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TUNDRA SWANS IN NORTHEASTERN KEEWATIN DISTRICT, N.W.T.

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Bellrose (1980) estimated that the total adult population of Tundra Swans (*Cygnus columbianus*) in the eastern Canadian Arctic (east of 90°W) in the 1960's was about 5000 birds. He also stated that continental populations (based on surveys of wintering areas) increased by 25% from then until 1976, with most of the increase occurring in Canadian nesting areas. More specifically, winter censuses by the U.S. Fish and Wildlife Service along the Atlantic coast revealed that numbers in 1976 were 22.4% higher than the average of the previous 10 years (R. M. Alison, pers. comm.). Assuming that numbers increased by the same proportion throughout the breeding range, about 6000 Tundra Swans nested in the eastern Canadian Arctic in 1976.

No one area of high swan abundance has been reported in the eastern Arctic to date. In this paper, we report the occurrence of a major concentration of nesting Tundra Swans in the lowlands adjacent to the Rasmussen Basin, Keewatin District, Northwest Territories, and comment on the reproductive success of this population.

THE STUDY AREA

The avifauna of the 'Rasmussen Lowlands' was studied during the summers of 1975 and 1976 as part of a series of similar studies along the route of a proposed natural gas pipeline. The Rasmussen Lowlands comprise an area of 9800 km^2 in northern Keewatin District (Fig. 1). It is an area of recent marine submergence, bounded to the west by Rasmussen Basin and Rae Strait, and to the north, east and south by landforms dominated by Precambrian rock. Vegetation consists primarily of graminoid communities dominated by *Carex* spp. and *Eriophorum* spp. Large numbers of small shallow lakes and ponds occur throughout. The area is crossed by the Inglis and the Murchison rivers, and numerous small tributaries.

In 1975, the land was snow-free and ice had left rivers, lakes, and ponds by 13 June, the date of our earliest survey. In 1976, the lowlands were 50–95% snow-covered when we arrived on 14 June. Lakes and ponds remained entirely frozen as did several of the channels in the Inglis-Murchison delta. A meltwater channel flowed over the ice of the Inglis River but the river itself remained frozen. The Murchison River was 50–80% open. Snow melt and ice melt occurred rapidly after 24 June and were virtually complete by 1 July.

Freeze-up occurred early in 1976. Many tundra ponds and parts of the major rivers were frozen by 27 August and very little open water remained by 17 September, our last survey. We have no information about freeze-up in 1975.

METHODS

Most of the work consisted of aerial surveys. In 1975, surveys were conducted by fixed-wing aircraft on 13–14 June and 28–29 August; surveys by helicopter were conducted on

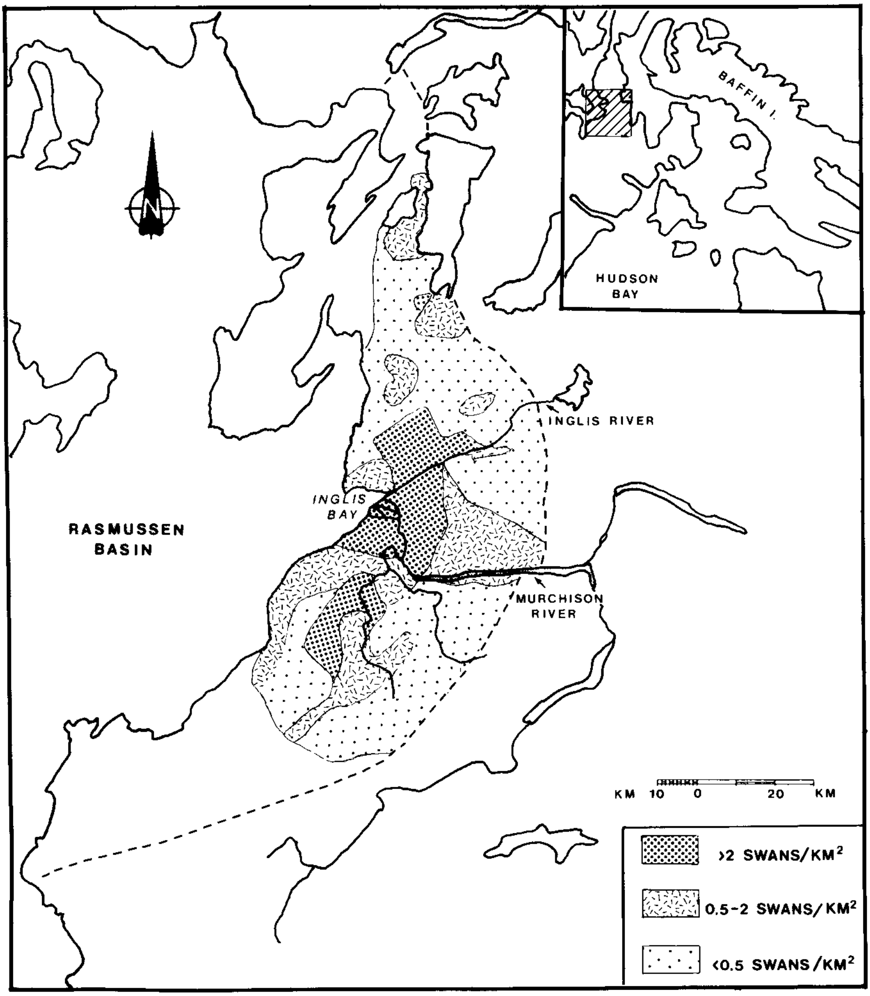

FIG. 1. Densities of nesting Tundra Swans in the Rasmussen Lowlands, N.W.T., Canada. The area between Rasmussen Basin and the dashed line includes about 9800 km^2; the surveyed area includes 5846 km^2.

4–11 July. In 1976 fixed-wing surveys were conducted on 12–14 August, 27–28 August, and 17 September. Helicopter surveys were conducted in the period 20 June–15 July, including surveys of nesting swans conducted on 3–10 July. Fixed-wing surveys were flown at 30 m AGL and at 160 km/h.

Surveys for nesting swans were conducted from a Hughes 500-C helicopter. About 60% of the lowland area (5846 km^2) was sampled (Fig. 1). Coverage was most intensive in habitats where we expected the highest densities of nesting birds. In general, our predictions were

TABLE 1
ESTIMATED NUMBERS OF ADULT TUNDRA SWANS IN THE RAMUSSEN LOWLANDS, KEEWATIN DISTRICT, N.W.T.

	Stratum					
	1	2	3	4	5	Total
Area (km^2)	565.5	1101.4	1428.9	1287.2	1463.2	5846.2
No. transects	17	30	31	18	24	120
No. km^2 surveyed	29.4	50.1	61.0	32.7	43.6	216.8
No. swans seen	17	93	20	50	5	185
Density (swans/km^2)	0.58	1.86	0.33	1.53	0.11	0.85
Estimated population[a]	385.1	2045.3	398.7	1968.8	167.8	4965.7
SE	143.7	431.2	104.8	484.5	82.0	677.5

[a] Apparent discrepancies between this line and density × area calculations are due to rounding error.

correct and the area was divided, a posteriori, based on habitat and distance from the coast, into five strata for analysis. Coverage in each stratum varied from 3–5%. Observers sat in the right front and left rear seats and dictated into tape recorders information about all birds seen. The helicopter flew at 50 km/h and 9 m above the ground. All birds seen within 100 m of the helicopter's path were considered to be on the transect strip. A total of 120 transects of average length 9 km was surveyed. Estimates of the adult swan population in the lowlands were based on sightings of single birds and pairs with no correction for the absent member in observations of singles. The population estimate for each stratum was calculated by the ratio estimate of Caughley (1977) for sampling without replacement for each stratum. The stratum estimates were then pooled to provide an overall estimate of the number of swans present and its standard error, following Cochran (1963) and Caughley and Grigg (1981).

RESULTS

The adult population of Tundra Swans in the 5846 km^2 sampled by our surveys was estimated to be 4966 $\pm$ 678 SE (Table 1). The overall density recorded was 0.85 swans/km^2 but the density was considerably higher in certain portions of the lowlands, especially in areas near the coast (Fig. 1). The highest average densities (>2 swans/km^2) occurred in the area inland from Inglis Bay.

In addition to adults, the lowlands support a substantial but unknown number of presumably immature swans in summer. We observed flocks of 14–70 of these swans primarily in the area east of Inglis Bay.

The late spring in 1976 affected brood size and the number of swans that nested, but did not appear to affect the timing of nest initiation substantially for those birds that did nest. We saw nesting swans during the first (13–14 June) survey in 1975 but no broods had been seen by the end of the 4–11 July survey period; 24 nests with eggs were found on 4–11 July. In 1976, despite considerably more extensive surveys, only 21 nests were found. The earliest cygnet in 1976 was seen on 2 July but no others were seen until 12 July. We saw 50 broods in 2143.2 km of survey in late summer in 1975 and only 11 in 2724.3 km in 1976. Average brood size was significantly smaller in 1976 (2.48 in 1975 vs 1.63 in 1976; $P < 0.01$, Mann-Whitney U-test, N = 50, 11, $z = 2.39$).

DISCUSSION

We estimated that about 500 Tundra Swans nested to the southwest of the area that we surveyed systematically. Including those swans, we estimated that about 5500 adult Tundra Swans occur in the Rasmussen Lowlands. When combined with numbers of adult swans elsewhere in the eastern Arctic (about 800 birds) this value agrees remarkably well with the estimated number of 6000 adults in the eastern Arctic. Thus, the Rasmussen Lowlands appear to be the center of the eastern Arctic population. The center of the Tundra Swan population in the Rasmussen Lowlands is within about 25 km of the coast and from 25 km north to 25 km south of the Inglis River (Fig. 1).

Macpherson and Manning (1959) and Ryder (1971) both reported that Tundra Swans were already present at study areas 180 and 300 km, respectively, west of the Rasmussen Lowlands when research parties arrived in late May and early June. Observations of nesting swans in mid-June in this study also indicate a similar arrival date. Our earliest observation of a cygnet in the Rasmussen Lowlands was 2 July. Back-dating about 31 days to egg-laying (Bellrose 1980) and another week to arrival (Parmelee et al. 1967) indicates that the first adult swans had arrived about 23 or 24 May. The major influx is probably only slightly later.

The number of young produced by Tundra Swans in the Rasmussen Lowlands probably fluctuates widely among years. In terms of both number of broods and number of young per brood, 1975 was clearly much more successful than 1976. Fluctuation in nesting success between years is also typical of other areas. Lensink (1973) found that between 15% and 47% of the adult swans on territories in western Alaska produced young in any one year. Lensink (1973) also noted that the proportion of cygnets from the Yukon-Kuskokwim Delta surviving autumn migration was much greater in years with early springs than in years with late springs. He suggested that in more northerly areas, where shorter seasons are the rule, conditions for survival may be marginal.

In the Yukon-Kuskokwim Delta hatch did not begin later than 6 July but did begin as early as 20 June over 9 years of study (Lensink 1973). Although a cygnet was seen in the Rasmussen Lowlands as early as 2 July, the peak of hatch there does not occur until after 10 July. Cygnets are flightless for 60–75 days and thus the majority of young would not be able to begin migration until the latter half of September. In 1976, most swans departed from the Rasmussen Lowlands during the first 2 weeks of September but families were still present on 17 September when only the ocean and small patches of the Murchison River remained ice free. The young of these families were still flightless (pers. obs.). Comparison of mean daily temperatures for the Yukon-Kuskokwim Delta and the Rasmussen Lowlands suggests a precarious existence for swans in the latter area. Mean daily temperatures in May and September in the Rasmussen Lowlands are −10.1°C and −1.1°C, respectively (Anon. 1982). In the Yukon-Kuskokwim Delta, temperatures in May and September average about 2°C and 6–8°C, respectively (Brower et al. 1977).

Conditions for survival of the Tundra Swan population in the Rasmussen Lowlands are probably not optimal. Late springs result in nonbreeding by a substantial proportion of the population and small broods for pairs that do breed. Most cygnets hatch after 10 July in both good and bad years and the length of the fledgling period is such that they cannot leave the lowlands before consistent freezing temperatures occur.

SUMMARY

Tundra Swans (*Cygnus columbianus*) in the lowlands adjacent to the Rasmussen Basin, Keewatin District, N.W.T., were counted during fixed-wing and helicopter surveys in 1975 and 1976. The lowlands support an estimated population of 4966 ± 678 SE nesting swans and we estimated an additional 500 nesting swans to the southwest in an adjacent area that we did not survey systematically. Since only 6000 Tundra Swans are estimated to nest in the eastern Canadian Arctic, the Rasmussen Lowlands appear to be the center of abundance in this region for the species. Flocks of presumably immature swans also occur in the lowlands in summer.

Spring was much later in 1976 than in 1975. Fewer Tundra Swans nested in 1976 and the broods of those that did nest were significantly smaller than broods in 1975 ($P < 0.01$). In both years the peak of hatch occurred after 10 July and, at least in 1976, family groups with flightless young were observed when freeze-up of freshwater was almost complete. The short summer season in the Rasmussen Lowlands in comparison with other areas with high densities of nesting Tundra Swans suggests that conditions for survival of this lowland population are less than optimal.

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The Hawk Mountain Sanctuary Association is accepting applications for its 8th annual award for raptor research. To apply for the $500 award, students should submit a description of their research program, a curriculum vita, and two letters of recommendation by 30 September 1984, to James J. Brett, Curator, Hawk Mountain Sanctuary, Rt. 2, Kempton, Pennsylvania 19529. The Association's Board of Directors will make a final decision late in 1984. Only students enrolled in a degree-granting institution are eligible. Both undergraduate and graduate students are invited to apply. The award will be granted on the basis of a project's potential to improve understanding of raptor biology and its ultimate relevance to conservation of North American raptor populations.