

**POPULATION STUDY OF GREATER SNOW  
GEESE ON BYLOT ISLAND (NUNAVUT) IN 2003:  
A PROGRESS REPORT**



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## INTRODUCTION

In 2003, we continued our long-term study of the population dynamics of Greater Snow Geese (*Chen caerulescens atlantica*) and of the interactions between geese, plants and their predators on Bylot Island. Like many goose populations worldwide, Greater Snow Geese have increased considerably during the late XX<sup>th</sup> century (annual growth rate of ~10%). The exploding population of snow geese has imposed considerable stress on its breeding habitat, while extensive use of agriculture lands provides an unlimited source of food during winter and migratory stopovers for them. Remedial management during autumn, winter and spring has been undertaken since 1999 to curb the growth of this population. The long-term objectives of this project are to (1) study changes in the demographic parameters of the Greater Snow Goose population, and especially the effects of the recent spring conservation hunt, (2) determine the role of food availability and fox predation in limiting annual production of geese, and (3) monitor the impact of grazing on the vegetation of Bylot Island.

## OBJECTIVES

Specific goals for 2003 were as follows:

- 1) Monitor productivity (egg laying date, clutch size and nesting success) of Greater Snow Geese on Bylot Island
- 2) Study the spatial structure of colonies and movements between colonies based on marked females and genetic markers.
- 3) Mark goslings in the nest to provide a sample of known-age individuals to be used to assess the growth of goslings by their recapture in late summer.
- 4) Collect live goose eggs to conduct experiments on metabolism, thermoregulation and growth of goslings in the laboratory.
- 5) Band goslings and adults, and neck-collar adult females at the end of the summer to continue the long-term study of demographic parameters such as survival and breeding propensity.
- 6) Monitor the level of intestinal parasite infestations in goslings.
- 7) Evaluate the diet, food selection and variation in plant quality of geese grazing in mesic habitats.
- 8) Monitor the abundance of lemmings and the breeding activity of snowy owls.
- 9) Expand our survey of fox dens and monitor the breeding activity of foxes at these dens.
- 10) Capture and radio-mark arctic foxes to study their activity and diet at their dens around the snow goose colony.
- 11) Study egg caching by arctic foxes using radio-tagged eggs to assess the contribution of eggs to the seasonal and annual diet of foxes.

- 12) Sample plants in exclosures to assess annual production and the impact of goose and lemming grazing on plant abundance in wet meadows.
- 13) Carry out the aerial survey of snow geese breeding on Bylot Island during brood-rearing (conducted every 5 years since 1983).
- 14) Maintain and upgrade our automated environmental and weather monitoring system.

## FIELD ACTIVITIES

**Field camps.** — In 2003, we operated two field camps on Bylot Island: the main camp, located at 6 km from the coast in the largest glacial valley on the island (“*Base-camp Valley*”, 73° 08' N, 80° 00' W), was occupied from 30 May to 21 August. A secondary camp, located in a narrow valley 30 km south of the Base-camp and 5 km from the coast (“*Camp-2 area*”, 72° 53' N, 79° 54' W) was occupied from 6 June to 20 July. Finally, a dozen fly camps were also established for 2-5 days at a time throughout the island, west of Pointe Dufour.

New facilities replaced old ones at our Base-camp this year. The old parcoll and kitchen tent were replaced by 2 semi-permanent *Weatherhaven* shelters, thus providing larger and better living space. The Base-camp was also surrounded by a semi-permanent bear fence. This fence was installed by Andy McMullen from *BearWise*, Yellowknife, with the assistance of Carey Elverum and his staff.

**Field party.** — The total number of people from our group in the camps ranged from 2 to 13 depending on the period. Members of our field party included project leaders Gilles Gauthier, Austin Reed, Dominique Berteaux, and Jean-François Giroux. There were also graduate and undergraduate students whose thesis projects addressed several of the objectives laid out above. Students were: Nicolas Lecomte (PhD, objectives 1, 2 and 3), Benoît Audet (MSc, objective 7), Nicolas Ouellet (MSc, objective 4), Guillaume Szor (MSc, objectives 8 and 9), Ilya Klvana (objective 9), Caroline St-Pierre (objective 10 and 11), Patrick Bergeron (objective 10), Anna Hargreaves (objective 3), Marie-Claire Bédard (objective 12). Other people in the field included Denis Sarrazin, a research professional responsible of the weather stations and his two assistants Natasha Fontaine and Philippe Thériault. For the goose banding, the following people joined our crew: Gérald Picard, a technician, and Marie-Christine Cadieux, a research professional from Université Laval; and James Inootik and Amos Ootovak from Pond Inlet.

Other people that shared our camp for part of the summer include the field party of Esther Lévesque and Line Rochefort (Claudia St-Arnaud and Johanne Pelletier) who studied plant ecology. The Parks Canada field party lead by Vicki Sahanatien, ecosystem secretariat manager (other members: Tom Knight, Josée Gérin-Lajoie and Susan Abs), also stayed at our camp for a few days during their vegetation mapping work. Finally, Carey Elverum, the chief warden of *Sirmilik Park*, visited the camp on 2 occasions with some of his assistants.

**Environmental and weather data.** — Environmental and weather data continued to be recorded at our three automated stations. Our network includes 2 full stations, one at low and one at high elevation (20 m and 370m ASL, respectively) where air and ground temperature, air humidity, solar radiation, wind speed and direction are recorded on an hourly basis throughout the

year. A third station monitors soil surface temperature in areas grazed and ungrazed by geese (i.e. exclosures). All automated stations were visited during the summer to download data and were found to be operating normally. A few damaged sensors (especially those recording ground temperature) were replaced. A fourth weather station was set up in 2003 in wet polygon fens as part of the SILA Network, a northern network of climate and environmental change observatories. This station has a 10-m tower in order to meet all national meteorological standards. Instrumentation on this tower should become operational in summer 2004. Finally, daily precipitation was recorded manually during the summer and snowmelt was monitored by measuring snow depth at 50 stations along two 250-m transects at 2-day intervals.

**Monitoring of goose arrival and nesting.** — We monitored goose arrival in the Base-camp Valley by counting goose pairs every two to three days from our arrival on the island until the end of snowmelt on sample plots. Nest searches were carried out within walking distance (~6 km) of both the Base-camp Valley and the Camp-2 area between 7 and 21 June. Nests were found in 2 ways: 1) through systematic searches at the Base-camp and Camp-2 (limited to a high-density area in the colony centre in the latter case) or 2) searches of randomly located 2.25-ha plots at Camp-2. We also attempted to find the nests of as many neck-collared females as possible throughout both study areas. During the hatching period, we visited a sample of nests almost every day to record hatch dates and to web-tag goslings.

**Collection of eggs.** — During late incubation, we removed 40 live eggs from goose nests and sent them to the university laboratory in a portable incubator, where they hatched. Young were used for laboratory studies on thermoregulation, energetic cost of locomotion and nutrition.

**Goose banding.** — From 6 to 14 August, we banded geese with the assistance of local Inuit people and a helicopter. All geese captured were sexed and leg banded, and all recaptures (web-tagged or leg-banded birds) were recorded. A sample of young and adults was measured (mass and length of culmen, head, tarsus and 9<sup>th</sup> primary). Young were fitted with coded black plastic leg bands and a sample of adult females were fitted with coded yellow plastic neck-collars. Some young were injected with droncit© as part of a study on the impact of parasites on survival.

**Snow goose population survey.** — The aerial photographic survey was conducted on the south plain of the island on 22-24 July. A series of additional sample plots were surveyed on the north side of the island on 17 July. Ground counts, aimed at determining average brood size, were conducted from 16 to 24 July. The main survey on the south plain covered 77 sample plots (27% of total area), each covering 2 x 2 km. Of these plots, 31 represented habitats judged to be of highest quality for brood-rearing, 33 of intermediate quality, and 13 of poorest quality. A total of ~350 photographs were taken, from which the geese were later counted in the lab.

**Diet of snow goose goslings in upland habitats.** — In early July, we removed 25 goslings from nests at hatch and imprinted them on humans to study their feeding habits by direct observation. Every week, goslings were brought to 3 mesic tundra habitats and all plants ingested were determined visually during short observation bouts. Goslings were sacrificed at the end to examine their gut content and compare it to field observations. We also collected by hand and sacrificed 46 wild goslings, and examined their gut content to determine the type of food eaten. The intestines of all birds sacrificed were removed for future analyses of intestinal parasites. Plant abundance was sampled at every site where captive goslings were observed feeding or where wild

goslings were collected to compare plants eaten with those available. Finally, every 10 days samples of 5 plant species representative of those eaten by goslings were collected and will be analysed for their quality (protein and fibre content).

***Fox den survey and marking of foxes.*** — An exhaustive survey of fox dens was conducted on the south plain of Bylot Island. A total area of 600 km<sup>2</sup> was covered. Every fox den was identified and described. Each denning site was visited two or three times during the summer to monitor fox activity around the dens and its use by foxes. Samples of scats were collected, when found on dens, for later analysis of fox diet. When breeding foxes were found, trapping was carried out at the den with Tomahawk collapsible live traps (cage traps). Traps were kept under continuous surveillance. When a fox was caught, it was measured, weighted and tagged on both ears using Dalton Rototags®. Samples of winter and summer fur, and scats were collected when possible. Adults foxes were anaesthetized using Telazol®, an anaesthetic commonly used for domestic dogs, to allow us to equip them with radio-collars and minimize risks of injuries.

***Egg caching by arctic foxes.*** — We created artificial nests by placing one radio-tagged egg similar in size, shape, and color to a goose egg into a nest made of old goose down. Five to ten artificial nests were put along transect lines at different locations near the main colony (Camp-2). When an egg had been removed, it was searched by telemetry. The location of the cache was noted and its fate checked every two days during the first week and every week thereafter until our departure from Bylot Island in late August. To determine when foxes retrieve cached eggs after our departure, we replaced the remaining radio-tagged eggs by real eggs (previously collected in abandoned goose nests) linked to an electronic device (modified watch) that will eventually record the date that eggs are retrieved. We also searched for natural egg caches along 1-km transects throughout the colony. These were indicated by remnants of eggshells and a small hole in the tundra. Transects were run three times during the summer (incubation, hatching and brood-rearing periods) to look at the seasonal variation in cache use.

***Small mammals and other birds monitoring.*** — We participated again in the small-mammal survey coordinated across the NWT and Nunavut by the Renewable Resources office in Yellowknife. The methods and detailed results are given in a separate report. We also monitored the nesting activity of Lapland Longspurs (*Calcarius lapponicus*) and Snowy Owls (*Nyctea scandiaca*), and banded some longspurs.

***Monitoring of plant growth and goose grazing.*** — The annual impact of goose grazing was evaluated in wet meadows dominated by graminoid plants at 3 sites: the Base-camp Valley and Dufour Point (two brood-rearing areas), and the Camp-2 area (nesting area). At each site, 12 exclosures (1 x 1 m) were installed in late June, and plant biomass was sampled in ungrazed and grazed areas (i.e. inside and outside exclosures) at the end of the plant-growing season on 12 and 15 August. Plants were sorted out into sedges (*Eriophorum scheuchzeri* and *Carex aquatilis*) and grasses (*Dupontia fisheri*). Use of the area by geese was monitored by counting faeces on 1 x 10 m transects located near each exclosure every 2-weeks in the Base-camp Valley and once at the end of the season at the other sites.

## PRELIMINARY RESULTS

**Weather conditions.** — The spring 2003 was characterized by an early snowmelt due to a very thin snow-pack and mild temperatures. Snow depth on 2 June was 7 cm compared to a long-term average of 32 cm (Fig. 1). Temperature in spring was also relatively mild with an average air temperature of 0.45°C between 20 May and 20 June compared to a long-term average of -0.08°C. Consequently, the rate of snowmelt was rapid and comparable to the earliest years such as 1997 and 1998 (Fig. 1). Precipitation was extremely low for the first half of the summer (only 8 mm from 1 June to mid-July) with very long spells of sunshine and warm temperature. This weather, in combination with the limited spring run off, lead to almost drought conditions in early July. However, there was a dramatic turnaround in weather conditions as the rest of the summer was cool with little sunshine and very high precipitations (35 mm of rain from mid- to late July and 49 mm from 1 to 20 August), including a precipitation record for a single day (24 mm on 4 August). This resulted in extensive flooding of lowlands in August, especially polygon tundra which was covered by several cm of water for several days. Finally, the ground was partially or totally covered by snow from 13 August until camp closure due to frequent snow showers.

**Goose arrival and nesting activity.** — Arrival of geese on Bylot Island was relatively early in 2003 compared to previous years, which is in accordance with the favourable weather conditions prevailing in spring on Bylot Island. The number of geese counted on the hills surrounding the Base-camp Valley increased from 15 pairs on 30 May to a peak of 484 pairs on 7 June (Fig. 2); this number declined rapidly afterwards as geese dispersed to nesting grounds in the lowlands, which opened early. The peak number of geese on the hills was only surpassed in 1996 when a late-snowmelt delayed the movements of geese to lowland areas. The early arrival of geese in 2003 contrasted with the situation in 2002 when goose arrival was considerably delayed despite an early snowmelt (Fig. 2).

Median egg-laying date was 9 June, which is a few days earlier than normal (Table 1). It is noteworthy that since the instauration of the spring hunt in 1999, it is the first time that nest initiation is earlier than the long-term average, as nest initiation dates during the four previous years were all late or very late. Our field observations suggest that the reproductive effort of geese was very high at the main breeding colony (Camp-2); only 2 nests were found in the Base-camp Valley (which is predominantly a brood-rearing area), a situation common in years when no owls are nesting (see below). Average clutch size was 3.90, which is above the long-term average (Table 1). As with nest initiation date, it is the first year that clutch size is higher than the long-term average since the instauration of the spring hunt in 1999.

**Nesting success of geese.** — Nesting success (proportion of nests hatching at least one egg) was very good this year (82%), and among the highest values ever reported (Table 1). Activity of predators at goose nests, especially Arctic foxes (*Alopex lagopus*), was low even if the lemming population (the main prey of predators) was still very low on Bylot Island following the peak of 2000 (see below). During nesting and brood-rearing, 222 neck-collared birds were sighted, a high number compared to last year (79). Peak hatch was on 6 July, also earlier than normal (Table 1). We tagged 2958 goslings in nests at hatch, all of them in the Camp-2 area.

**Density of broods.** — In 2003, goose faeces density at the end of the summer in wet meadows of the Base-camp Valley was low ( $4.9 \pm 1.0$  [SE] faeces/m<sup>2</sup>, Fig. 3) and very similar to

last year ( $4.4 \pm 1.2$ ). Accumulation of faeces was delayed and only occurred in late July, with little accumulation thereafter. In contrast, faeces density at the end of the summer was higher than in 2002 in the wet meadows of the nesting colony at Camp-2 ( $4.9$  faeces/m<sup>2</sup> vs.  $3.1$  in 2002) and considerably higher at Point Dufour, the other brood-rearing area ( $10.8$  faeces/m<sup>2</sup> vs.  $4.6$  in 2002).

**Goose banding.** — The banding operation was very successful this year. We conducted 12 drives in the lowlands and hills bordering the Base-camp Valley to the south and north (<8 km). We banded a total of 5259 geese (a record number), including 605 adult females marked with neck-collars and 1569 young with plastic tarsal bands. We injected 719 young with droncit© and 717 with a saline solution (control group). In addition, there were 96 recaptures of web-tagged young and 300 recaptures of adults banded in previous years. The gosling:adult ratio among geese captured at banding (1.31:1) and mean brood size (2.74 young, SD = 1.14, n = 54; counts conducted from 29 July to 5 August) were both above the long-term average (Table 1). By combining information on brood size and young:adult ratio at banding, we estimated that 96% of the adults captured were accompanied by young. All these values are indicative of a very good production of young on Bylot Island this year.

**Snow goose population survey.** — Preliminary analyses of the data for the south plain indicated a population of  $47,738 \pm 5,647$  (SE) adult geese and  $58,017 \pm 7,168$  goslings. Based on a mean brood size of 3.04 goslings/family (n = 318 broods), the adult component was estimated to include 37,024 successful breeders (adults with young) and 10,714 non- and failed-breeders (adults without young). The overall number of geese did not change significantly from that of the previous survey in 1998, with the exception of non/failed breeders which declined by 54%. A breakdown by strata (habitat quality) showed that all categories of geese declined significantly (in comparison to 1998) in the best quality stratum, but in the other strata the only significant change was a decline in non/failed breeders in the intermediate stratum. The data for the plots surveyed on the north side of the island, an area not covered in previous surveys, has not yet been completed but is not expected to yield an estimate of more than several hundred geese.

**Diet of goslings in upland habitats.** — The diet of wild goslings collected during the brood-rearing season consisted of more than 27 vascular plant species. The main food items in the oesophagi were Gramineae (>50% of diet), especially *Arctagrostis latifolia*, and Polygonaceae (16% of diet; mainly *Oxyria digyna*). Leaves were the dominant food item of goslings (74% of the diet) with Gramineae and Polygonaceae accounting for 68% and 11%, respectively, of all leaves consumed by goslings. Throughout the brood-rearing period, a total of 56 feeding trials were performed with captive goslings in upland habitats. Overall, 3220 minutes of feeding observations were recorded and more than 39 vascular plant species were grazed by goslings during these observations. Preliminary results indicate that captive goslings consumed mainly the Gramineae *Arctagrostis latifolia*, *Hierochloe alpina* and *Poa arctica*, the Leguminosae *Astragalus alpinus* and *Oxytropis maydelliana*, the Juncaceae *Luzula confusa* and *Luzula nivalis* and the Polygonaceae *Oxyria digyna* and *Polygonum viviparum*. Combining these data with measurements of plant availability in the plots will enable us to determine which plants species were selected by goslings. This information will be analysed in relation to the protein and neutral detergent fibre content of plant species (currently underway) to determine to what extent food selection is influenced by the quality of different plant species or plant parts.

**Fox den survey and marking of foxes.** — We found 42 new fox denning sites on the island, bringing the total to almost 100 known sites. We found signs of activity (fresh digging and/or footprints) at 44 dens. However, the breeding activity of foxes was low as we found only 3 litters (3% of known denning sites with a different litter) for a minimum total of 17 pups. In comparison, no fox litters were found in 2002 and 8 in 2001 out of 48 known denning sites (16% of dens used). Three adult foxes were captured, ear-tagged and equipped with radio-collars, and 12 young were captured and ear-tagged. Observations of marked individuals in the following years will provide interesting information on fox behaviour as well as population dynamics.

**Egg caching by arctic foxes.** — Twenty-nine radio-tagged eggs were removed by foxes from 59 artificial nests placed along 8 transects near the main colony. They cached 14 eggs at a distance of about 500 meters from the nests and seven of them were later moved to a new cache; the remainder of the stolen eggs were partly destroyed by foxes. We found 41 egg caches used by foxes at the goose colony and we linked 30 real eggs to our recording devices. The retrieval date of those eggs will be determined next summer.

**Small mammals.** — For our small-mammal survey, we accumulated 1098 trap-nights in the Base-camp Valley split between 2 trapping sites (one lowland and one upland) and 550 trap-nights in the upland habitat at Camp-2. In all three trapping sites, no lemmings were captured (Fig. 4). Therefore, they were still in the low phase of their cycle on the island following the peak of 2000 at the Base-camp Valley and 2001 at Camp-2. Based on the 3 to 4-year cycle of abundance that prevail on Bylot Island since 1993, we expect a peak in lemming abundance in 2004.

**Plant growth and grazing impact.** — This year, plant production in wet meadows was moderate, being the lowest value recorded in the past 6 years (Fig. 5). Above-ground biomass of graminoid plants in the Base-camp Valley reached  $43.8 \pm 5.1$  [SE]  $\text{g/m}^2$  in ungrazed areas in mid-August compared to  $53.1 \pm 8.1$  in 2002. Much of the annual variation in plant production since 1998 is due to variations in *Eriophorum*, the preferred plant of geese; in contrast, production of the Gramineae *Dupontia* varied little during this period (Fig. 5). Consequently, whereas *Eriophorum* accounted for 45% to 47% of the total graminoid biomass from 2000 to 2002, this proportion was reduced to 25% in 2003. This year, total plant production tended to be slightly reduced at the Camp-2 area (nesting area:  $23.3 \pm 4.5$   $\text{g/m}^2$  vs.  $26.1 \pm 2.6$   $\text{g/m}^2$  in 2002) but higher at Dufour Point (another brood-rearing area:  $46.0 \pm 8.4$   $\text{g/m}^2$  vs.  $42.6 \pm 8.2$   $\text{g/m}^2$  in 2002).

Goose grazing was very low in the wet meadows of the Base-camp Valley where geese removed only 18% of the above-ground biomass (difference between paired grazed and ungrazed plots) by mid-August. This grazing impact is comparable to 2002 (17%) but much lower than in 2001 and 2000 (43% and 44%, respectively; Fig. 5). However, grazing impact at Camp-2 (nesting area) was much higher with 41% of the graminoid biomass removed by geese compared to 17% in 2002. Similarly, at Dufour Point, another brood-rearing area, geese also removed 41% of the total biomass compared to 33% in 2002.

## CONCLUSIONS

The production of young on Bylot Island was high in 2003 due to the early arrival of geese in spring and the ensuing high reproductive effort, early nesting, large clutches, and low nest predation rate. Based on the young:adult ratio during our banding operation, we anticipated a proportion of young in the fall flock around 35%, a high value. Apparently, this prediction was only partially upheld as juvenile counts conducted in Québec this fall indicated a lower proportion of young (27%,  $n = 15,900$ ) than anticipated. However, variability in age-ratios among flocks was unusually large this fall, with many flocks averaging 40% (A. Reed, pers. obs.). Moreover, the fall migration pattern of snow geese was also unusual as a very large number of geese stayed in the Lac St-Jean area (>200,000 birds) north of the St. Lawrence estuary, and thus escaped age-ratio counts conducted there in early October (normally, few geese use the Lac St-Jean area in fall). These combined factors may have thus weakened the reliability of fall age-ratio counts this year. The value of 27% young in the fall flock is nonetheless slightly above average (24%).

The good reproduction of geese on Bylot Island in 2003 contrasts with the situation that has prevailed since the instauration of the spring hunt in 1999. In the 4 previous years, egg laying date was late, clutch size was low, and production of young was moderate to very low in comparison to the long-term average. We previously suggested that these results provided support for the hypothesis that the spring hunt negatively affected the reproduction of geese. At first glance, the results from 2003 are in contradiction with this conclusion, as the spring hunt still occurred in 2003. The spring temperature and snow condition on Bylot Island were very favourable, and this undoubtedly contributed to the good reproduction of geese this year. However, spring conditions were also favourable in 2002, and yet goose reproduction was poor. Therefore, spring weather alone cannot explain the difference in the production of geese between 2003 and the other years with spring hunt. Statistics from the spring hunt, however, indicate a large reduction in both the number of geese killed in Québec (68% decline) and the number of active hunters (50% decline; P. Brousseau, pers. comm.). It is therefore likely that hunting disturbance on spring staging geese was considerably reduced in 2003, which may have enabled the geese to reach a better body condition at the end of staging than in other years with a spring hunt (Féret et al. 2003). With the continuation of the spring hunt for a 5<sup>th</sup> year, it is also possible that geese have gradually adapted their spring pattern of habitat use to minimize the impact of hunting disturbance on their nutrient accumulation, a trend already apparent in the results of Féret et al. (2003) for 1999-2001. Therefore, an improved spring body condition combined with good weather conditions in the Arctic upon arrival are likely responsible for the good reproduction of geese in 2003.

The moderate plant production in wet meadows of Bylot Island this year may be due to the extreme weather conditions encountered, i.e. near drought conditions in early summer followed by cool temperatures, record rainfall, and flooding conditions in late summer. However, the low grazing impact observed in wet meadows of the Base-camp Valley is surprising. This result is consistent with the low faeces density recorded there, which suggests a low use by broods, but difficult to reconcile with the good reproduction of geese and the overall high brood density found during the survey this year. However, results of the colony survey also showed that use of the “best” habitats (mainly low-lying wetland areas, including the Base-camp Valley) was lower than during the previous survey in 1998. We believe that the low use of wet meadows by geese in the Base-camp Valley may be partly explained by early brood movements to upland areas, as unusually large flocks

were observed in upland, mesic habitats when we banded geese in August. It is possible that many broods left the lowlands for the uplands because of extensive flooding in low-lying areas in late July.

The spring survey of the total Greater Snow Goose population was 678,000 geese in 2003 (CWS, unpubl. data), a value similar to the previous year (640,000). These data confirm that the population has declined by about 30% since the peak population recorded in spring 1999 (938,000 including a telemetry correction). Population trend over the last 5 years shows an average decline of 8%/yr, which matches well the decline of 5-10%/yr predicted by a revised population model including both a reduction in survival and fecundity due to the spring hunt (Gauthier, unpubl. data). The results of the colony survey also suggest a stabilisation in the number of breeding adults on the South Plain of Bylot Island but a slight decline in the total number of adults (breeders+non-breeders) since 1998. In spite of the high production observed this year, the population is anticipated to remain stable or increase only slightly in spring 2004, assuming that current hunting regulations remain unchanged and that hunting pressure is maintained. Therefore, the objective of stabilizing the Greater Snow Goose population proposed in the Arctic Goose Joint Venture report of 1998 has been attained.

## PLANS FOR 2004

The long-term objectives of our work are to study the population dynamics of Greater Snow Geese, and the interactions between geese, plants, and their predators on Bylot Island. A major focus of the project is to monitor changes in demographic parameters (such as survival rate, hunting mortality, breeding propensity, reproductive success, and recruitment) and habitat in response to the spring conservation hunt and other special management actions implemented since 1999 in Québec. Other focuses of the project include *i*) a better understanding of the spatial structure of colonies and goose movements on Bylot Island; *ii*) expanding our estimate of the carrying capacity of the Island for geese to upland habitats; *iii*) determining long-term effects of geese on the arctic landscape; and *iv*) study indirect interactions between snow geese and lemmings via shared predators, especially arctic foxes. In 2004, we anticipate to:

- 1) Monitor productivity (egg laying date, clutch size and nesting success) and nesting distribution of Greater Snow Geese on Bylot Island.
- 2) Study the spatial structure of colonies and movements between colonies.
- 3) Mark goslings in the nest to provide a sample of known-age individuals to assess the growth and pre-fledging survival of goslings by their recapture in late summer.
- 4) Band goslings and adults, and neck-collar adult females at the end of the summer, to continue the long-term study of demographic parameters such as survival and breeding propensity.
- 5) Monitor the level of intestinal parasite infestations in goslings and study their impact on survival.
- 6) Monitor the abundance of lemmings and the breeding activity of snowy owls.
- 7) Monitor the breeding activity of foxes at dens and study their selection of denning sites.
- 8) Capture and radio-mark adult arctic foxes, and capture and ear-tag their pups to study their movements around the goose colony.

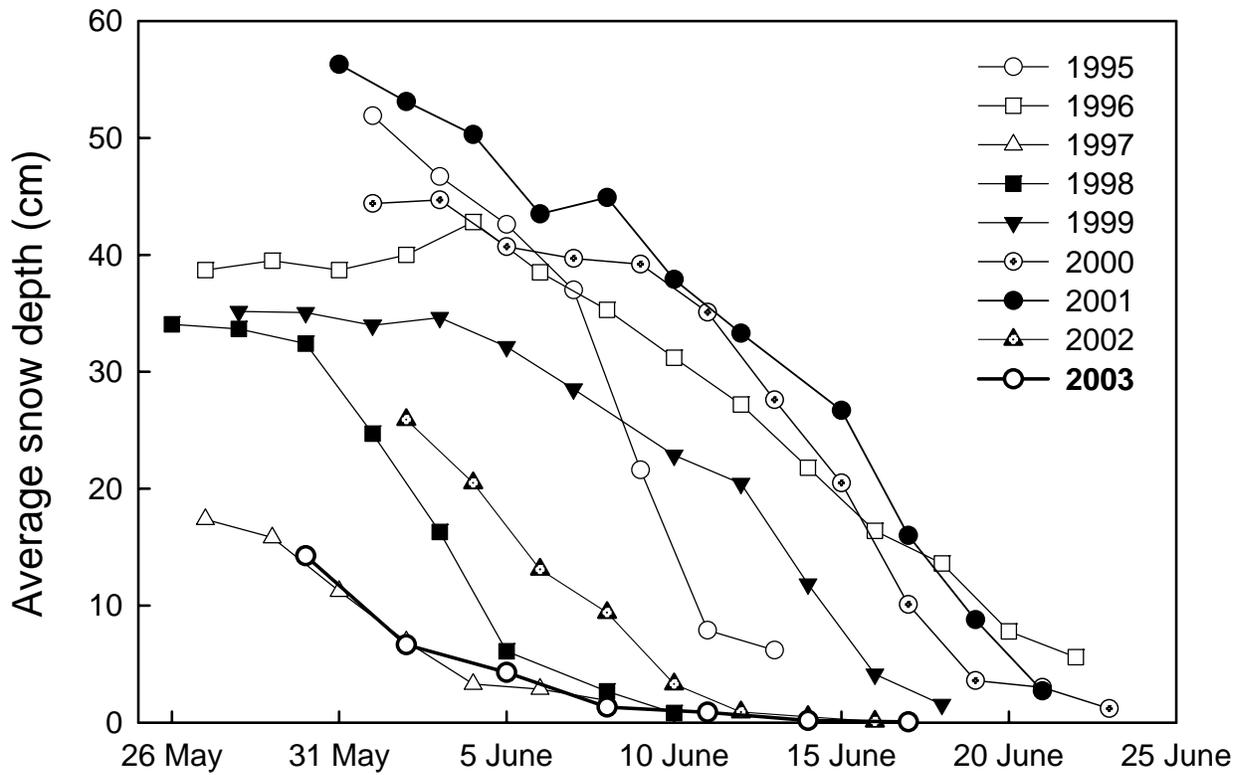
- 9) Study egg caching by arctic foxes in the goose colony using radio-tagged eggs.
- 10) Sample plants in exclosures to assess annual production and the impact of goose and lemming grazing on plant abundance in wet meadows.
- 11) Maintain our automated environmental and weather monitoring system.

In 2004, at least 4 graduate students will be involved in the Bylot Island snow goose project. **Nicolas Lecomte** (PhD) will continue his project on the spatial structure of snow goose colonies and movements between colonies using neck-collared females and genetic markers. **Marie-Hélène Dickey** (MSc) will investigate the relations between several climatic variables and goose reproductive phenology in order to develop predictive relationships. **Guillaume Szor** (MSc) will continue his study of fox den use and fox activity, and diet at the dens around the snow goose colony. Finally, **Vincent Careau** (MSc) will study the egg caching behaviour of foxes to assess the contribution of eggs to the seasonal and annual diet of foxes.

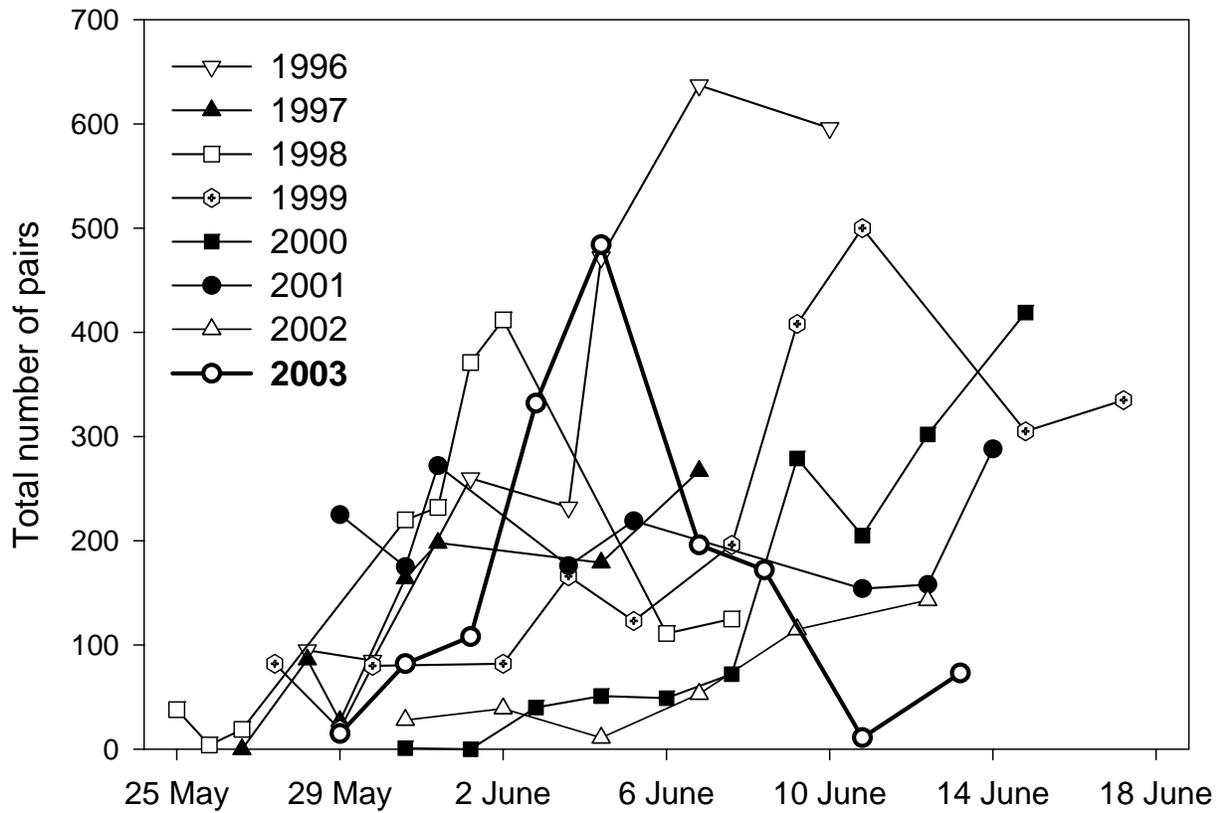
**Table 1.** Productivity data of Greater Snow Geese nesting on Bylot Island over the past decade

	1994	1995	1996	1997	1998	1999	2000	2001	2002	<b>2003</b>	Average <sup>2</sup>
Number of nest monitored	846	312	367	326	350	266	386	296	470	<b>585</b>	--
Median date of egg-laying	11 June	10 June	14 June	10 June	7 June	17 June	16 June	13 June	16 June	<b>9 June</b>	12 June
Clutch size	3.55	3.64	3.99	4.27	4.00	3.09	3.51	3.43	3.43	<b>3.90</b>	3.71
Nesting success <sup>1</sup>	40%	14%	65%	83%	79%	12%	83%	57%	53%	<b>82%</b>	63%
Median date of hatching	7 July	7 July	11 July	7 July	4 July	13 July	13 July	9 July	11 July	<b>6 July</b>	9 July
Number of geese banded	3531	3985	3824	3956	3998	1717	4269	3430	2650	<b>5259</b>	--
Ratio young:adult at banding	0.79:1	1.10:1	0.83:1	1.06:1	1.09:1	0.54:1	1.08:1	1.03:1	0.81:1	<b>1.31:1</b>	1.04:1
Brood size at banding	2.66	2.50	2.34	2.47	2.70	1.67	2.78	2.37	1.67	<b>2.74</b>	2.48
Proportion of adults with young at banding	60%	88%	71%	86%	81%	65%	78%	87%	97%	<b>96%</b>	83%

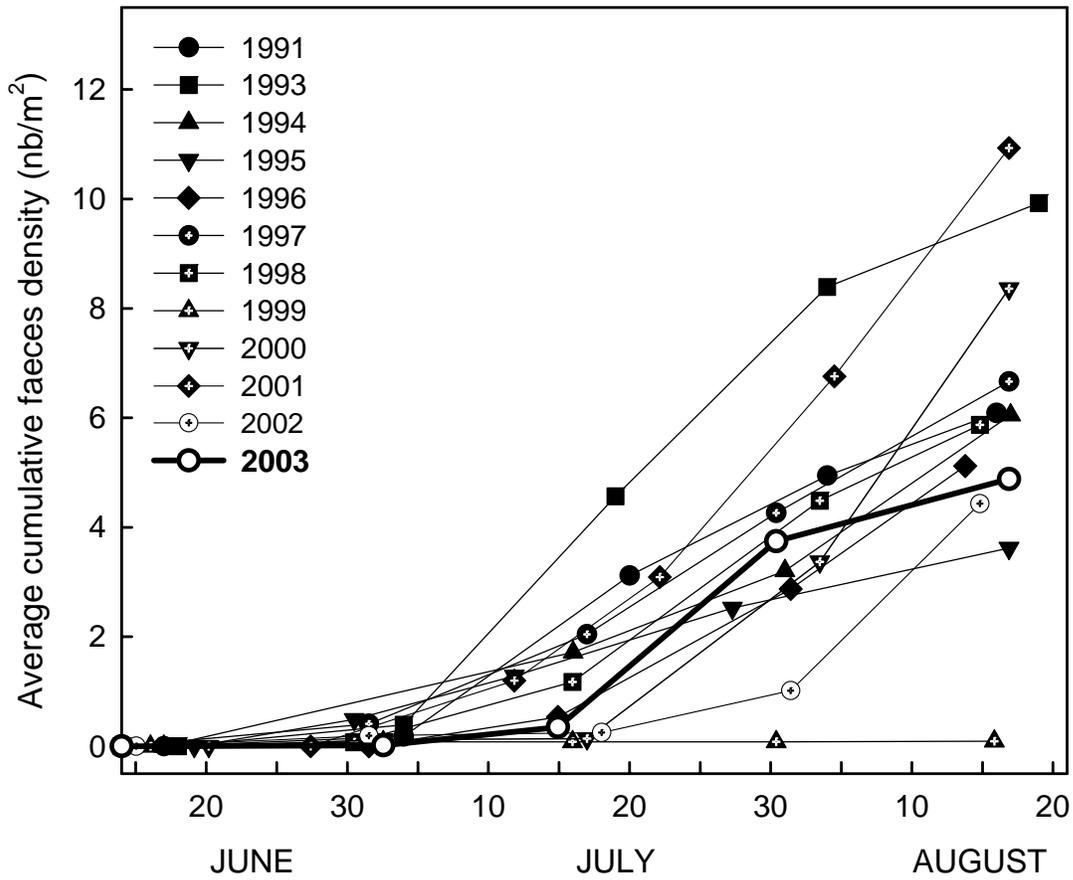
<sup>1</sup> Mayfield estimate<sup>2</sup> Period 1989-2003



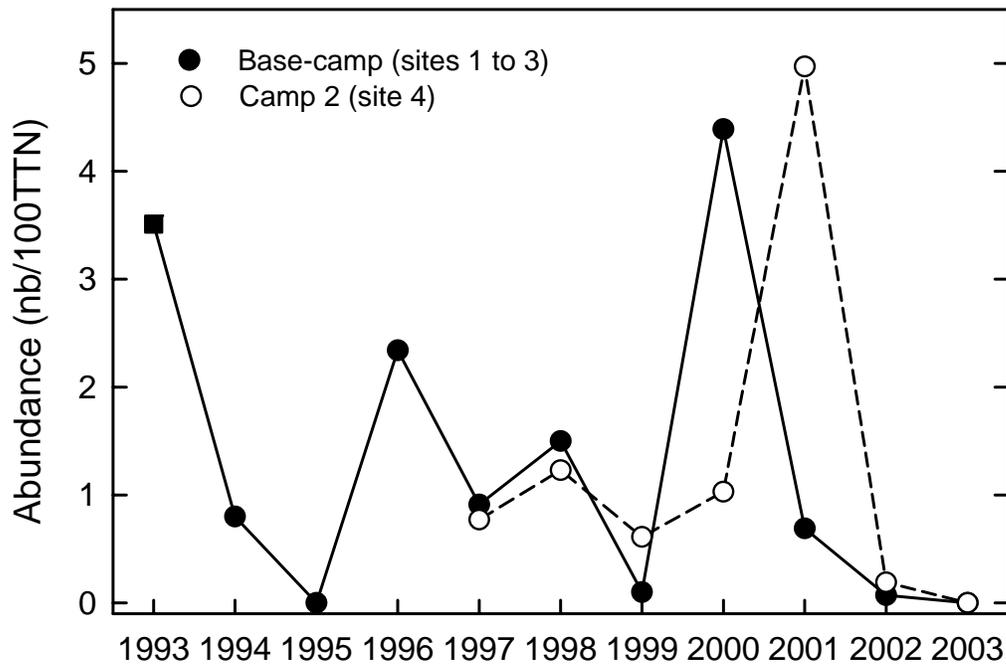
**Figure 1.** Average depth of snow along 2 transects showing the rate of snowmelt in Bylot Island lowlands ( $n = 50$  stations).



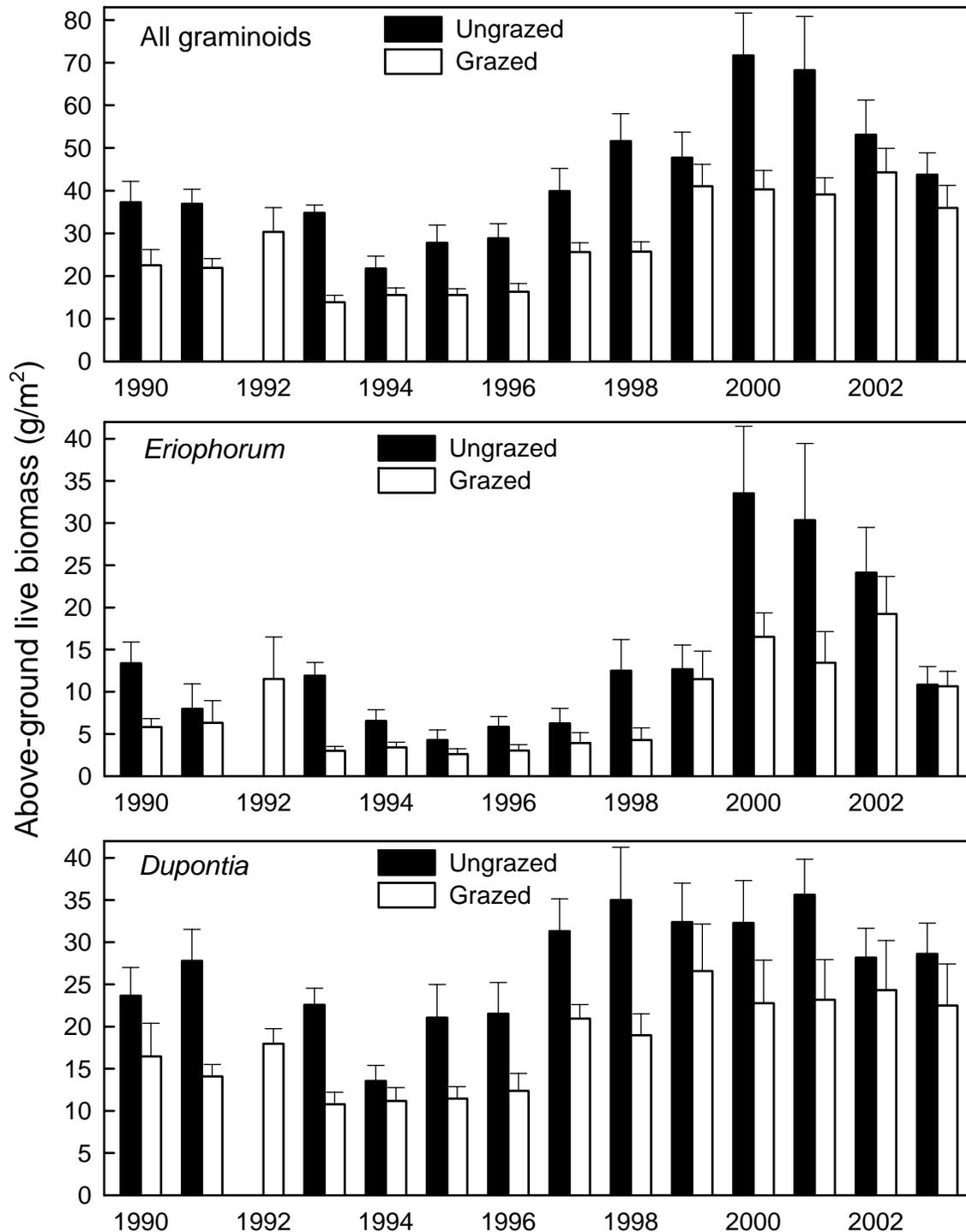
**Figure 2.** Total number of goose pairs counted in the Base-camp Valley from arrival of our crew on Bylot Island until the end of snowmelt.



**Figure 3.** Average cumulative faeces density showing the use of Base-camp Valley by Greater Snow Goose families on Bylot Island throughout the summer ( $n = 12$  transects of  $1 \times 10$  m).



**Figure 4.** Annual abundance of lemmings at two study areas (Base-camp Valley and Camp-2) located 30 km apart on Bylot Island.



**Figure 5.** Live above-ground biomass (mean  $\pm$  SE, dry mass) of graminoids around 15 August in grazed and ungrazed wet meadows of the Base-camp Valley, Bylot Island ( $n = 12$ ). Total graminoids include *Eriophorum scheuchzeri*, *Dupontia fisheri* and *Carex aquatilis*. There is no data from ungrazed area in 1992.