2023 Anderson Bay Light Goose Colony Surveys, Victoria Island, NU

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Introduction

We surveyed the Anderson Bay light goose colony 21 and 22 June 2023 to obtain updated estimates of abundance and species composition at this breeding colony on Victoria Island, Nunavut. Although mainland light goose colonies in the Queen Maud Gulf area have declined in recent years (Weegman et al. 2022), the colony at Anderson Bay has reportedly been expanding in size. Historical surveys of light goose abundance have been periodically carried out in the area (Groves and Mallek 2011 and Kerbes et al. 2014), and the colony boundary was delineated in 2018, 2019 and 2021 by staff with Polar Knowledge Canada, although no population estimates were computed in these years. The status of this light goose colony is of great interest to people in Cambridge Bay, to whom geese are culturally important, especially in terms of traditional harvesting (geese, eggs, and feathers/down). Local people have expressed concern about potential ecological interactions (i.e., goose mediated habitat alteration) og geese with other animals, including caribou and musk ox and there is substantial local interest about presence of novel diseases and parasites, in light of the rapidly changing arctic climate. The Ekaluktutiak Hunters and Trappers Organization (EHTO) represents local harvesters in the nearby community of Cambridge Bay, and reported die-offs of juvenile geese in late August 2017, 2021, and 2023. The ultimate cause of these mortality events remains unknown.

Methods

Colony Delineation and Aerial Survey Methods

Due to the size of the colony in previous years, and limited helicopter time and personnel, we elected to use a helicopter-based survey to estimate abundance and variation in nest densities. We first delineated the colony boundary, and then overlaid systematic north-south transects at systematic 1 km intervals across the colony. To determine the boundary of the colony, we flew at an elevation of about 300' AGL and used a GPS and moving map to plot a track along the extent of nesting light geese. The route of travel was eastward from Cambridge Bay along the southern coastline of Victoria Island, and then counter-clockwise around the colony. In cases where the start and end of nesting activity was difficult to discern, we circled and collected waypoints to mark the approximate boundary. Because we lacked the technology to geo-reference specific observations, we established 2 km segments within transects to allow post-hoc density analyses. The last segment flown in each transect was usually less than 2 km.

Aerial survey methods followed Ross et al. (2004), who found that this method produced comparable estimates of abundance to those obtained from photo inventory methods. Transects were flown at 100-150' AGL, and 2 observers (F. Baldwin, front left and J. Leafloor, rear right) counted light goose pairs on the ground and unoccupied nests on a 100 m strip width (50 m either side of the helicopter); direction of travel alternated between north and south. Flying birds were not counted unless they were seen leaving a nest. To ensure a consistent strip width, we conducted training by placing high visibility life preservers on the ground, spaced at a measured 50 m from the centre of a transect line. We then flew at survey altitude to determine a reference point on each window for the strip boundary. T. Verbiwski recorded data and alerted observers to the start and end of transect segments. Observers recorded nests and pairs on hand tally counters and totals were verbally given to the recorder at the completion of each 2 km segment of a transect.

Statistical Methods

We used the equations from Garrettson et al. 2020 to estimate abundance of light geese and precision around the estimate. Abundance *N* was estimated as,

$$N = A\hat{R}$$

where, *A* is the colony area, and $\hat{R}$ is the estimate of light goose density. Light goose density was estimated as

$$\hat{R} = \sum y_i / \sum x_i$$

Where y_i is the number of nests/pairs on transect I, and x_i is the area of transect I (total length multiplied by 0.10 km, the width of the transect).

Variance of goose abundance was estimated as the area of colony squared (*A*), multiplied by the variance of goose density $(\hat{\mathrm{R}})$, which was calculated as

$$VAR\ (N) = A^2(Var[\widehat{R}])$$

Variance of goose density was calculated as

$$\mathrm{VAR}\ (\hat{\mathrm{R}}) = \frac{1}{\mathrm{x}^{-2}}\left(\sum_{i=1}^{n}\left[y_i - \hat{R}x_i\right]^2\right)\Big/ n(n-1)$$

where n is the number of transects surveyed.

Species Composition Methods

Ross's geese and white phase snow geese are indistinguishable during aerial surveys, and can be difficult to differentiate on the ground with binoculars. To provide information on species composition in the colony, we measured eggs from several different areas of the colony. Areas where measurements were taken were quasi-random. We selected areas of different habitat types, but where nest density was reasonably high, such that a relatively large sample of egg measurements could be taken by 3 personnel in a short time.

We used the equation for egg discrimination developed by Alisauskas et al. 1998 to classify nests based on length and width of a randomly measured egg. A value of $D < 0$ indicates eggs are those of Ross's geese, whereas $D>0$ indicates eggs are those of snow geese.

$$D_{egg} = 0.538 \cdot w_{egg} + 0.124 \cdot l_{egg} - 36.559$$

Results

The colony perimeter was delineated 21 June. A Bell 206 L3 helicopter on pop-out floats (pilot, Xavery Mulholland, Great Slave Helicopter Ltd) was used for delineation and aerial transect surveys. Colony delineation required 2.3 hours of helicopter time and was completed the morning of 21 June. The crew returned to Cambridge Bay and plotted transect lines over the colony extent (Figure 1) and uploaded start and end point to the aircraft GPS. The colony area was estimated as 322 km^2. At its greatest extent east-west, it was about 43 km, and ranged from 2.2 km to 13.3 km in a north-south direction, with a mean of 7.3 km. In total, 292.4 km of transects were flown, representing 29.24 km^2 area, or 9.1% of the colony area. A total of 3.6 hours of helicopter time was spent surveying on 21 June, and 4.3 hours were spent surveying on 22 June.

Over the course of the survey, 13,614 observations of light goose nests/pairs were made, 6864 by the left-front observer (F. Baldwin) and 6750 by the right-back observer (J. Leafloor). Other *Anseriformes* (cackling and white-fronted geese, pintails, tundra swans) were observed at very low densities, and were not recorded. There were 3 transects (transect 30-32) where no observations were made. This was an area of relatively low nesting density between 2 areas of higher density on the eastern side of the colony (Figure 1 and 2). Densities of geese on transects with observations ranged from 19 geese/km^2 to 2730 geese/km^2. The overall mean density for all transects was 797.6 geese/km^2. The 2023 light goose abundance estimate for the Anderson River colony was 299,834 (95% CL, 260327-339338).

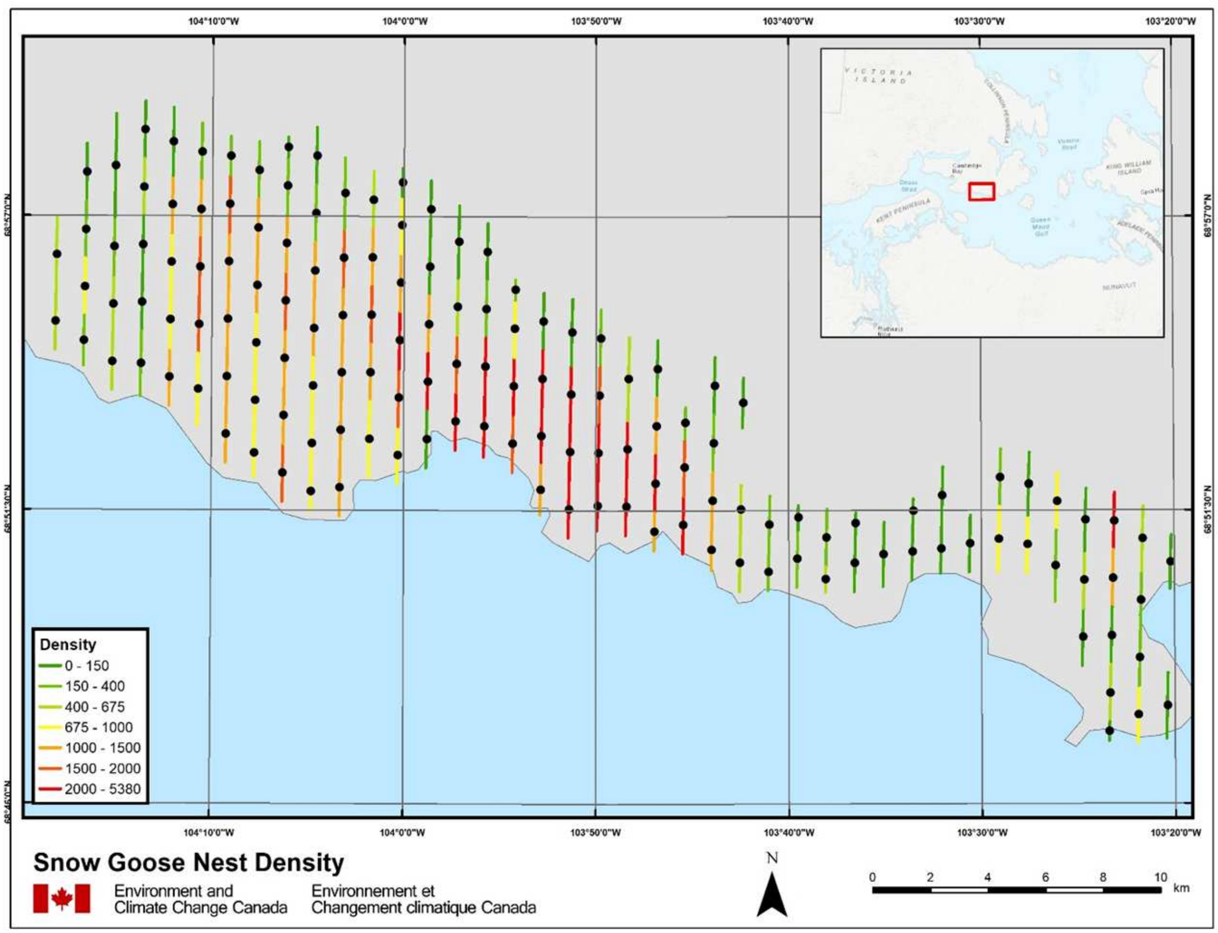

Figure 1. Anderson Bay light goose colony transects, with segments colored by estimated goose density (geese/km^2).

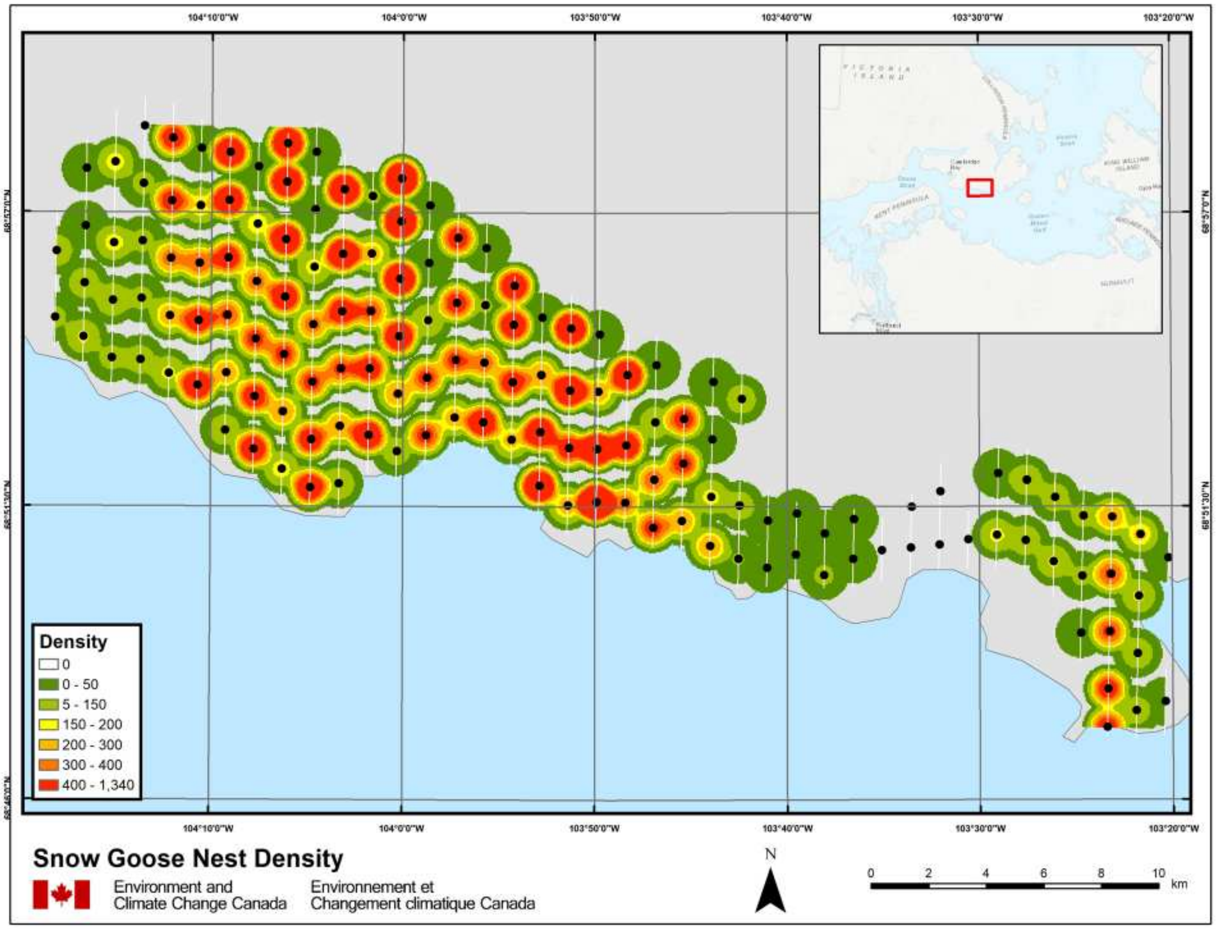

Figure 2. Anderson Bay light goose density surface (geese/km^2) based on density estimates in segments of systematically spaced transects.

After surveys of transects were completed on 22 June, we continued eastward to the Icebreaker Channel area to investigate light goose nesting densities. A large colony was present, with nesting starting about 43 km from the eastern edge of the Anderson Bay colony, and extending eastward to within a few km of the eastern edge of Victoria Island. Due to limited fuel, mapping was very coarse, but this colony appears to be larger in area than Anderson Bay, but probably lower nesting density. Helicopter time to investigate this area and return to Cambridge Bay totaled 1.3 hours.

A total of 0.9 hours of helicopter time was spent ferrying crew around to measure eggs on 22 June. One random egg from each nest was measured by 3 observers (FB, JOL, TV) in 251 light goose nests. Using measurements of the length and width of eggs, 13% of nests were classified as Ross's geese, and 87% were classified as snow geese. Clutch size of nests ranged from 1-7 eggs, with a mean of 3.74 (95% CL, 3.58-3.90). Clutch size of nests classified as Ross's geese (3.81, 95% CL 2.82-4.80)) were not different from clutch size in nests classified as snow geese (3.80, 95% CL 3.24-4.23). Eggs were all in advanced stages of incubation (float stage 5) on 22 June, and peak hatch at the colony was estimated to occur on June 28.

Discussion

The 2023 estimate of nesting light geese in the Anderson Bay colony is more than double the number of light geese that Groves and Mallek (2011) estimated in all of southeast Victoria Island in 2011. The apparent growth of light geese in this area is in stark contrast to declines in both species occurring in the Queen Maud Gulf region. Between the Anderson Bay colony and nesting activity in the Icebreaker Channel area, there are likely in excess of half a million nesting snow geese in southeast Victoria Island.

Although it was not possible to estimate detection probability during this survey, and observers likely undercounted available pairs and nests, the helicopter transect sampling method approach produced an abundance estimate with reasonable precision (CV=6%), and was completed with a relatively small amount of helicopter time. Additionally, there was no difference in counts on transects by the two observers (t_{78}=0.08, P=0.93), and the highest density transect was similar to that (2500 birds/ km2) estimated by Kerbes et al. (2014). The sampling approach could be replicated in future years, with a relatively low investment of resources, and a small number of personnel.

Nesting phenology was relatively early in 2023, and mean clutch size was high. Mean hatch at Karrak Lake, NU, has only occurred in June six times during monitoring between 1991 and 2019 (R. Alisauskas, Science and Technology Branch, ECCC, unpublished data).

Egg measurements suggest that 13% of the colony consisted of Ross's geese, but sampling was restricted to only a few areas in the colony. Observers did not observe or hear Ross's geese while on the ground during egg measurements. Species ratios at banding in August will be helpful in validating the composition of broods in the area, with banding projected to occur over a large portion of south-east Victoria Island.

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