.33	0.37	3, 4	1 - 6
23	3	3.00	1.15		1 - 5	65	3.78	0.20	3	1 - 10
24						16	4.94	0.50	6	1 - 9
25	1	6.00				12	3.58	0.43	3, 5	1 - 6
26						3	4.67	0.33	5	4 - 5
27						13	3.54	0.37	4	1 - 6
28	50	3.56	0.20	4	1 - 7	4	4.50	0.50	5	3 - 5
29	78	3.71	0.15	4	1 - 8	4	3.25	0.25	3	3 - 4
30	68	3.35	0.13	3	1 - 6	6	3.83	0.65	2, 4	2 - 6
October										
01	61	3.11	0.18	2	1 - 6	7	4.29	0.68	3, 4	3 - 8
02						4	3.50	0.50	3	3 - 5
03	50	3.48	0.16	3	1 - 5	6	4.00	0.52	5	2 - 5
04	49	3.88	0.21	4	1 - 7					

Table 5. Continued.

	Ground counts					Incidental observations				
	Number	Mean	SE	Mode	Range	Number	Mean	SE	Mode	Range
October										
05	4	3.50	0.96	5	1 - 5	5	2.60	1.12	1, 2	1 - 7
06	15	3.33	0.45	4	1 - 6	9	4.33	0.67	4	2 - 9
07	10	3.00	0.47	2	1 - 6	11	3.00	0.56	3	1 - 7
08	31	3.13	0.28	2	1 - 8	1	5.00			
09	21	3.29	0.27	3, 4	1 - 6					
10	24	3.13	0.26	4	1 - 7					
Totals or means	477	3.45	0.06	3	1 - 8	379	3.74	0.09	3	1 - 10

both categories was 3 and the range of young observed was 1 - 8 for ground counts, and 1 - 10 for incidentals (Table 5). We do not know if the largest groups tallied were siblings or a result of brood-mixing. Prevett and MacInnes (1980:40) found that potential group count bias was negligible in lesser snow geese, using methods previously described.

In fall 1985, Butler et al. (1985) reported 15.6% and 7.4% young for emperor geese counted from aerial photographs taken in early October at Cinder River. Aerial photograph sampling is sometimes dubious because weather and light conditions often dictate the time periods available for flying. In most instances, aerial photograph sampling is done on an "as can" basis. The sample sizes reported by the authors were comparatively small to our samples. In contrast, our samples were taken up to 4 times/day, and it is highly likely that in several counts we sampled many of the same birds. The regular resightings of individual neckcollared geese support this possibility. It is possible that the timing and location of composition counts, as well as sample size could invalidate any direct comparisons between aerial and ground composition counts if not synchronized, as suggested below.

For 2 days (24 and 28 September, Table 3) in which we have data for 3 sampling periods either side of low tide, there was a trend that showed the proportion of young was highest just prior to low tide, than it was at low tide, or shortly thereafter (Table 3) (X^2=34.4, df=2, P<0.001 for 24 September; X^2=81.3, df=2, P<0.001 for 28 September). These differences show a pattern that we suspected in our day-to-day observations of geese. It suggests that family groups arrived at the feeding area earlier than geese without young. If our suspicions are correct, then attempts to compare and assess productivity from aerial photographs and ground counts from the same study area should be timed to adjust for potential biases from differential arrival of geese to local feeding areas. Further study is recommended.

Geese Observed with Neckcollars

The first neckcollared emperor goose was seen on 24 September, despite search efforts the previous week. A total of 5 individual collars were read (Table 6, Appendix 1) on 28 separate occasions on 13 days. One collar was not read for an adult seen on 24 September, although this bird was probably one of the 5. Two collars were found in a hunter's cabin near our camp (Appendix 1), which were from emperors harvested during the fall 1984 hunting season (H. Pederson, Anchorage, Alaska, pers. comm.). This hunter told us he had reported the band numbers.

All 5 individuals (adults) were present until at least 4 October, and at least 2 were still present within 2 days of our departure. It appears that these geese regularly fed in the same general area, within view from the spit (Appendix 1), but not always in specific sites. Raveling (1969:309) found that wintering Canada geese **Branta canadensis** habitually fed in the same areas. Our observations suggested that 3 of the individuals left the area by 5 October. However, given the wide-spacing between some observations of individual geese, (e.g., 81E and 06E, Table 7), the information is inconclusive.

The primary activity of all individuals - when observed - was feeding or resting (Table 7, Appendix 1). Three of the individuals were observed in family groups at least 5 times. The number of young accompanying the adult(s) varied among observations (Appendix 1). The "other adult" in the "family" was observed 14 of 16 times (88%) when young were seen with the collared bird (Table 7). Prevett and MacInnes (1980) found that during fall, members of snow geese families were frequently separated, but invariably regrouped. In this

Table 6. Chronology of observations of emperor geese observed with neck collars, Cinder Lagoon, Alaska, 24 September - 09 October 1986.[a]

	Unkn.	A87	81E	00H	06E	1A0	Totals
September							
24	x						1
25							0
26		x	x				2
27		x	x (2)				3
28		x		x	x		3
29		x		x			2
30		x		x			2
October							
01		x (2)		x			3
02		x				x	2
03				x (2)			2
04		x	x	x		x	4
05					x		1
06			x				1
07							0
08		x	x				2
09			x				1
Totals	1	10	7	7	2	2	29

[a]Individual histories and accounts of known birds are listed in Appendix 1.

Table 7. Companion birds and general activity of 5 neck-collared emperor geese observed in Cinder Lagoon, Alaska Peninsula between 24 September and 09 October 1986. All observations occurred in counting area.

Collar code	With					Activity	
	Large groups	Adult(s) & young	Young only	Adult(s) only	Small group mixed age	Feeding	Resting
A87	3	3	2		2	9	1
81E	2	5				6	1
00H	1	6				7	
06E	1			1		2	
1A0	2					2	
Unkn.	1					1	

study, family units readily intermixed. One example (Appendix 1) was goose A87, observed at 1903 h on 4 October with 2 "adult-plumaged" birds and 9 young. At 1923 h, this adult was seen with 5 young.

There was no evidence that neckcollars inhibited any of the geese. One individual was observed preening its neck around the collar for about 10 min.

Feasibility of Rocket Net Capture of Geese

Two "unloaded" rocket nets were set up in a goose roosting area NW of camp (6-9 October) in an attempt to assess the potential for capturing geese. Albeit we did not directly observe geese within capture range of the nets, fresh droppings on and around the nets suggested use. This evidence was masked, however, by a high tide that probably inundated the capture sites.

Emperor geese regularly used certain general areas for roosting, but the exact location of geese for a given period within this area could not be predicted for capture purposes. We believe geese can be captured in Cinder Lagoon with rocket nets, but the birds must be lured to specific locations within the range of the nets. We highly recommend the use of decoys to draw emperors to the nets. Perhaps 2 or 3 commercial decoys altered to resemble an emperor family would be adequate for each capture set.

CONCLUSION AND RECOMMENDATIONS

The proportions of young emperor geese observed during this study were above the 20-year average of 28.5% (see U. S. Fish and Wildlife Service 1986). This information was supported by the comparatively higher average number of young seen in groups. We have no direct comparative data for Cinder Lagoon from studies with similar counting methods. Although annual variation in the proportion of young geese in the population can give a useful indication of productivity, a high proportion of juveniles could as likely be caused by a scarcity of subadults in adult plumage as by above normal production of young (Prevett and MacInnes 1980:32). If we consider the below average production of emperor geese in recent years (U. S. Fish and Wildlife Service 1986), then the proportions of young geese observed could well be a reflection of poor past production or good productivity in 1986, or both.

The data provide a baseline. Further study is required during migration so that seasonal differences are understood and annual age composition monitored. Observations of neckcollared geese are important in the understanding of migration, distribution, the habits and local movements of geese, family integrity and related parameters. The information could be used in part, to help resolve the task of refining estimates of recruitment of this imperiled species.

We recommend the continuation of ground observations of emperor geese in Cinder Lagoon with additional guidelines:

1) Expand the studies to include both spring and fall migration periods.
2) Study periods should span at least 30 days about the predicted peak of staging or migration (especially in fall) to ensure that the most information is obtained.
3) Strategies for conducting counts should focus on one exhaustive "low tide" count per day, to estimate total numbers of geese, age composition, and group counts. Also, one count of roosting geese in nearby upland or seacost areas should be conducted.
4) Further study of the relationship between age composition and stage of the low tide is necessary to quantify and determine if differential arrival of feeding geese occurs, and to what degree.
5) Perhaps once every 3 days, a "ground count" should be conducted from the NE spit, to compare data from 2 separate locations, ensuring representative sampling.
6) Rocket-netting of geese is feasible, and should be attempted using decoys to lure birds to capture sites. A large sample from all age classes should be measured, banded and neckcollared, enabling daily observations of goose social groups in the lagoon and other areas.
7) A study should be implemented, to quantify social relationships among emperor geese, to determine how the resulting knowledge could be applied towards the management of the species.
8) As this study was conducted, 2 or 3 observers are and ideal number for accomplishing the work.

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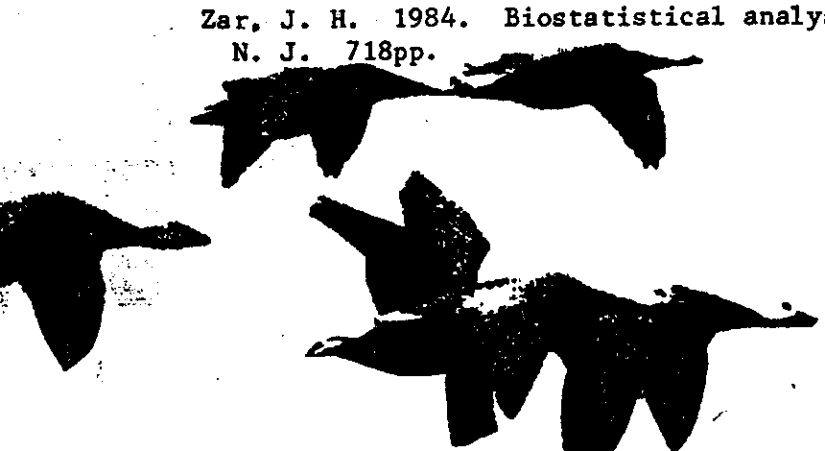

Appendix 1. Chronological summary of observations of neck - collared emperor geese seen at Cinder Lagoon, Alaska Peninsula, 24 September - 09 October 1986.[a]

	Collar code	Time	Site[b]	Tarsus band number	Age-sex	Year banded	Alaska location banded	Description of observation[c]
September								
24	unknown	0915	1					Among hundreds of other geese feeding at low tide.
26	A87	1104	1	887-36294	AHY-F	1982	Kokechik Bay	Among hundreds of other geese feeding at low tide.
26	81E	1545	2	887-35476	AHY-M	1984	Azun River	Among large numbers of geese, feeding; with an adult and 2 HY birds.
27	81E	1240	1					With other birds feeding; with adult and 3 HY.
27	A87	1310	1					Feeding with other geese; with adult and 4 HY.
27	81E	1526	1					Feeding with other geese.
28	00H	1220	3	887-34801	AHY-F	1984	Kokechik Bay	Feeding with other geese.
28	A87	1447	3					Feeding among other geese; with 4 HY.
28	06E	1526	2	887-35099	AHY-M	1984	Azun River	Feeding among other geese.
29	00H	1252	1					Feeding among other geese; with adult and 4 HY.
29	A87	1920	3					Sleeping (resting) on shore among among other AHY and HY birds.
30	00H	1402	1					Among other feeding geese; with adult and 4 HY.
30	A87	1429	1					Among other feeding geese; with adult and 3HY.

Appendix 1. Continued.

	Collar code	Time	Site[b]	Tarsus band number	Age-sex	Year banded	Alaska location banded	Description of observation[c]
October								
01	00H	1608	3					Among other feeding geese; with adult and 4 HY.
01	A87	1615	1					Feeding among other geese.
01	A87	1654	2					Same as above, except with 4 HY.
01	1A0	1630	1	887-34845	AHY-F	1986	Kokechik Bay (nest trapped)	Among other geese feeding on lagoon shore.
02	A87	1609	1					Feeding among mixed-age numbers of geese.
03	00H	1730	1					On shore with adult and 4 HY; flew when hazed by aircraft.
03	00H	1843	2					Feeding among other geese; with adult and 4 HY.
04	00H	0955	2					Feeding among others; with adult and 4 HY.
04	1A0	0958	2					Feeding among other geese.
04	81E	1015	1					Sleeping (resting) with adult and 2 HY among other geese.
04	A87	1903	2					Among others in group with 2 other adults and 9 HY; at 1923, seen with 5 HY.
05	06E	1010	1					Feeding among other geese; this bird with 3 adults.

Appendix 1. Continued.

	Collar code	Time	Site[b]	Tarsus band number	Age-sex	Year banded	Alaska location banded	Description of observation[c]
October								
06	81E	1030	1					Feeding among other geese.
08	81E	1037	1					Feeding among other geese, with adult and 2 HY.
08	A87	1117	2					Feeding among other geese, with adult and 5 HY.
09	81E	1058	2					Feeding among other geese, with adult and 3 HY.
Other observations								
September								
18	E67			1067-12872	L-M	1982	Azun River	Found collar in cabin adjacent to our field cabin. Later, cabin owner told RJW/KIW he shot the bird in fall 1984 and reported the band numbers.
18	C95			887-34761	L-F	1982	Kokechik Bay	Same as above.

[a]Banding history data provided by Alaska Office of Fish and Wildlife Research, Anchorage.
[b]Locations keyed to text Fig. 2.
[c]All observations made were associated with birds occurring in the study observation area when hundreds to thousands of birds were feeding, or loafing within about $\pm$ 3 hrs. of low tide in Cinder Lagoon.

Appendix 2. Annotated species accounts for birds and mammals observed in Cinder Lagoon study area, Alaska Peninsula, 17 September - 10 October 1986. Phylogenetic sequence and most scientific and common names follow the A. O. U. checklist of North American Birds (6th ed., 1983, and 35th supplement, 1985), and MacDonald, S. O. 1980. Checklist of mammals of Alaska, Univ. Ak., Fairbanks.

BIRDS

Gavia stellata. Red-throated Loon. Observed in the lagoon on only 3 occasions between 20 and 24 September - probably the same individual.

Podiceps auritus. Horned Grebe. Three individuals were observed in the lagoon on 17 September. A single was seen again on 30 September.

P. grisegena. Red-necked Grebe. A pair of adults was observed on 21 September. Individual adults were occasionally seen thereafter. On 23 September, a juvenile of this species was observed near the cabin. On the morning of 1 October, we found a fresh dead juvenile in rigormortis on the lagoon shore next to the cabin. Cause of death was unknown. We believe this bird was the same juvenile observed earlier (specimen collected).

Puffinus tenuirostris. Short-tailed Shearwater. Only beach-cast birds were found along the shores of Bristol Bay and the lagoon. We found $\geq$ 15 carcasses of this species in various stages of decomposition, including at least 1 fresh specimen following a storm.

Oceanodrama furcata. Fork-tailed Storm Petrel. Two single individuals were seen flying near the outlet of the lagoon during a storm on the afternoon of 22 September.

Phalacrocorax auritus. Double-crested Cormorant. Observed 3 times during the first week. On 18 September, a group of 3 was seen among loose rafts of hundreds of eiders **Somateria** spp. on the water outside the mouth of the lagoon. Two other observations of single birds flying over the lagoon were made on 20 and 24 September.

P. pelagicus. Pelagic Cormorant. Seen regularly during the study. The highest confirmed count was 4 birds. We observed flocks of up to 22 unidentified cormorants flying S, SW, and SE, high over the study area between 26 September and 4 October.

Cygnus columbianus. Tundra Swan. Common fall migrant observed 8 times. Most birds were seen migrating NE over the study area. The highest daily count was 12. Swans were seen in family groups and in groups of birds with adult plumage. We observed swans twice "on ground": in a small pond at the tip of the field camp spit, and across the lagoon outlet, near the NE spit, in vegetation.

Anser albifrons. Greater White-fronted Goose. A single juvenile was observed at site 1 (text Fig. 2) among hundreds of emperor geese during lagoon feeding on 24 September. This bird may have been fostered by emperor goose parents.

Chen canagica. Emperor Goose. See text.

Branta bernicula. Brant. Uncommon fall migrant in Cinder Lagoon. We observed brant between 20 and 22 September only. Three individuals were seen flying SW over the lagoon on the 20th. Single individuals were observed on the 21st and 22nd, feeding among large flocks of emperors and other waterbirds.

Branta canadensis minima. Cackling Canada Goose. Cacklers were seen almost daily in very low numbers, among feeding emperor geese. Between 1 and 4 individuals occurred in the counting area almost daily. We believe they were the same individuals, which perhaps were as good an indicator of migration turnover as neckcollared emperors. On 6 October a cackler was seen during high ride with a loose flock of roosting emperors in an alkalai grass flat W of the cabin. At least one of these cacklers may have been "adopted" by an emperor family. A flock of 49 geese was seen flying about the freshwater marshes SW of of camp on 30 September.

Anas crecca carolinensis. Green-winged Teal. Observed on only 2 occasions, during walks to the freshwater marshes west of the study area. We estimated 543 birds on 8 October.

A. platyrhyncos. Mallard. Abundant fall migrant along intertidal flats, commonly observed among feeding emperors and other species at low tide.

A. acuta. Northern Pintail. Most abundant dabbling duck. We conservatively estimated 7,000 in Cinder Lagoon during our arrival flight on 17 September. This species remained abundant during the study.

A. clypeata. Northern Shoveler. A group of 5 was seen in a freshwater pond W of the study area on 30 September.

A. strepera. Gadwall. Observed on 2 days during walks to the freshwater marshes W and SW of camp. The groups of 21 and 10 seen on 30 September and 8 October, respectively, were perhaps some of the same birds - observed on the same pond.

Aythya marila. Greater Scaup. First observed on 26 September, we observed this species in the lagoon in gradually increasing numbers thereafter. High daily counts ranged between 20 and 40 birds.

Somateria mollissima. Common Eider. Observed regularly among king **S. spectabilis** and Steller's eiders **Polysticta stelleri**, in the lagoon during incoming and high tide (especially in the outlet off the study spit point), but recorded as least abundant of the 3 species. The highest count was 262 on 20 September. Counts for 17 other days for which the species was recorded ranged from 1 - 125 birds. This species may have been more abundant, but appeared to be easily disturbed. We saw many flush among flocks of roosting eiders in advance of our approaches near the shore. Prior to our departure, 2-3 males were observed in almost full alternate plumage.

S. spectabilis. King Eider. Second most abundant of the eiders seen in the lagoon. A high count of 210 was tallied on 28 September. $\geq$ 115 individuals were recorded on 5 other days. Most males were in eclipse plumage.

S. fischeri. Spectacled Eider. On 18 September, we observed what we suspected was a female of this species among loose groups of other eiders, but mostly kings. We did not confirm this species until the evening of 21 September when a solitary female was observed during a goose count, off the study spit point, again among a loose group of king eiders. Dau and Kistchinski (1974:72) stated that autumn findings of this species were very rare. Since that paper was published, Dau (pers. comm.) is aware of only 4 other observations of spectacled eiders reported in fall or winter. Our observation of this single female is apparently the furthest eastern record for the southern Bering Sea and Alaska Peninsula. Although we did not observe this species after 21 September, we are uncertain whether it was absent or was "lost" among the thousands of seaducks in the area.

Polysticta stelleri. Steller's Eider. By far the most common eider observed in the lagoon. We conservatively estimated 1,700 at the outlet on 4 October. More than 600 birds were tallied on 5 other days. Flightless birds commonly congregated on the spit point. Perhaps several dozen males were seen in near or full alternate plumage by study's end.

Histrionicus histrionicus. Harlequin Duck. Observed reguarly in low numbers (high count=14 on 2 October). Most were females. Two drakes in full alternate plumage were seen flying NE along the seacoast on 6 October.

Clangula hyemalis. Oldsquaw. Observed only 3 times in September (high count=7). Rafts of 30-101 birds were seen daily in October, among other seaducks. Several males were observed in full winter plumage by our departure.

Melanitta nigra. Black Scoter. Abundant, along with white-winged scoters, and observed daily. This species was the first to ride in with the tide, and was widespread in the lagoon. Our high count of 390 was certainly conservative. This species eerie wail was our indicator that the tide was in.

M. perspicillata. Surf Scoter. Observed regularly but the least abundant of the 3 scoter species. The highest count was 120 on 20 September. Seen on 13 days.

M. fusca. White-winged Scoter. Abundant among loose flocks of black scoters, and other seaducks. Several hundred were observed daily (high estimate=695 on 2 October). On at least 6 occasions, we observed an apparent partially albinistic scoter which was associated with this species. The bird was white with black and gray spots on wing and contour feathers not unlike the patterns on a Dalmatian. We were unable to confirm or photograph the species, however, we believe, by association, it was this species.

Mergus merganser. Common Merganser. An adult male in alternate plumage was seen flying W just over the field cabin during a goose count on 20 September.

M. serrator. Red-breasted Merganser. Fairly common in generally low numbers in the lagoon, among other species at feeding. Except for high counts of 83 and 143 on 28 and 29 September, respectively, all other daily totals ranged between 1 and 14. Most were observed in "tight" rafts.

Haliaeetus leucocephalus. Bald Eagle. Common. Observed on all but 5 days. We knew of at least 3 adults and 2 subadults in the area. Eagles were the major avian disturbance factor on geese, raising thousands of birds each time they flew over. An adult was seen SW of the cabin, feeding on an unidentified waterfowl.

Circus cyaneus. Northern Harrier. Uncommon. We observed only females and immatures along the spit during 10 of 13 days in September, then only once in October (10/8). No more than 2 individuals were observed in any one day.

Falco peregrinus. Peregrine Falcon. Uncommon. Observed on 3 occasions. Probably the same subadult was observed on 26 September and 2 October. On 2 October a subadult was seen pursuing prey (probably dunlins **Calidris alpina** and/or rock sandpipers **C. ptilocnemis**) along the study spit shore, while geese and other species were feeding. This bird landed on the shoreline with unidentified prey in its talons. An adult was observed hunting off the spit point on 9 October.

F. rusticolus. Gyrfalcon. Observed commonly in September (7 days) and only once in October (10/7). On a few occasions, this species was seen flying over feeding geese on the flats, without major disturbance. Geese appeared to be more wary of this species than of peregrines. On another occasion, we observed Lapland longspurs **Calcarius lapponicus** mobbing a flying bird of this species.

Grus canadensis. Sandhill Crane. Cranes were seen or heard migrating **en masse** between 17 and 20 September only. We conservatively counted 215 on the 17th, 408 on the 18th and 10 on the 20th. A major storm stymied counts on the 19th. All birds were seen flying NE over the lagoon.

Pluvialis squatarola. Black-bellied Plover. Observed on 8 days in the intertidal feeding areas at low tide. Highest counts ranged from 1 to 26 birds. An individual was seen in the lee of the upland next to camp during a 9 October storm.

P. dominica. Lesser Golden Plover. Observed on only 4 days. (Both species of) plovers were most commonly seen on the flat SW of camp at low tide. Daily counts ranged from a pair to 7 birds.

Tringa melanoleuca. Greater Yellowlegs. Abundant. Heard or observed daily on intertidal flats. On some days, counts exceeded 50 birds, although more were present.

Numenius phaeopus. Whimbrel. An individual was heard and seen flying SW over the lagoon shore near camp on 20 September.

Limosa haemastica. Hudsonian Godwit. An individual was seen among mostly bar-tailed godwits **L. lapponica** and some marbled godwits **L. fedoa** on 30 September on the SW flats at low tide.

L. lapponica. Bar-tailed Godwit. Observed twice on the intertidal flats SW of camp. We recorded 21 individuals on 21 September and 365 on the 30th.

L. fedoa. Marbled Godwit. Observed on 6 days during September. Most birds were seen foraging on the flats at low tide. We recorded 130 on the 21st, and 110 on the 23rd. Other high counts ranged from 3 to 27. We found 5 beach-cast birds on the lagoon shore (bones and feathers only). Last observed on the 30th.

Arenaria interpres. Ruddy Turnstone. Common early in the study period. We saw ruddys on both sides of the spit on 11 days in September. The highest daily count was 35 on the 17th. We observed only 7 birds on 5 days after 24 September - the last being a single on 6 October.

A. melanocephala. Black Turnstone. An individual was seen on the seacoast shore on 19 September.

Calidris alba. Sanderling. Single birds were seen roosting with western sandpipers **C. mauri** on the sandy beach on 20 and 21 September. Small groups were seen foraging along the seacoast beach on 23 (4) and 30 (3) September.

C. mauri. Western Sandpiper. Abundant fall migrant. Observed daily between 17 and 23 September, we counted between 605 and 1,100 roosting in the seacoast beach between the 18th and 21st. A confirmed sighting of this species was not obtained after the 23rd, although flocks of thousands of unidentified "small" to "medium" shorebirds seen at a distance probably included this species.

C. melanotos. Pectoral Sandpiper. Observed in the freshwater marshes W of camp on 30 September and 8 October, when 4 and 1 were seen, respectively.

C. acuminata. Sharp-tailed Sandpiper. Two juveniles were seen in a marsh W of camp on 8 October.

C. ptilocnemis. Rock Sandpiper. Abundant. We counted a high of 2,120 roosting on the lagoon shore during a storm on 22 September. Thousands of other unidentified "small to medium" shorebirds seen may have included this species. Among roosting birds seen on 22 September, light and dark races occurred, in a ratio of about 1:15-20.

C. alpina. Dunlin. Abundant. Observed almost daily. We estimated 5,150 on the seacoast beach on 20 September, and 2,350 on the 30th. In October, the highest daily count was 160. Many of the small-medium unidentified shorebirds recorded probably included this species.

Limnodromus spp. Dowitcher spp. Five individuals were observed flying NW over the intertidal flats toward the outlet on 25 September. These birds were probably Long-billed Dowitchers **L. scolopaceus.**

Gallinago gallinago. Common Snipe. One bird flushed from crowberry - beach rye grass upland just north of camp on 20 September. Seven were seen along marsh ponds and in wet meadows SW of camp on 30 September.

Phalaropus lobatus. Red-necked Phalarope. Observed on 6 days in September only. Seventy-seven were seen feeding near shore adjacent to camp on 21 September. One to 14 birds were seen on other days. Most were seen in the lagoon, but were also observed near shore along seacoast.

Stercorarius longicaudus. Long-tailed Jaeger. An individual adult in alternate plumage was observed flying over the study point on 23 September. Two light and 1 dark-phase jaegers were seen the day before in the same area, but species were not confirmed.

Larus philadelphia. Bonaparte's Gull. Common fall migrant. Observed on 14 days along both shores. A high count of 180 occurred on 27 September; other daily counts ranged from 3-173.

L. canus. Mew Gull. Common. Observed daily in the lagoon and along the seacoast with counts ranging from 1 - 175 birds.

L. glaucescens. Glaucous-winged Gull. Next to emperors, the second most abundant species seen in the lagoon and along the seacoast. Daily estimates were in the thousands, with a high of 5,775 (conservative) on 29 September. In the lagoon and along the coastal beach, gulls were seen among feeding and roosting emperors.

Rissa tridactyla. Black-legged Kittiwake. Common. Observed on 13 days, with a high count of 1,475 on 2 October. Occasionally, we observed large, loose flocks of kittiwakes flying through the outlet to areas well inside the lagoon, perhaps to feed.

Sterna paradisaea. Arctic Tern. An individual was observed flying about the lagoon outlet on 23 September.

Uria aalge. Comon Murre. Two beach-cast birds were found. One fresh adult washed ashore following a storm. No living birds of this species were recorded.

Asio flammeus. Short-eared Owl. An individual was seen flying NE over the spit at dusk on 20 September.

Corvus corax. Common Raven. First seen on 25 September, and observed commonly thereafter. Ravens sometimes elicited disturbance clamor from feeding geese, when flying over. The highest count was 6 on 7 October.

Ixoreus naevius. Varied Thrush. An individual was observed flying over upland crowberry NW of camp on 20 September.

Anthus spinoletta. Water Pipit. Single birds were seen on 18 and 19 September in crowberry hummock on the spit.

Lanius excubitor. Northern Shrike. Observed on 6 occasions over 5 days. At least half of the birds seen were juveniles. Shrikes were observed pursuing lapland longspurs that regularly migrated over the spit in large numbers. A juvenile was observed on two occasions, perched on the radio antenna.

Spizella arborea. American Tree Sparrow. Six birds were observed in the vegetated uplands N of camp on the day of our arrival. None were seen thereafter.

Passerculus sandwichensis. Savannah Sparrow. Uncommon. We observed this species on 4 days. Most observations were of birds in the uplands on the spit. Seven were seen on 19 September. This species was last seen on 2 October.

Calcarius lapponicus. Lapland Longspur. Abundant fall migrant observed daily in almost continuous flocks of 20-80 birds. All birds were migrating NE along the seacoast and study spit uplands.

Plectrophenax nivalis. Snow Bunting. We observed an individual on 23 September. On 3 days in October we counted between 9 and 61 birds for daily totals. This species was sometimes seen mixed with flocks of Lapland longspurs, migrating along the spit.

Carduelis flammea. Common Redpoll. An individual was observed over the cabin, flying SW on the day of our arrival.

MAMMALS

Sorex cinereus. Masked Shrew. One specimen found on 7 October was identified to be this species. Individuals of this genus were observed alive on 5 occasions, usually in or around man-made structures.

Microtus spp. Vole spp. Individuals were seen in beach rye grass and upland crowberry on 21 September and 6-7 October, but could not be identified to species.

Spermophilus parryii. Arctic Ground Squirrel. Omnipresent and abundant. Observed daily, but occurrence diminished over time. The uplands near camp were essentially a loose colony of this species. A red fox **Vulpes vulpes** was observed capturing one of this species on 28 September.

Erethizon dorsatum. Porcupine. We knew of 3 individuals occurring on the spit. Two were adult and 1 was judged to be a young of the year, based on relative size. This species was observed foraging on low shrub willow **Salix spp.**, and oysterleaf on separate occasions. An old carcass of this species was found next to the field cabin.

Whale spp. A whale - possibly a gray whale **Eschrichtius robustus** - was seen briefly surfacing and blowing, about 1 km off the coast, 2 km W of camp on the evening of 8 October.

Vulpes vulpes. Red Fox. Four individuals were observed. One adult and 2 siblings of the year were observed daily on the spit and at camp. The young became habituated to us, but the adult maintained avoidance. Two other old and hideless carcasses were found near camp. We observed the siblings resting on the lagoon shore 40m from hundreds of feeding geese. We also observed the adult approach to within 2m of feeding geese, without incident. Fox tracks were regularly observed along the coast especially after storms.

Ursus arctos. Grizzly Bear. Observed only twice. A large adult was seen on the NE spit on 27 September and 7 October. We observed fresh bear tracks commonly on the study spit, and judged that one female with cub, and 1 medium-sized individual were in the area.

Phoca vitulina. Harbor Seal. Common on exposed shoals at lagoon outlet where 35-70 were counted. Seals were occasionally seen in the lagoon adjacent to camp during low tide, feeding in the channels or hauled-out on the flats.

Rangifer tarandus. Barren-ground Caribou. An individual was seen on the NE lagoon shore on 5 October, and 2 were observed in the W upland on 8 October

Appendix 3. Chronology of bird observations at Cinder Lagoon, Alaska, 17 September - 10 October 1986.

Species	September														October									
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01	02	03	04	05	06	07	08	09	10
Horned Grebe	x													x										
Emperor Goose	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mallard	x		x	x	x	x		x	x	x	x	x	x	x	x			x	x	x	x	x	x	x
Northern Pintail	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Black Scoter	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
White-winged Scoter	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bald Eagle	x	x	x					x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Northern Harrier	x	x	x	x	x			x		x	x	x		x								x		
Lesser Sandhill Crane	x	x		x																				
Greater Yellowlegs	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Marbled Godwit	x				x		x		x	x				x										
Ruddy Turnstone	x	x	x	x	x	x	x	x	x	x	x	x							x	x				
Western Sandpiper	x	x	x	x	x	x	x																	
Rock Sandpiper	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Red-necked Phalarope	x				x	x	x					x		x										
Phalarope spp.	x																							
Mew Gull	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Glaucous-winged Gull	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
American Tree Sparrow	x																							
Savannah Sparrow	x		x											x		x								
Lapland Longspur	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Common Redpoll	x																							
Double-crested Cormorant		x		x				x																
Pelagic Cormorant		x		x	x	x	x	x																
Tundra Swan		x	x	x					x			x		x				x		x			
Cackling Canada Goose		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x		x			x	

Appendix 3. Continued.

Species	September													October									
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01	02	03	04	05	06	07	08	09	10
Common Eider		x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x		x	
Steller's Eider		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Black-bellied Plover		x		x	x	x				x				x								x	x	
Lesser Golden-Plover		x			x									x								x		
Dunlin		x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x		x
Bonaparte's Gull		x	x		x	x	x	x			x	x		x	x	x				x	x		x	
Black-legged Kittiwake		x				x	x	x			x	x	x	x	x	x	x		x		x			
Water Pipit		x	x																					
King Eider		x	x	x	x	x	x	x	x		x	x	x		x	x		x	x		x	x		
Black Turnstone			x																					
Red-throated Loon				x			x	x																
Brant				x	x	x																		
Harlequin Duck				x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Oldsquaw				x				x				x			x	x		x	x	x	x	x	x	
Surf Scoter				x	x		x	x	x	x	x	x	x		x	x		x		x	x			
Red-breasted Merganser				x			x	x				x	x	x	x	x	x			x		x		
Gyrfalcon				x		x	x	x	x			x		x							x			
Whimbrel				x																				
Sanderling				x	x		x							x										
Common Snipe				x										x										
Short-eared Owl				x																				
Red-necked Grebe					x		x		x		x	x											x	
Spectacled Eider[a]					x																			
Common Merganser					x																			
Bar-tailed Godwit					x									x										
Varied Thrush					x																			
Fork-tailed Storm Petrel						x																		

Appendix 3. Continued.

Species	September														October										
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01	02	03	04	05	06	07	08	09	10
Jaeger spp.						x																		
Long-tailed Jaeger							x																	
Arctic Tern							x																	
Northern Shrike							x											x	x		x	x		
Snow Bunting							x												x		x	x		
Greater White-fronted Goose								x																
Dowitcher spp.									x															
Common Raven									x		x	x		x				x	x	x	x	x		
Grebe spp.										x														
Greater Scaup										x	x	x	x	x	x	x	x	x	x	x	x		x	
Peregrine Falcon										x						x							x	
Cormorant spp.											x					x	x	x			x	x		
Green-winged Teal														x								x		
Northern Shoveler														x										
Gadwall														x								x		
Hudsonian Godwit														x										
Pectoral Sandpiper														x								x		
Sharp-tailed Sandpiper																						x		
New species	21	13	1	11	5	2	3	1	2	2	0	0	0	5	0	0	0	0	0	0	0	1	0	0
Total species per day	21	27	24	34	33	25	32	29	25	24	25	29	21	38	23	24	17	24	22	24	26	28	18	12
Cumulative new species	21	34	35	46	51	53	56	57	59	61	61	61	61	66	66	66	66	66	66	66	66	67	67	67

[a]Unconfirmed observation of one individual of this species (female) occurred on 18 September.

A FALL RECORD OF A SPECTACLED EIDER IN BRISTOL BAY, ALASKA

RANDALL J. WILK, KAREN I. WILK AND ROBERT C. KUNTZ II

Because the fall and winter distribution of the Spectacled Eider (Somateria fischeri) is a mystery (Gabrielson and Lincoln 1959, Palmer 1976, Dau and Kistchinski 1977, Bellrose 1980), we report here a fall observation of a single Spectacled Eider from Bristol Bay in the southeastern Bering Sea.

On 18 September 1986, while conducting a study of Emperor Geese (Chen canagica) with the U. S. Fish and Wildlife Service in Cinder Lagoon (57° 31'N, 158° 7'W), in the northcentral Alaska Peninsula, we observed what we believed was a female Spectacled Eider. This bird was seen near the outlet of the lagoon on the Bristol Bay side among other species of eiders (King S. spectabilis, Common S. mollissima, and Steller's Polysticta stelleri), but was most closely associated with small loose groups of King Eiders. At the time of the observation, we were using 10 x 40 binoculars, but we were not absolutely certain of the identification of the species due to the rolling surf, and wariness of the birds.

On 21 September 1986 RJW made a positive identification of an adult female Spectacled Eider (with aid of a 15-60 x spotting scope) among a small group of King Eiders, in the same vicinity as the first sighting 3 days earlier. Identification of the species was confirmed by the occurrence of distinctively large, pale brown spectacle-like patches

around the eyes, contrasted with the basic tawny coloration in the head and body plumage, and a "saddle" of feathering on the mandibles - extending to the nostrils, making direct field comparison unmistakeable and identification indisputable from the other 3 eider species which we observed daily. These features were observed on both occasions, and are not found in other eiders (Gabrielson and Lincoln 1959, Bellrose 1980). As much as this bird was among other eiders, it appeared spatially and behaviorally dissociated from nearby individuals of other species. Judgement of the age of the species was based on the high contrast between the eye patches and the feathering around them (Palmer 1976:89), and the general appearance of barring, and overall uniformity of plumage. Although we remained in the study area until 10 October 1986, the bird was not seen again. The eider may have been present, but an increasing build-up of eiders and other seaducks in the lagoon limited our abilities to detect her.

Spectacled Eiders nest in a narrow coastal Arctic tundra strip in W and NW Alaska and NE Siberia (Bellrose 1980:372), however autumn findings are very rare (Dau and Kistchinski 1977). Since Dau and Kistchinski's paper was published, Dau (personal communication) is aware of only 4 other fall or winter sightings - three in the eastern Aleutian Islands (one female at Unimak Pass on 16 Oct. 1975; six males and 20 females north of Unimak Pass on 18 Nov. 1975, Gould et al. 1982:34; a pair at Dutch Harbor, Jan. 1983, S. Kerr personal

communication to Dau) and one south of St. Lawrence Island (about 20 individuals observed by A. Sowls on 8 March 1984, reported to Dau). This sighting appears to be the easternmost record of the species for the southern Bering Sea.

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