POPULATION STUDY OF GREATER SNOW GEESE ON BYLOT ISLAND (NWT) IN 1998:

A PROGRESS REPORT

by

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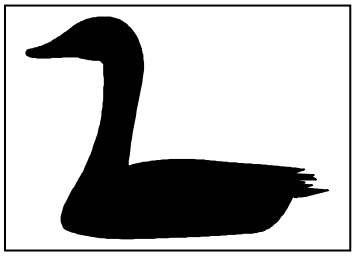

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INTRODUCTION

In 1998, 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 most goose populations worldwide, the greater snow goose has increased considerably over the past 20 years. During this period, the average annual growth rate was almost 10% despite occasional breeding failures such as in 1992. In the near future, breeding habitats in the Arctic could potentially become a limiting factor for goose populations as extensive use of agriculture lands in winter and during migratory stopovers now provides an almost unlimited source of food during these periods. Our long-term objective is to evaluate the effect of the continuous population increase on the arctic habitat and its consequences on the population dynamics of this species.

OBJECTIVES

Specific goals for 1998 were as follows:

1) Monitor productivity (egg laying date, clutch size and nesting success) and nesting distribution of greater snow geese on Bylot Island.
2) Monitor movements of geese during their reproductive cycle on Bylot Island, and determine reproductive performance of radio-marked geese.
3) Examine the relationship between nest site selection, predator abundance, lemming cycles and nesting success.
4) Assess the growth and pre-fledging survival of goslings using goslings marked in the nest.
5) Collect goose eggs to continue experiments on metabolism and thermoregulation of growing goslings in the laboratory.
6) Band a large number of 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.
7) Fit a number of adult females with conventional radio-transmitters to study their movements during the spring and fall migration, and next summer on Bylot Island.
8) Conduct an aerial survey of snow geese on Bylot Island during brood-rearing.
9) Sample plants in exclosures to assess annual and long-term impact of goose grazing on plant abundance.
10) Sample and classify wetland habitats on the basis of their plant communities and geomorphologic, hydrological and soil characteristics.
11) Band and monitor nesting success of small birds (Lapland Longspurs) and Snowy Owls.

FIELD ACTIVITIES

***Field camp.* —** The main study area was located on southwest Bylot Island and was the same as in previous years. It is a large glacial valley which opens to the sea and is surrounded by mountains to the north, and hills to the south. This area covers ~50 km^2 and will be referred to as the *Base-camp Valley* in this report. We established the camp at the same site (73° 08' N, 80° 00' W) on 22 May and closed it on 23 August. We had a secondary study area where we established a temporary camp, 30 km south of the Base-camp and 5 km from the coast (72° 53' N, 79° 54' W). This camp, referred to the *Camp-2 area*, was located along a river in a narrow valley and was occupied from 1 June to 15 July.

Field party.* —** The total number of people in both camps ranged from 5 to 14 depending on the period. Members of our field party included project leaders Gilles Gauthier, Austin Reed, Jean-François Giroux and Esther Lévesque. There were also graduate and undergraduate students whose thesis projects addressed several of the objectives laid out above. Students were: Joël Bêty (PhD, objectives 2 and 3), Eric Reed (PhD, objective 6), Hélène Massé (MSc, objectives 9 and 10), Stéphanie Rioux (MSc, objective 5), Arnaud Béchet (PhD, objective 7), Frédéric Demers (MSc, objective 7), Diane Leclerc (BSc), Dominique Fiset (BSc, objective 9) and Stéphane Menu (PhD, objective 6). Other members of our field party included Gérald Picard (wildlife technician) and Sam Ootovak, Amos Ootovak and Philip Awa from Pond Inlet. George Koonoo, the Pond Inlet wildlife officer, and Ely Panipakochoo, a member of the HTO board, also visited the camp during the banding operation. At the end of the season, a film crew of 10 people directed by Jean Lemire (Max Films) visited our camp (from 18 to 23 August). They filmed the geese for the novie ***Lumière des Oiseaux scheduled for release in 1999.

***Weather station.* —** Weather data continued to be recorded at our two automated weather stations. Air and ground temperature, air humidity, solar radiation, wind speed and direction were recorded on an hourly basis without interruption throughout the year. Daily precipitation was also recorded manually during the summer. Snowmelt was monitored by measuring snow depth at 50 stations along two 250-m transects at 2-day intervals.

***Monitoring of goose nesting.* —** During the pre-laying and laying periods, transects were conducted on skis to assess the relative abundance of nest predators on each study area. Intensive nest searches were carried out within walking distance (~6 km) of both the Base-camp Valley and the Camp-2 area between 3 and 15 June. We also conducted behavioral observations to record the activity of predators (presence, attacks, and predation event) around goose nests during incubation. During the hatching period, we visited a sample of nests every day or other day to record hatching dates and to weigh, measure and web-tag goslings at the two study areas.

***Tracking of geese fitted with radio-transmitters.* —** We regularly scanned from one receiving station located at each study area to detect the presence of geese with radio transmitters. Scans were done every 1 to 2 days during the pre-laying and laying periods and every 1 to 5 days during incubation. We also used a snowmobile to track geese around the Base-camp (from 23-31 May) and the Camp 2 (from 1-15 June). Before and during nesting, we did aerial tracking with the helicopter over most of the south plain of Bylot Island (on 1, 9, 13, 28 June and 13 July) to locate marked geese. Nests of geese with radio-transmitters were found on foot using a portable antenna.

During brood-rearing, we scanned every 1 to 3 days from one receiving station at the Base-camp Valley. Aerial tracking was also conducted during the aerial survey of snow geese on Bylot Island (22 and 23 July) and during trips from the Base-camp to Pond Inlet (16 July, 8 and 18 August).

Aerial Survey. — The aerial survey of the goose population was conducted from 21 to 23 July. The south plain was divided into 403 plots, each 2x2km, and each allocated to one of three strata representing the quality of brood rearing habitat (i.e. anticipated brood density). A total of 71 plots (ca 18% of total) were selected (stratified random sampling) to be surveyed. Each of the 71 plots was surveyed by an exhaustive search by helicopter and by photographing all flocks encountered (some very small flocks were counted visually). Geese are later counted (adults and goslings separately) from the photographs, and the resulting data allow estimation of the total population into its three main components: adult breeders, adult non and failed breeders, and goslings.

Monitoring of plant growth and goose grazing. — The annual impact of grazing by geese was evaluated in wet meadows dominated by graminoid plants at 3 different sites on the island. These sites are the Base-camp Valley (brood-rearing area), Camp-2 area (nesting area) and Dufour Point (brood-rearing area). At each site, 12 exclosures (1 x 1 m) were installed in mid to 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 14-15 August. Use of brood-rearing areas by families was monitored by counting faeces on 1 x 10 m transects located near each exclosure. Faeces counts were made every 2-week in the Base-camp Valley and only once when plants were sampled in August at the other 2 sites. Plant biomass was also sampled in the 18 long-term exclosures (4 x 4 m) at the peak of plant growth (1-3 August).

Goose banding. — From 9 to 15 August, we banded geese with the assistance of Inuit people from Pond Inlet. Banding drives were conducted using the Inuit method with people on the ground that surround the geese and direct them into the nets. The helicopter was only used to move people and material to the banding site. All geese captured were sexed and leg banded. A sample of young and adults were measured (mass and length of culmen, head, tarsus and 9th primary). A sample of young was fitted with coded yellow plastic leg band and most adult females were fitted with coded yellow plastic neck-collars.

In a parallel banding operation, conventional radio-transmitters were also placed on adult geese. These radios were glued on green neck-collars, resulting in a package with a total weight of 60g. The mates of these females also received yellow neck-collars (without radios). This operation, which was conducted with the help of an Inuk, involved the capture of only a few families (<6) in each capture.

Small mammal, predator and bird monitoring. — We participated for the fifth time in the small-mammal survey coordinated across the NWT by the Renewable Resources office in Yellowknife. The trapping method and detailed results are given in an appendix to this report. The breeding activity of foxes was monitored by regularly visiting dens. We also monitored the nesting activity of Lapland Longspurs (*Calcarius lapponicus*) and Snowy Owls (*Nyctea scandiaca*), and banded some longspurs.

PRELIMINARY RESULTS

***Weather conditions.* —**The spring of 1998 was characterized by a moderate snow-pack (on 1 June, snow depth was 25 cm compared to values ranging from 9 to 51 cm in previous years; Fig. 1) and very mild and sunny weather. Snowmelt was thus early and comparable to 1997. Temperature in July and August were near average. Precipitation was moderate in June (34 mm of rain, all in the second half of June, and no snow) and July (34 mm) but lower in August (25 mm). The growing conditions for plants were thus excellent in 1998 (see below).

***Goose nesting activity.* —** The first geese were observed on 22 May, slightly earlier than usual. This may be related to a very early departure of geese from their spring staging areas in southern Québec due to unusually warm spring weather. Daily counts of geese on the hills surrounding the Base-camp Valley showed that numbers steadily increased between 27 May and 5 June with a large influx of birds in the last days of May.

Median egg laying date was 7 June, the second earliest initiation date on record (Table 1). As usual, the abundance of goose nests was low in the Base-camp Valley with only 18 nests found despite extensive nest searches. These nests were located mostly in lowland polygon tundra near the sea. In contrast, reproductive effort at the Camp-2 area was massive, with several thousand nests within a few km of camp. Nests were almost uniformly distributed in all habitat types available there (hillside, dry and moist tundra). Clutch size was 3.80, slightly higher than the long-term average (Table 1).

***Monitoring of geese fitted with radio-transmitters.* —** For a second year, monitoring of geese with radio transmitters before and during laying was highly successful. Of 70 birds radio-tracked along the St. Lawrence River in spring, the signal of 54 of them was detected on Bylot Island during the summer. Arrival dates of these birds on Bylot Island was slightly earlier than in 1997 (median: 7 June, range: 28 May to 13 June, vs 10 June in 1997). The signal of 42 birds was detected only around Camp-2, 1 was detected only at Base-camp and 12 at both sites. The period during which these birds were tracked before laying was short (mean: 3 days, range: 0-12 days, n = 27). We found 27 nests of birds fitted with radio-transmitters. All those nests were located near the Camp-2. In addition, one marked female, observed during the nesting period, was classified as breeder even though we were unable to locate precisely her nest. Among the 27 nesting birds, only 5 were detected at the Base-camp before eventually nesting at the Camp-2 area.

Eight marked females were found nesting in both 1997 and 1998. Five of those females nested at less than 525m from their previous year nesting site (mean: 300m, range: 179 to 525m), while the three other birds moved more than 2 km between the 2 years (mean: 4.8 km, range: 2.9 to 7.1 km). This observation confirmed that nesting strategy used by individuals is variable in Greater Snow Geese with some birds showing relatively good site fidelity while others having low fidelity.

Of the 28 radio-marked birds that nested, 15 produced young at hatch. All these females left the Camp-2 area with their young one to three days after hatch, eight of them moving rapidly to the Base-camp Valley (a 30-km distance in straight line). The movement from the nest to the brood-rearing site occurred in 6 days on average for these females (range: 4 to 8 days). One female arrived at the Base-camp Valley 28 days after hatch, another one was found dead at a fox den half way between the Camp-2 and the Base-camp Valley, and the five others raised their young elsewhere on

the south plain of the island. Since all radio-marked females were captured at or near the Base-camp Valley at the end of brood-rearing in 1996 or 1997, this suggests that a high proportion of females exhibit site fidelity to their brood-rearing site.

All but one radio-marked birds for which no nests were found, or which lost their nest before hatch, disappeared from the south plain of Bylot Island before 1 July (n = 39). Only one female, which lost her nest shortly before hatch, was detected until 16 July. The absence of signals from these birds in July despite extensive searches suggests that all non or failed breeders left the island for molting, a result also found in 1997.

Nesting success, hatching and brood density. — Overall, nesting success was good this year (79%) compared to the long-term average (65%; Table 1). Success, however, was only 15% in the Base-camp Valley (where few nests were found and nesting density was very low), compared to Camp-2 area (82% success) where density was very high. This good success contrasts with observations conducted at the Camp-2 which suggest that Arctic foxes (*Alopex lagopus*) were more numerous than in 1996 or 1997 during incubation. However, we also observed an increase in the number of attacks by foxes on lemmings, which showed a slight increase in abundance compared to 1997. This, in combination with the dilution effect caused by the massive breeding effort of geese in 1998, may partly explain their good nesting success. The high density of nesting geese and an intensive effort enabled us to observe a high number of neck-collared geese at the nest. During incubation, a total of 494 different neck-collars were read.

Peak hatch was on 4 July, the second earliest on record (Table 1). At hatch, we tagged 1985 goslings, all at the Camp-2 area. As usual, many broods hatched outside the Base-camp Valley moved there for the rearing period, and use of the valley by broods was high despite the low number of geese nesting there. Cumulative faeces density at the end of the summer in the Base-camp Valley (58.7 faeces/m^2) was relatively high and comparable to values recorded in the previous 2 years (Fig. 2). Cumulative faeces density at the Dufour Point and Camp-2 sites were respectively 66.6 and 32.0 faeces/m^2. This suggests that Dufour Point and the Base-camp Valley were more heavily used by broods than the Camp-2 area.

Aerial survey. — A preliminary count has been conducted for each photograph but an estimate of the population should be available only early in 1999. However, several flocks of geese were observed in all plots surveyed, including those in the low density stratum, which suggests that the number of geese present on the island was very high.

Plant growth and grazing impact. — Above-ground biomass of graminoid plants sampled in ungrazed areas in mid-August was the highest ever recorded in the Base-camp Valley (44.2 g/m^2, SE = 5.2, Fig. 3). This shows that plant production in wet meadows was excellent in 1998. It is noteworthy that annual plant production in ungrazed areas steadily increased since the very low values of 1994, which coincided with a drought that year and a very high grazing pressure in the previous year (1993). Production of *Eriophorum scheuchzeri*, the preferred plant of geese on Bylot Island, was especially high in 1998 compared to previous years (Fig. 3). Plant biomass in ungrazed wet meadows was low at the Camp-2 (nesting area; 28.1 g/m^2, SE = 4.0) but high at the Dufour Point site (brood-rearing area; 47.1 g/m^2, SE = 4.2)

By mid-August, goose grazing had removed 50% of the above-ground biomass (difference between paired grazed and ungrazed plots, Fig. 3) in the wet meadows of the Base-camp Valley, which is the most severe impact since the record year of 1993. The impact was much higher on *Eriophorum* (66% of biomass removed compared to 75% in 1993) than on *Dupontia* (45% of biomass removed). Goose grazing removed 36% of the above-ground biomass at Camp-2 area but only 16% at Dufour Point. This low value at the Dufour Point site is surprising and does not agree with the high faeces density recorded at this site. The apparantly low grazing impact at Dufour Point could be related to the high proportion of *Carex*, a low quality forage plant for geese, which accounted for 50% of the graminoid biomass at this site compared to 18% at Camp-2 and only 8% at the Base-camp Valley site.

Goose banding. — The banding operation was again very successful with 11 drives conducted in the lowlands and hills bordering the Base-camp Valley to the south (all within 8 km of our base camp). We banded 3998 geese, including 687 females marked with neck-collars and 1441 young with plastic tarsal bands. In addition, there were 54 recaptures of web-tagged young and 326 recaptures of adults banded in previous years. The gosling:adult ratio among geese captured at banding this year corresponded to the long-term average (1.09:1, Table 1). The average brood size was 2.70 young (SD = 1.16, n = 56; counts conducted between 1-10 August), a value above the long-term average (2.61; Table 1). By combining information on brood size and young:adult ratio at banding, we estimated that 81% of the adults were still accompanied by young at banding (Table 1). This suggests that brood loss was moderate this year.

During a parallel banding operation, 355 additional birds were banded and 79 new small conventional radio transmitters were fitted on adult females. Among those, 10 transmitters were replaced on females marked with similar transmitters in 1996 or 1997. All females recaptured with transmitters were healthy, had maintained body mass (2444 $\pm$ 61g [SE] at original marking vs 2460 $\pm$ 72g one or two years later), and showed no signs of injury on the neck..

Small mammal and predator monitoring. — For our small-mammal survey, we accumulated about 1000 trap-nights in the Base-camp Valley equally split between 2 trapping sites (one lowland and one upland) and over 500 trap-nights in upland habitat at Camp-2. In the Base-camp sites, we captured 11 brown lemmings (*Lemmus sibiricus*) and 4 collared lemmings (*Dicrostonyx groenlandicus*) for an index of abundance of 1.55 lemming/100TTN. One brown lemming and 5 collared lemmings were captured in the Camp-2 site, for an index of abundance of 1.24 lemming/100TTN (see report: **Small mammal trapping results - Bylot Island 1998**). This suggests that lemming abundance was moderate in 1998 and slightly higher than in 1997. So, contrary to the previous cycle (1993-95), we have not observe yet a year of very low lemming abundance since the peak of 1996.

We found signs of fox activity (digging or fresh prey remains) at 18 of 32 known denning sites, and we confirmed the presence of pups at 9 dens, 4 at the Base-camp Valley and 5 at the Camp-2 area. Eight dens were occupied by Arctic Foxes and one by Red Foxes (*Vulpes vulpes*). Litter size was a minimum of 1 to 5 pups. No Snowy Owl was found nesting this year and one Rough-legged Hawk (*Buteo lagopus*) nest was found at the Base-camp Valley.

CONCLUSION

Overall, 1998 was a good breeding year for geese on Bylot Island. The early snowmelt lead to a very high nesting effort and, in combination with good nesting success, resulted in high brood density. Although predators were again abundant, the increase in lemming abundance and the high number of nesting geese on the island may have contributed to the low predation rate. The moderate young:adult ratio at banding was surprising since gosling survival appeared relatively good. Based on this young:adult ratio, we predicted an average production this fall (about 25% juveniles in the fall flock). However, preliminary observations conducted along the St. Lawrence estuary suggest a higher production (33% juvenile). For the third year in a row, the young:adult ratio at banding on Bylot Island underestimated the fall production estimated in the St. Lawrence estuary.

Again this year, our greatest success was our ability to track movements and reproductive performance of a large number of radio-marked birds, both in the spring along the St. Lawrence River and throughout the summer on Bylot Island. This enabled us to study individual variation in reproductive behavior with unprecedented details. Results of this year confirmed the rapid disappearance from the island of most birds that did not breed or lost their nest before hatch. This shows that these birds moved to a yet unknown area to molt, which supports our previous observation that groups of adult molting birds without young are rare on Bylot Island. We suspect that these birds may move to the area of Ericksen and Quartz lakes on Baffin Island just north of Foxe Basin, an area where flocks of non-breeding snow geese have been recorded during surveys in 1993.

This year, plant production in wet meadows of the Base-camp Valley was the highest ever recorded since the beginning of the monitoring in 1990. Feeding conditions for geese were thus very good during brood-rearing in 1998. The high brood density resulted in a high grazing impact, as shown by the amount of biomass removed by geese which was the second highest value after the record year of 1993. Grazing impact was most intense in the Base-camp Valley, intermediate at the Camp-2 area (mostly a nesting area) and lowest at Dufour Point. This confirms that the Base-camp Valley is one of the most heavily used brood-rearing areas on Bylot Island. Although the annual impact of goose grazing can be severe, the record plant production of 1998 shows that there is no evidence yet of habitat degradation due to grazing on Bylot Island.

PLANS FOR 1999

The long-term objective of our work is to evaluate the effect of the continuous population increase on 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 population dynamics (population size, survival and reproduction), harvest and habitat that will occur in coming years following the implementation of the recommendation to stop the growth of this population through a doubling of sport harvest (B. Batt ed., 1998, status report of the Greater Snow Goose). Other focuses of the project include *i*) improving estimates of annual variation in survival and especially breeding propensity, a poorly known parameter; *ii*) a better understanding of movements of geese on the island, especially between nesting and brood-rearing areas; *iii*) expanding our estimate of the carrying capacity of the island for geese to the upland habitats; and *iv*) determining long-term effects of geese on the landscape of Bylot Island. In 1999, 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) Monitor movements from arrival until fledging, and determine reproductive performance of radio-marked geese (fitted with conventional radio transmitters in 1997 and 1998).
3) Examine the relationships between nest site selection, predator abundance, lemming cycles and nesting success.
4) Mark goslings in the nest to provide a sample of known-age individuals to be used to assess the growth and pre-fledging survival of goslings by their recapture in late summer.
5) Collect goose eggs to continue experiments on metabolism and thermoregulation of growing goslings in the laboratory.
6) Band a large number of goslings and adults, and neck-collar adult females at the end of the summer, to continue the long-term monitoring of several demographic parameters (e.g. survival, breeding propensity) and factors affecting them.
7) Fit some adult females with conventional radio-transmitters.
8) Sample plants in exclosures to assess annual impact of goose grazing on plant abundance.
9) Expand our study of goose/plant interaction to the upland habitat to eventually estimate the carrying capacity of this habitat for geese.
10) Examine the effect of goose grazing on the thermal regime of the soil and the evolution of polygon landforms.

In 1999, 5 graduate students will be involved in the Bylot Island snow goose project. **Joël Bêty** (PhD) will continue to study movements and reproductive performance of radio-marked geese. **Eric Reed** (PhD) will study the cost of reproduction and annual variations in breeding propensity and recruitment of geese based on the resighting/recapture of neck-collared birds. **Arnaud Béchet** (PhD) and **Jonathan Olson** (MSc) will mark geese with conventional radio-transmitters for studies on dispersal of geese during the migration in southern Québec. **Daniel Fortier** (MSc) will examine the effect of goose grazing on the thermal regime (permafrost dynamic) of the polygons of Bylot Island.

Table 1. Productivity data on Greater Snow Geese nesting on Bylot Island

	1989	1990	1991	1992	1993	1994	1995	1996	1997	**1998**
Number of nests monitored	86	168	239	199	367	846	312	367	326	**349**
Median date of egg-laying	11 June	13 June	11 June	20 June	6 June	11 June	10 June	14 June	10 June	**7 June**
Clutch size	3.82	3.52	3.59	3.21	4.41	3.55	3.64	3.71	3.95	**3.80**
Nesting success[1]	70%	79%	72%	70%	89%	40%	14%	65%	83%	**79%**
Median date of hatching	7 July	8 July	8 July	15 July	3 July	7 July	7 July	11 July	7 July	**4 July**
Number of geese banded	--	729	1859	2004	3134	3531	3985	3824	3956	**3998**
Ratio young:adult at banding	--	1.15:1	1.46:1	0.81:1	1.55:1	0.79:1	1.10:1	0.83:1	1.06:1	**1.09:1**
Brood size at banding	--	2.74	2.83	2.20	3.12	2.66	2.50	2.34	2.47	**2.70**
Proportion of adults with young at banding	--	84%	100%	74%	99%	60%	88%	71%	86%	**81%**

[1] Mayfield estimate

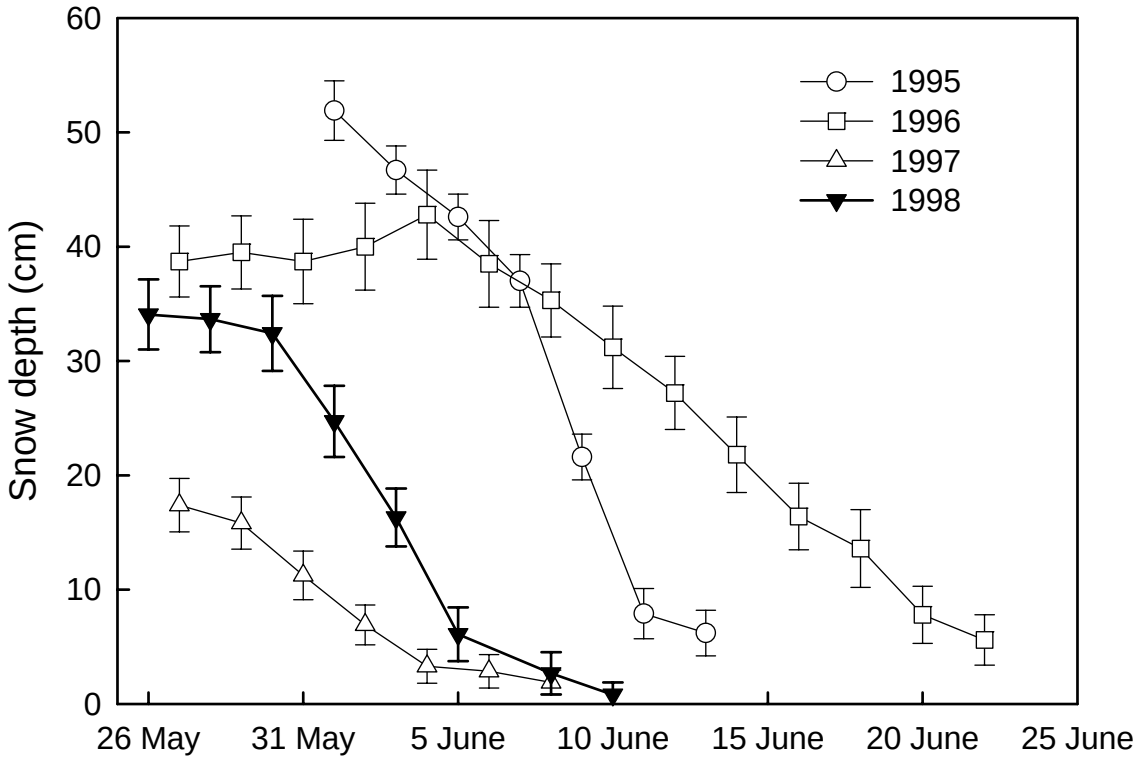

Figure 1. Depth of snow (mean ± SE) along 2 transects showing the rate of snow-melt in Bylot Island lowlands (n = 50 stations).

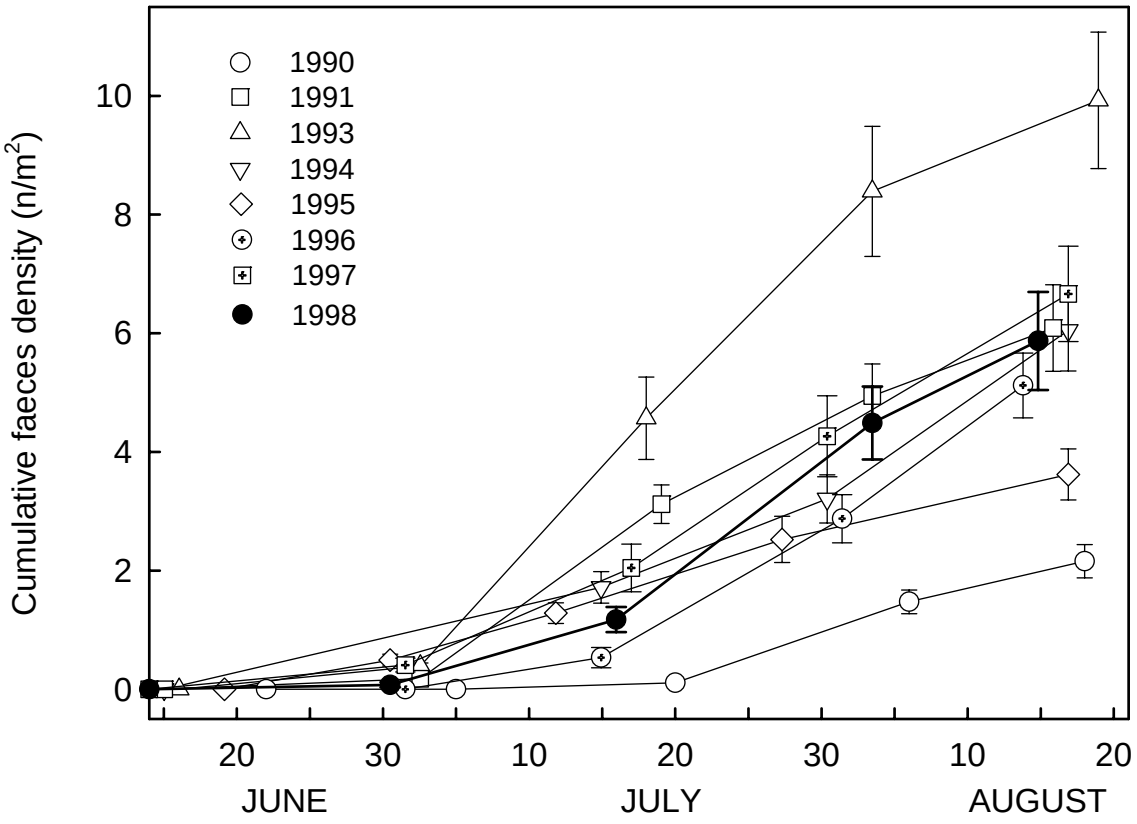

Figure 2. Cumulative faeces density (mean ± SE) showing the use of Base-camp Valley by Greater Snow Goose famillies on Bylot Island throughout the summer, 1990-1998 (*n* = 12 transects of 1x10m).

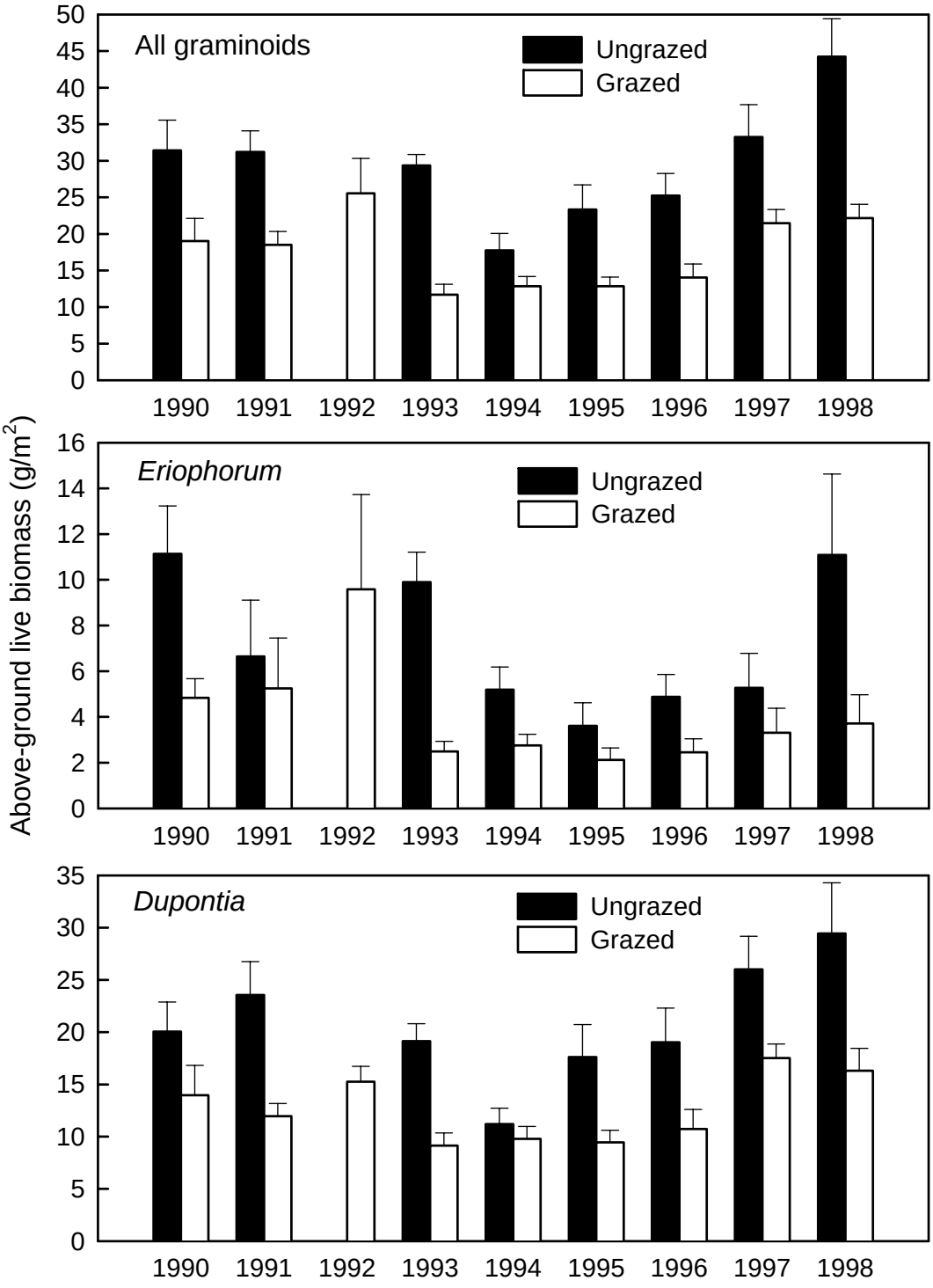

Figure 3. Live above-ground biomass (mean ± SE, dry mass) of graminoids on 15 August in grazed and ungrazed wet meadows of the Base-camp Valley, Bylot Island, 1990-1998 (n = 12). No data from ungrazed area in 1992 because grazing was negligible following the almost complete breeding failure of geese.