A preliminary study of the breeding biology of Ross's Goose

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Summary

Studies of a breeding colony of Ross's Goose in the Perry River region, N.W.T. from June to August, 1963 are reported. The first geese arrived on 5th June, probably about 10 days later than usual. The first eggs were laid on 9th June. No courtship was seen and copulation probably occurred somewhere further south. Nests are made on islands in lakes, preferably in cover provided by scrub or rocks. Nests on open moss are larger than those in sheltered places. Nesting territories, which were fiercely defended, may be as small as 150 sq. ft. Eggs are usually laid daily. The average size of 769 clutches was 3·67, range 1-6 eggs. Egg size did not vary with sequence in the clutch. The female alone incubates for 23-24 days from the laying of the last egg. 90 of 93 nests (96·7%) were successful, and 93·5% of eggs laid hatched. Though the goslings are polymorphic, 75% of broods were monomorphic. 1963 was mild but in some years bad weather may be a serious mortality factor. Some goslings died after being trapped in bushes or in crevices. Predation, by gulls and jaegers, is slight. There was an unexpected excess of males in yearlings caught for banding.

Ross's Goose (*Anser rossii* Cassin) breeds primarily in the Queen Maud Gulf region of the central Canadian Arctic. It has also been recorded in the Lesser Snow Goose (*A. c. caerulescens* (L.)) colonies on both Southampton and Banks Islands. All known nesting grounds of Ross's Goose are within Migratory Bird Sanctuaries administered by the Canadian Wildlife Service. Ross's Goose was first described by Samuel Hearne in 1772 from observations made during his search for the Coppermine River. However, the nesting grounds were not discovered until June, 1940 when Angus Gavin, manager of the Hudson's Bay Company trading post at Perry River, was successful in a direct attempt to find them. The nesting grounds of the Ross's Goose were the last to be discovered among those of the native North American geese. Subsequent investigations in the Perry River region have been few. Hanson, Queneau and Scott (1956) obtained considerable data on nesting Ross's Geese, but unfortunately were not present at a colony for the entire season. MacInnes and Weske (1962) spent part of July and August in the region surveying banding potential there.

In the spring of 1963, the author, supported by the Canadian Wildlife Service, initiated an intensive study of the breeding biology of Ross's Geese. The present report is based on the results of the first seasons' work. Included in the report are winter inventories from 1961 and 1962, by courtesy of the United States Fish and Wildlife Service. The population estimates and location of major nesting colonies are from aerial surveys by the Canadian Wildlife Service.

Population status

Over the past two decades there has been an apparent increase in the total population of Ross's Geese. Estimations made in the 1940's were done primarily on the wintering grounds of the species and put the population at five to six thousand. Hanson *et al.* (1956), were the first to count Ross's Geese along the Queen Maud Gulf and estimated two thousand in the region between the Perry River and the Simpson River. In July and August, 1960 Canadian Wildlife biologists surveyed the Central Canadian Arctic in an effort to map out and count geese numbers on the major nesting colonies. From this survey much valuable information was obtained as to the whereabouts of the greatest concentrations of Ross's Geese. The survey extended from the Anderson River on the west to Sherman Inlet on the east. Nesting areas between these two points included Victoria Island, Banks Island and the mainland of the Queen Maud Gulf. Nine thousand Ross's Geese were counted along the Gulf and two hundred (+) on Banks Island. At the time of the survey over the Queen Maud Gulf (16th-22nd August, 1960), many of the geese had completed their post-nuptial moult and were able to fly. Consequently, many of the birds were situated a considerable distance from their nesting sites. However, a large number was concentrated around a large unnamed lake (67°20′N, 98°25′W) and river which flows into McLauglin Bay of the Queen Maud Gulf, one-hundred miles east of the Perry River (T. W. Barry, personal communication). The size and location of other colonies are listed in Table I.

Figures obtained from aerial surveys of the wintering grounds in California show that the number now stands in the vicinity of twenty-five thousand and Mr. A. Dzubin estimates the population to be from 35,000-40,000 from counts made on the

Table I. Sites and size of known breeding colonies of Ross's Geese

location	*numbers*	
Banks Island (72°N, 123°W)	200+	(est.)
Queen Maud Gulf Mainland	9,000	(est.)
Atkinson Pt. (67°55′N, 103°W)	48	
Perry River (67°42′N, 102°15′W)	282	
Ogden Bay River (67°40′N, 101°30′W)	12	
Pitok River (67°42′N, 101°18′W)	22	
Simpson River (67°45′N, 100°40′W)	101	
McLauglin Lake and River (67°45′N, 98°25′W)	2,365	

comparatively narrow migration route in south-western Saskatchewan (see MacInnes, 1964).

Ross's Geese also occur in the Hudson and James Bay areas of the eastern Canadian Arctic. The first record was that of Hearne in 1772, when he reported flocks of them near Churchill, Manitoba (Hearne, 1795). Subsequent investigations by Cooch (1954), Barry and Eisenhart (1958) and MacInnes and Cooch (1963), indicate that the species has inhabited the eastern Arctic for a long time and that the distribution in this area does not necessarily represent an extension of the range eastward from the Perry River region, but simply is the result of increased activity of Arctic ornithologists. Perhaps with the gradual accumulation of data concerning the breeding biology and distribution of Ross's Geese it will no longer be considered a relict and vanishing species.

Topography of the Region

The Queen Maud Gulf region is described admirably by Hanson *et al.* (1956) as follows: 'The Ellice River-MacAlpine Lake-Simpson River-Queen Maud Gulf quadrangle is underlaid by folded, foliated, pre-Cambrian rocks of varying hardness. Relief is generally low. Glaciation and differential erosion have frequently produced a "banded" topography of parallel ridges separated by elongated, roughly parallel lakes or river courses. This relief is more pronounced where the strike of the formation approximates the northerly direction of past glacial movement. Many parts of the area are underlaid by massive rocks of more uniform character which has resulted in a low, rounded "mamillated" topography. The terrain occasionally has a rather rugged appearance due to "crag-and-tail" and "roches moutonnees" hills, which in the more extensive tundra areas "crop up like seal-heads in the sea". Actually the term "whalebacks" would be more appropriate in some cases than Knud Rasmussen's simile. The altitude of the hills at the coast does not exceed 200 feet; inland the ground rises gradually to a maximum of 800 feet just north of MacAlpine Lake.'

The Ross's Goose colony studied is located at Arlone Lake, N.W.T. (67°22′N, 102°10′W), approximately twenty-five miles inland. There are eight islands on the lake, six of which are utilized by Ross's and Lesser Snow Geese. The two islands at the south end of the lake are too high and steep sided for suitable nesting sites (Hanson *et al.*, 1956). In Figure 1 the islands are designated by letters, as assigned by Hanson. Their approximate dimensions are shown in Table II.

Table II. Dimensions of breeding islands, Arlone Lake, N.W.T.

island	*area in square metres*
A	8,536
B_1	24,021
B_2	4,745
C	8,036
D	13,482
E	17,100
Total area	75,920

The immediate vicinity of the Arlone Lake is surrounded by low drumlins. The flat terrain between the hills is composed of tundra corrugations, each corrugation being approximately one foot high.

The lake is shallow (approximately 10 feet) and turbid due to the constant wind. At no time during the season was the bottom visible.

Gavin (1945) recorded –59°F as the coldest winter temperature. During the summer of 1963 we recorded 82°F on 30th June and 6th July. For weekly means see Table III. The winds are almost continuous, the maximum being estimated at 40 m.p.h. from 6th-9th June, 1963. The mean summer wind velocity approaches 15-20 m.p.h., primarily from the N.E. and N.W.

The ice on the lake started to break up during the first week in June, and by 7th June four to six inches of water were present on the surface of the lake. Bottom ice continually rose to the surface throughout the major part of the nesting season.

Snow cover upon our arrival at Arlone Lake on 2nd June was 85%. No snow cover existed by 12th June, except on the sides of the drumlins, where deep drifts persisted well into July. The islands were free of snow by the middle of the second week in June.

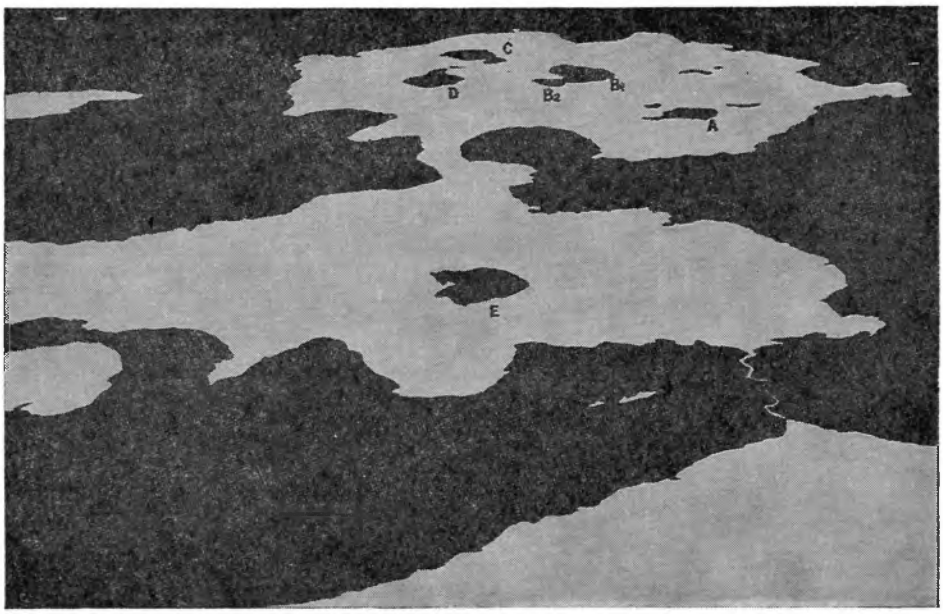

Figure 1. Arlone Lake, N.W.T. (67°22′N, 102°10′W), after Hanson, Queneau and Scott, 1956.

Table III. Weekly temperatures (°F.), Perry River Region, 1963

week	*maximum*	*minimum*	*mean*
June 3–9	56	20	34
10–16	72	33	48
17–23	74	32	46
24–30	82	33	54
July 1–7	82	35	54
8–14	74	38	54
15–21	65	35	48
22–28	80	39	56
Aug. 1–4	69	33	50
5–10	76	37	54

Arlone Lake supported 1,538 breeding Ross's Geese and approximately 600 Lesser Snow Geese. In addition, nests of two King Eiders (*Somateria spectabilis* (L.)), two Red-throated Loons (*Gavia stellatus* (Pontoppidan)), one Old Squaw (*Clangula hyemalis* (L.)), and one Glaucous Gull (*Larus hyperboreus* Gunnerus) were found on the islands. A complete faunal survey report is being published by M. Aleksiuk (1964).

Arrival

Arrival dates of Ross's Geese are entirely lacking in the literature. Hanson *et al.* (1956) reported sighting them near the mouth of the Perry River, at the junction of the Gavin River, on 7th June, 1949.

In 1963 the first Ross's Geese (12) were observed flying over Arlone Lake on 5th June. Snow cover at this time was 75%. On 6th, a total of 21 were observed over Arlone Lake. These were in small flocks and not in association with Lesser Snows, which were comparatively abundant at this time. On 7th, 50 white geese were seen on islands B_1 and B_2 (Figure 1); the majority of these were Ross's Geese. Seventy Ross's Geese were seen on these same islands on 8th June. Ross's Geese continued to arrive in small flocks until by the end of June a total of approximately 1,500 were present on all six islands.

The arrival in the area was probably late. Other geese were noted before the Ross's Geese, although in small numbers. The Eskimos on the coast reported that Ross's Geese are usually present in the area by the last week in May. If this is true, then the arrival was about one and a half weeks late. Spring temperatures and other meteorological factors might affect the arrival of geese on the nesting grounds. Reports in the 'Canadian Weather Review' for June 1963 state that temperatures were below normal in the eastern Arctic. The June minimum temperature (4°F) at Cambridge Bay was the lowest ever reported. These facts suggest a possible correlation between arrival of the geese and weather conditions. Perhaps they follow the 35° isotherm as do Canada Geese (Lincoln, 1939).

Territorial behaviour

Based on observations at Arlone Lake, it appears that the geese are mated when they arrive on the nesting grounds. Presumably copulation has occurred somewhere further south. No courtship behaviour was observed in the vicinity of the lake. Mr Lawson Sugden, Wildlife Biologist for the Canadian Wildlife Service, Edmonton, Alberta, observed two pairs of Ross's Geese copulating at Beaverhill Lake, Alberta (53°27′N, 112°32′W) during the 1963 spring migration. Courtship is a lengthy and strenuous process, which would most certainly be selected against in such a region (Barry, 1962). It seems almost inevitable that most copulation should occur during spring migration, so that successful completion of egg laying, hatching and brood raising can be achieved during the extremely short Arctic season.

As soon as the geese arrive on the breeding grounds, territories are established and nest building begins. Nesting began on 9th June, four days after the first Ross's Geese were seen. The peak of arrival was 7th June, so the geese probably started to build their nests as soon as possible after they arrived.

The wind had been blowing constantly from the south for five days at about 40 m.p.h. The effect of this on the geese was marked. They concentrated on the north side of the islands, even though more favourable nesting sites existed in the form of dense birch stands, and rock out-croppings, on the south side of the islands. As a result, the concentration of nests on the northern (lee) side of the islands was probably higher than if the wind force had not been so strong initially.

The first observation of 'aggressive' behaviour was as follows: 'An adult Ross, in an effort to ward off a neighbouring goose, charged the latter within or on the border of the territory. The neck was held horizontally outstretched, and the mouth agape. Actual physical contact was not achieved. Following the charge, the goose made a quick withdrawal back to the mate.'

Subsequent observations of territorialism and aggression indicated that during the egg laying period both partners take part in defence of the territory. Typically, the defence procedure takes the form of a charge with the neck held horizontal and mouth open. Accompanying the charges are two vocalizations: a high-pitched squawk, by both partners, and a low moaning grunt prior to and after the charge. The former is heard only during the more intensive fights, usually when physical contact is made, the latter during the more subdued interactions but also to a lesser extent during serious conflicts.

The member of the pair which pursues the intruder, presumably the male, then runs back to the mate, and with neck stretched upwards at about 60°, utters the low moaning sound. The retreat behaviour was considered to be a form of post-nuptial display (which is defined as any display or ceremony that takes place between the sexes after copulation has ceased and incubation has begun (Van Tyne and Berger, 1961)), since it happened more commonly during the incubation period than before it. Armstrong (1947) suggested that birds which exhibit this post-nuptial display recapitulate briefly the features of the pairing-up ceremony.

The length of the territorial 'fight' is short, usually lasting only a few seconds. Very little resistance is shown by intruders, which usually run away or take to the wing immediately. Even the larger Lesser Snow Geese do not show resistance to the small Ross's Geese.

On one occasion only, 27th June, I saw a Ross's Goose fly up at another which was flying low over the former's territory.

Nests and nest-sites

Two study areas, each of 13,500 sq. ft., were marked out on the south and north side of island E. The proportions of the different habitats in the plots were estimated, and the situation of each nest recorded. Nest composition, size, and density seem to be governed in part by the particular sub-habitat in which the nest is located. The rather high proportion of geese on the north side of the island probably resulted from strong south winds which prevailed during the initiation of the nesting period, when the leeward side offered considerably more protection. Subsequently, the birds distributed themselves over the entire area. The sub-habitats are described below:

A. *Open Moss*

Regions of open moss, with no apparent protection, are common on all the islands. The nests in such regions tend to be larger than others, and are composed of a thick circle of plucked moss, many old scats, and to a lesser extent dried leaves and grass. Open moss made up 40% of the study plots. Nine nests were found in the open, with a density of only 0·8 nests per 1,000 sq. ft.

B. *Rock-outcrop*

The nests occurring in this habitat inevitably are well protected by a single rock or group of rocks. Rocks formed 15% of the study plots, with 16 nests, 4·0 per 1,000 sq. ft.

C. *Birch and Willow Stand*

A large number of nests occur in this sub-habitat. The birch is more extensive in distribution than is the willow (35% and 5% of the study plots, respectively), but wherever each occur, utilization was seen. The nests consist primarily of a mound of dead leaves, twigs, and to a lesser extent old scats. Moss is absent. During the incubation period these nests were elaborately filled with down, so much that the entire nest seemed to be constructed of it. In the study plots there were 21 nests among birch and 4 among willow, at densities of 2·2 and 3·0 nests per 1,000 sq. ft.

The highest density of nests (6·7 per 1,000 sq. ft.) was found in a small tract (5% of the whole) where birch, willows and rocks were mixed.

Hanson *et al.* (1956) found that nests on the open moss are larger than those in the two other 'types'. Measurements of 15 nests in each habitat-type confirm this (Table IV).

The protection given by bare moss is nil. Presumably the larger nests there compensate for this.

There were 38 nests in the southern plot compared with 21 in the northern one. The difference was probably due to the predominance of shrubbery in the former, only 20% of which was open moss, against 60% of the northern plot.

The minimal distance between active nests was measured to find out the density within the three major sub-habitats. On the east side of island B_1 the habitat consists primarily of willow, large open moss patches, and scattered rock. The mean distance of fifteen active nests was 16·2 feet (range 7·5-27 feet). On the extreme north side of the island thick birch predominates. Here the distance between fifteen active nests was 13·7 feet (range 6-21 feet). The summit habitat contained many small scattered rocks, a long bare clay strip, and sparse vegetation. The mean separation of fifteen nests in this region was 23·4 feet (range 15-39 feet).

The data do not represent the territory size in the three areas, but suggest that the nest densities do vary. This in itself may indicate that the territory size is flexible in the species, depending on the type of terrain in which the nest is located. However, communal areas exist where any goose or group of geese can be situated, without aggressive interactions – a sort of 'no man's land'. Barry (1960) noted that Atlantic Brant (*Branta bernicla hrota* (O. F. Müller)) had similar areas and stated that during the incubation period, the males often stayed in these areas close to their own territories.

The difference in spacing of nests is presumed to indicate a difference in size of communal areas, the largest being on the open moss, and the smallest in the dense birch regions. One may speculate that the separation values in the birch are nearly equal to the individual territory, because birch is the preferred sub-habitat and crowding prevents the existence of communal areas. If this is the case, the territory is about 14 feet in diameter with an area of approximately 150 square feet. Communal grounds are secondary in importance to the nesting territories, and they occur only where the nesting habitat is not optimum. There are more extensive communal areas on the open moss simply because there are relatively few suitable nesting sites. Thus density calculations for the three sub-habitats are not a valid method of estimating territory size.

Egg-laying

The first Lesser Snow Geese eggs were seen on 7th June. The first Ross's Goose eggs were seen on 9th June, four days after the first geese were seen flying in the vicinity. Thus the geese were ready to lay as soon as they arrived on the breeding grounds, which may be indicative of a late season. The peak of the laying season fell between 11th and 13th June (Figure 2).

It has been found commonly among other species of geese that one egg is laid per day. From the rather scant data ob-

Table IV. Dimensions of nests in relation to sub-habitat (measurements in inches)

site	*outer diameter*	*inner diameter*	*depth*	*diameter of down*
Open Moss	18·1 (15–21·5)	6·8 (6–7·5)	2·9 (2–4·5)	10·6 (9–12)
Rock	17·7 (14–22)	6·5 (6–7)	2·9 (2·5–3·5)	10·6 (9–12)
Birch and Willow	15·7 (11·5–19)	6·4 (5·5–7)	2·8 (2·5–3·5)	10·6 (9–13)

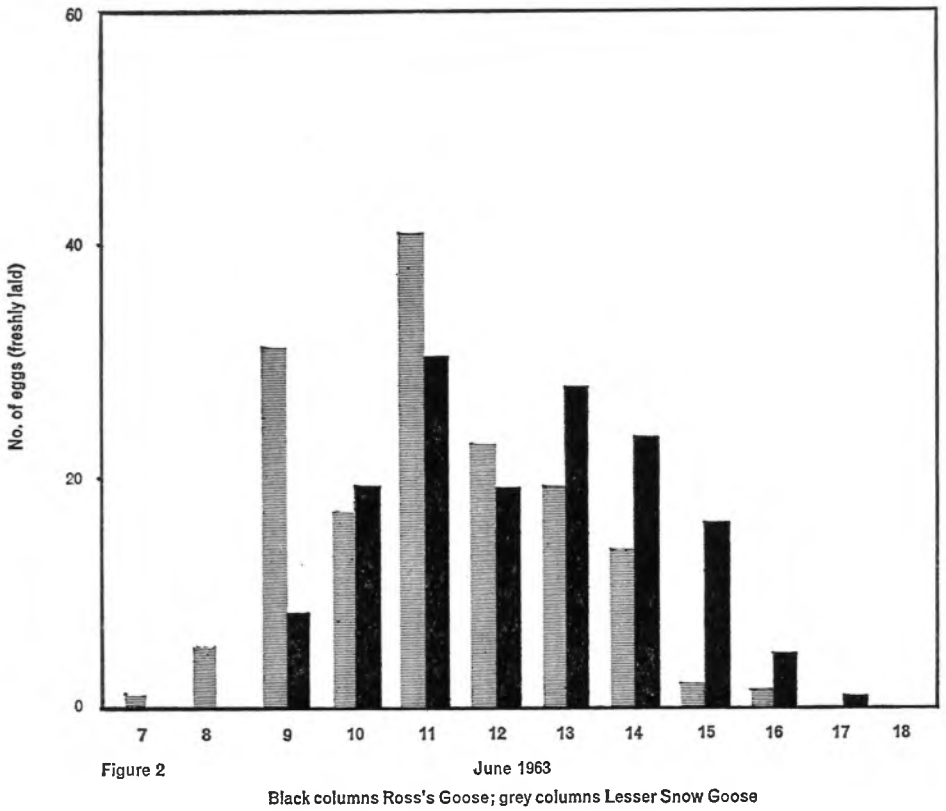

Figure 2. Frequency of egg laying in 67 marked goose nests at Arlone Lake, N.W.T. in June, 1963. Black columns – Ross's Goose; grey columns – Lesser Snow Goose.

tained during the 1963 season, the Ross's Geese seem to be no exception (see Table V).

Eggs

At first, difficulty was experienced in differentiating between the eggs of Ross's and Lesser Snow Geese. Both are a creamy white, but become darkened with age. However, their dimensions proved to be quite different, and with experience they became easy to identify. The average dimensions of 175 Ross's and 104 Lesser Snow Goose eggs were found to be 7·37 cms. × 4·88 cms., and 7·98 cms. × 5·27 cms. respectively. Barry (1960) found that both egg length and width varied according to laying sequence in the Atlantic Brant. He reported that the egg length decreased with each successive egg in the clutch and that egg width was smallest in the first, largest in the second, and then decreased with each successive lay. No such trends are apparent in the measurements of Ross's Goose eggs in 1963 (Table VI).

Clutch size

From observations in 1963, the Ross's Geese seem to be determinate layers of three to four eggs (see Figure 3). A total

Table V. Interval between laying of successive eggs by Ross's Geese

eggs	*number of nests*	*0 days skipped*	*1 day skipped*	*2 days skipped*
1st and 2nd	21	13 (61·9%)	7 (33·3%)	1 (4·8%)
2nd and 3rd	21	15 (71·4%)	5 (23·8%)	1 (4·8%)
3rd and 4th	17	10 (58·8%)	7 (41·2%)	
4th and 5th	4	2 (50%)	2 (50%)	

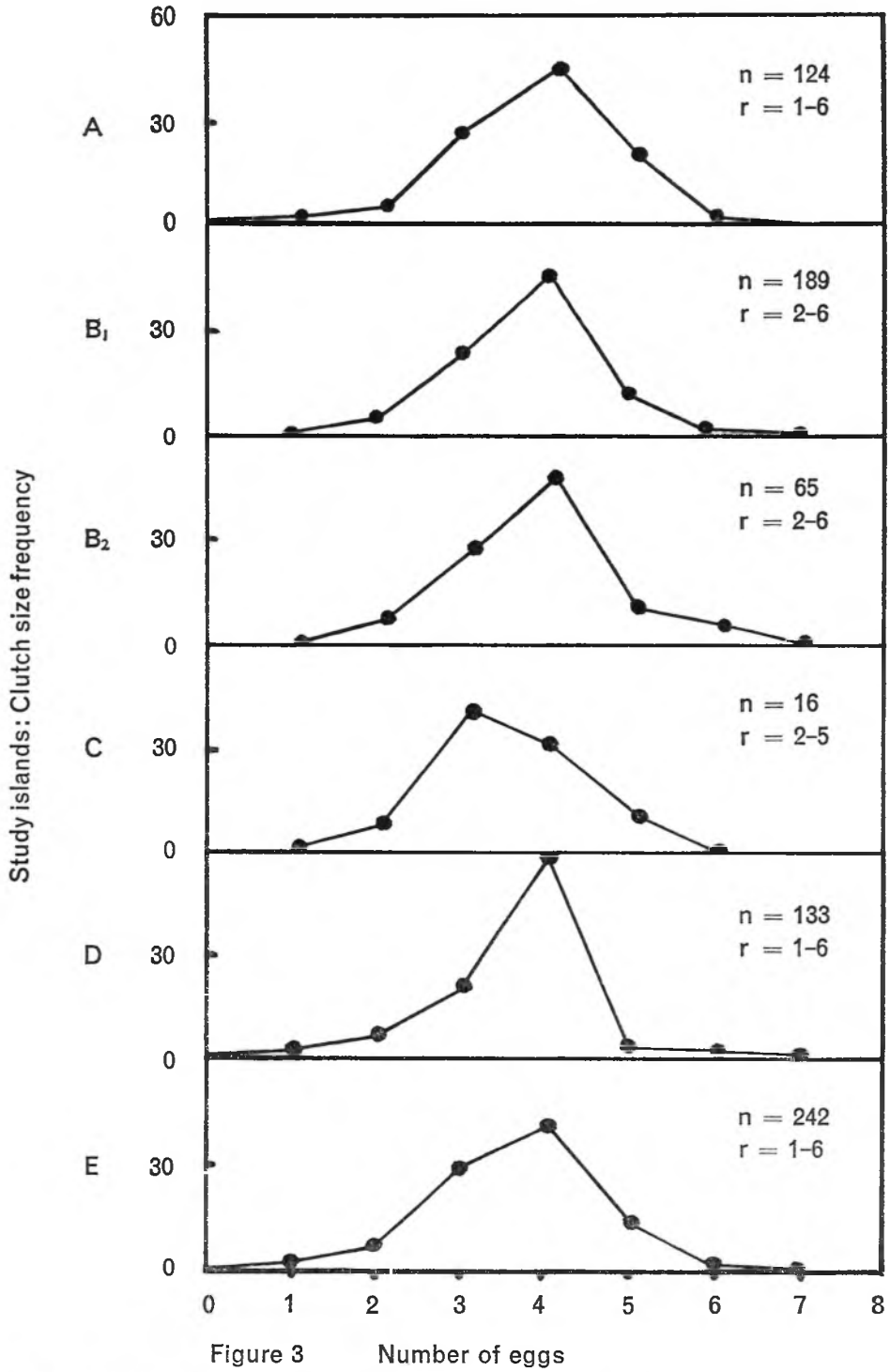

Figure 3

Figure 3. Clutch-sizes of Ross's Geese nesting at Arlone Lake, N.W.T., in summer 1963.

Table VI. Variation of egg-size with sequence of laying in Ross's Goose

egg number	*mean length (cms)*	*mean width (cms)*	*number of eggs*
1st	7·43	4·88	36
2nd	7·37	4·92	21
3rd	7·68	4·80	21
4th	7·31	4·87	21
5th	7·45	4·72	6
6th	7·30	4·85	3

colony count completed on 20th June, 1963 showed that 769 nests contained 2,849 eggs, giving an average clutch size of 3·70. The range was from one to six eggs. The individual averages for each island were not markedly different (Table VII). The frequency of egg numbers on each island is shown on Figure 3.

Table VII. Numbers of active goose nests and corresponding clutch sizes of Ross's Geese on nesting islands at Arlone Lake, N.W.T., 1963

island	*no. of active nests*	*mean clutch size before predation*	*mean clutch size after predation*
A	124	3·73	3·69
B_1	189	3·80	3·59
B_2	65	3·78	3·48
C	16	3·44	2·93
D	133	3·62	3·54
E	242	3·65	3·59
Total	769		
Mean		3·67	3·47

In 1949, the average size of 10 clutches was only 3·0, the range 2-4 (Hanson *et al.*, 1956).

Behaviour during the egg-laying period 7th-18th June, 1963

During this period, the geese remained for a major part of their time on the territories although frequent pair flights occurred. When on the territory or communal area one member of the pair usually sat down or crouched, while the other kept watch over the territory. The mated pair stayed together always; the author has never seen separation of mates.

The geese were timid and tended to retreat from the territory for almost no reason at all. When disturbed, large groups took flight, soon splitting into smaller 'subflocks', settling on the lake 10-40 yards from the islands. Within 10-15 minutes, the small groups and pairs returned to the islands and settled down on the territories. This was when territorial displays and conflicts were most commonly seen. The birds inevitably seemed to land in another's territory. The uproar continued until the birds arranged themselves on their appropriate grounds. Then the islands became comparatively quiet again.

A considerable amount of time was spent feeding on the islands. Despite the poverty of the flora, the geese apparently found enough to subsist. On island E there were two pools which furnished aquatic and semi-aquatic vegetation. At all periods of the day, pairs inhabited these areas.

Behaviour during the incubation period

No sign of incubation was observed during egg laying, indicating that, as in other geese, eggs are not incubated until a complete clutch has been laid. The start of the incubation period was taken to be 18th June, one day after no newly-laid eggs were found in the 67 marked nests on island B_1. The initiation of this period was marked by a noticeable silence over the area. When the birds were disturbed, they tended to hover in huge circles directly above the islands instead of dividing into small flocks as previously described. Within 5-10 minutes they were back on the territory.

Down deposition seemed to be characteristic of this period. This material fills the inside of the nest and, as stated before, is more abundant in nests in the birch subhabitat. Its cohesion is generally poor. At the beginning of this stage the willows and birch are covered with wind-strewn down. Later, when leaves, twigs and scats have been mixed with it, it remains in the nest. When leaving the nest, the incubating goose covers up the eggs with the down by pulling it over the clutch with its bill.

Three females were nest-trapped on island E, with the falconer's bow trap. They were neck-tagged with navy blue neck bands and painted so that I could tell them easily from a good distance. After hours of observations on these three geese and other unmarked birds, I came to the conclusion that only the female incubates. They are not constant incubators or 'close-sitters' as has been described for the Lesser Snow Geese. The longest observed period of incubation was 46 minutes. Generally the incubating goose sat on the nest for a short time, then got off and accompanied the male on the territory. During the time the female is on the nest, the male stands close by in the territory actively defending it.

The incubating posture of the Ross's Goose is similar to the Lesser Snow. The head and neck are held vertical, not horizontal as occurs for instance in Brant and the King Eider duck. The female often pushes down in towards her body with the bill. She often moves in circles while on the nest, presumably rotating the eggs, in this way distributing heat over the complete clutch.

Nest abandonment

Ross's Geese abandon their nests at any time during the breeding season. Many reasons have been postulated for this phenomenon, such as overcrowding, inter- and intraspecific competition, predation and weather. Sufficient information is not yet available to state an exact cause or causes.

Nesting success

The first evidence of pipping was seen on 5th July. On this date only a few goslings were hatched and dry, indicating that the process began early on 5th. The peak of the hatch occurred on 7th and 8th July.

Delacour (1954) records the incubation period as 24 days. This presumably refers to eggs laid in captivity. Though this period was not investigated in great detail in 1963, most clutches seem to have been incubated for 23 or 24 days, though some for no more than 22 days.

Information on hatching success was obtained by marking nests in which clutch size was known. Ninety-three were marked on 24th June on island E. Records were kept on egg losses as the result of predation and other causes. These 93 nests originally contained 351 eggs. Three of the nests, representing a total of 12 unproductive eggs, did not hatch. If a successful nest is defined as one where at least one egg hatches, then in 1963 the nesting success was 96·7%. The total number of unproductive eggs, including those from the 3 nests where none hatched, was 23 from 11 nests. This represents a 93·5% egg hatching success. 4 eggs (from 1 nest) were sterile; 8 (4 from 1 nest) were destroyed; 7 (4 in 1 nest) contained dead embryos; and 3 were addled.

Hanson *et al.* (1956) report that nesting losses were 'negligible' in 1949: of 260 nests located, 6 were destroyed by gulls and 3 or 4 were apparently deserted, so that nesting success that year was also about 96%.

Goslings

Young Ross's Geese are precocious. They are helpless until dry, but by the time they leave the nest a few hours later they have acquired protective instincts of concealment. When approached on land they crouch with head and neck flat on the ground. This makes them very hard to see, as they blend in well with the surroundings. On water they have been seen to dive in an effort to escape intruders.

As is mentioned by Hanson *et al.* (1956), the goslings are polymorphic. The colours basically are in two phases, yellow and grey, although intergrades occur between these two extremes. From 34 brood counts made one day after the first eggs were seen hatching 72·8% were monomorphic and 27·2% were dimorphic: in 1949, Hanson *et al.* (1956) found 42 of 56 (75%) broods to be monomorphic.

Behaviour of family groups

After the hatch the geese form small flock units or family groups. The common unit or flock is made up of two to fifteen family groups. By 9th July, four days after the initial pipping was observed, over 80% of the geese had left the breeding islands and were heading north for the post-breeding moult.

Movement from the breeding grounds to the lower reaches of the Perry River is slow but continuous. The birds do not congregate initially in large groups along the route north but maintain the small flocks of from 6-30 family groups. After the migration and moulting is in progress it was common to see large flocks of 100-200 geese on the river and inland lakes.

Unfortunately, because of bad ice conditions and limited time, the observations made during the moulting period were entirely restricted to the Perry River *per se*. Overland travel is arduous, and most time was spent banding the geese seen along the river itself. It was obvious from the total number of Ross's and Lesser Snow Geese seen while banding operations were in progress, that many, if not the majority, of the geese do not move to the mouth of the Perry, but stay inland and moult on the numerous lakes in the region. This fact in itself makes post-breeding studies on large numbers of Ross's Geese rather difficult.

Mortality factors

Mortality of adults on the nesting grounds is almost non-existent. A few old rifle shells were found in the area but these were probably used by the Eskimos during the spring caribou hunting rather than for shooting geese. The Eskimos I did interview showed little interest in geese as a food resource and said they do not bother the waterfowl unless the caribou or seal hunting is poor.

Only one Arctic fox was seen all summer. Presumably, even if the fox population was at a peak, the islands, being situated a considerable distance from the shoreline, offer ample protection from such potential predators.

The major mortality factor may well be the weather. A serious or late spring snowfall could decrease the annual productivity, as has been shown in other Arctic waterfowl. Fortunately, 1963 was a mild summer and productivity was on the whole good, despite a supposed two week delay at the beginning of the season.

A number of factors on the islands cause losses of young. The large willow and birch stands act as traps from which the newly-hatched goslings find it impossible to escape once entangled. Many young were rescued by the author and his assistant this summer. These trapped goslings are abandoned by their parents. Old Eskimo caches and rock piles acted as traps in the same way. Nests built in these regions often lost young before they had moved far. It seems almost ironical that the most suitable nesting habitats should be somewhat detrimental to the young.

Avian predation on the newly hatched birds is comparatively high. The most common predator was the Glaucous Gull. The Herring Gull (*Larus argentatus* Pontoppidan) occurred but to a lesser extent. All three species of jaegers were present: the Long-tailed Jaeger (*Stercorarius longicaudus* Vieillot) being the most common; the Pomerine Jaeger (*S. pomarinus* (Temminck)) and the Parasitic Jaeger (*S. parasiticus* (L.)). At the beginning of the hatching period a marked increase in the numbers of these predators occurred. They nest in large numbers between the lake and the coast, and presumably as soon as the geese start to hatch, they move to the lake. On one occasion eight Glaucous Gulls were seen flying over island B_1 at the same time. This is a high concentration over one island, as prior to this one or two per hour was normal. On two occasions, the author was fortunate enough to observe the taking of young Ross's Geese by both Glaucous and Herring Gulls. Only once was this situation encountered with a Parasitic Jaeger.

Egg predation was low. The low rate of egg loss probably can be attributed to the fact that the geese stay close to their nests for most of the season and it is not hard for them to ward off predators. However, when a gosling wanders off by itself it becomes vulnerable to attack.

Growth rate of young

The hatching weight and one-day-old weight of Ross's Geese is approximately 65 grams. Four-week-old goslings weighed on the average 900 grams. No information is yet available on the weight increment of migrating yearlings. Growth is rapid and by the time goslings are four weeks old the legs are the same size as those of mature geese. Although no specific data on food and nutrition are yet available, it is believed that the young goslings feed on insects while accompanying their parents on the northward moult migration, and hence have a high protein intake, which may in part account for the rapid growth.

Sex ratios

From ringing operations it was found that in a total of 420 geese (237 yearlings and 183 matures), the sex ratio was 137 males to 100 females among the yearlings and 84:99 for adults. A ratio close to 1:1 would be expected for a monogamous species. The adult ratio is not significantly different from unity, but the observed discrepancy in yearlings is unlikely to have arisen by chance.

Ringing operations

Banding started on 20th July at the mouth of the Perry River. A temporary camp was set up and the procedure was to canoe up the River for 15 miles every day intercepting as many flocks as possible. In 10 days 493 geese were ringed, 409 Ross's and 84 Lesser Snows. Sexes were separated in both age classes by ringing the left foot of males and the right foot of females. Four neckband colours were used to differentiate age-sex classes.

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References

ALEKSIUK, M. 1964. Observations of birds and mammals in the Perry River Region, N.W.T. *Can. Field Nat.* in press.

ARMSTRONG, E. A. 1947. *Bird Display and Behaviour.* Lindsay Drummond, London.

BARRY, T. W. 1960. Breeding biology of the Atlantic Brant (*Branta bernicla hrota*). Unpub. M. Sc. thesis.

BARRY, T. W. 1962. Effects of late seasons on Atlantic Brant reproduction. *Jour. Wildlife Mgt.* 26: 19-26.

BARRY, T. W. and J. EISENHART. 1958. Ross' Geese nesting at Southampton Island, N.W.T. *Auk* 75: 89-90.

COOCH, F. G. 1954. Ross' Goose in the Eastern Arctic. *Condor* 56: 307.

DELACOUR, J. 1954. *The Waterfowl of the World.* vol. I. Country Life, London. 284 pp.

GAVIN, A. 1945. Notes on mammals observed in the Perry River District, Queen Maud Sea. *Jour. Mamm.* 26: 226-330.

HEARNE, S. 1795. *Journey to the Northern Ocean.* New Ed., J. B. Tyrrel, editor. The Champlain Society, 1911.

HANSON, H. C., P. QUENEAU and P. SCOTT. 1956. *The Geography, Birds, and Mammals of the Perry River Region.* Arctic Institute of North America. Sp. Pub. No. 3. 96 pp.

LINCOLN, F. C. 1939. *The Migration of American Birds.* Doubleday, Doran, New York. 189 pp.

MACINNES, C. D. 1964. The status of Ross's Goose in 1962-63. *Wildfowl Trust 15th Ann. Report*: 137-139.

MACINNES, C. D. and J. S. WESKE. 1962. (July and August.) A Reconnaissance of Goose Banding Opportunities in the Perry River Area of the Central Arctic. Unpub. report. Canadian Wildlife Service.

MACINNES, C. D. and F. G. COOCH. 1963. Additional eastern records of Ross' Goose (*Anser rossi*). *Auk* 80: 77-79.

VAN TYNE, J. and A. J. BERGER. 1961. *Fundamentals of Ornithology.* John Wiley and Sons, Inc., New York. 624 pp.

The status of Ross's Goose in 1962-63

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Summary

In 1962-63 there were at least 25,000 Ross's Geese in California. Earlier estimates, of as few as 2,000 in 1949, were probably too low because too little was known about the distribution of Ross's Geese in California and of their mixing with Snow Geese. Attempts to estimate the population size by the mark and recapture technique, utilising 161 geese colour-marked in the Perry River breeding area in the summer of 1962 and a further 292 marked in Saskatchewan later that year, proved unsatisfactory. Some neck-bands had been lost and no red-dyed geese could be detected, but the main cause of failure was the low ratio of marked to unmarked geese.

During the summer of 1962, John S. Weske and I spent six weeks in the Perry River region of northern Canada (see Hanson, Queneau & Scott, 1956) trying to band moulting geese. I was primarily interested in the Canada Geese (*Branta canadensis*), as this was to be the last of four summers' work on this species. However, our chief sponsors, the Canadian Wildlife Service, requested that, in addition, we band as many species of geese as possible, including the Ross's Goose (*Anser rossii* Cassin).

As a part of my Canada Goose study I had attempted to adapt the well-known mark and recapture technique of population inventory for use on goose flocks. Because geese are so difficult to catch in large numbers during the winter, it appeared logical to substitute sight records for actual recaptures. Conspicuous plastic neck-bands with trailing streamers (Craighead and Stockstad, 1956) proved very satisfactory for this purpose. The principal difficulty encountered in the Canada Goose study was the large overall size of the population. Even though nearly 2,000 marked birds were present in the fall of 1961, the frequency of marks was less than six per thousand geese sampled. (Detailed results of the Canada Goose study will be presented elsewhere.) Ross's Goose seemed to offer a perfect opportunity to overcome this difficulty. Since the most liberal estimates available indicated that the population did not contain more than 20,000 birds, a total of only 150 colour-marked

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