Time budget of Greater Snow Geese during the brood-rearing period

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Introduction

In recent years, time budgets have been established for several bird species and have often been used to calculate energy budgets (see Gauthier *et al.* 1984; Weathers *et al.* 1984). From a selective point of view, proper allocation of time and energy to various requirements of life is essential, because these two resources are potentially limiting (Ettinger & King 1980). This is especially true for arctic nesting species which have to complete their reproductive activities within a restricted amount of time (Newton 1977).

The Greater Snow Goose *Anser (Chen) caerulescens atlanticus* is one of the most northern-breeding goose species with the majority of its population nesting in the Canadian High Arctic and a small proportion in Greenland (Palmer 1976). During a preliminary study on the ecology of this species on northern Baffin Island, we recorded the activity of geese during the brood-rearing period. The objectives of this paper are to describe time budgets of birds of different age and breeding status, and to look at the effect of a 24-hour daylight period on the activity.

Study area and methods

The study was conducted from 27 July to 17 August 1981 at Jungersen Bay (71°40'N, 84°30'W) in the southeast portion of Admiralty Inlet, on northern Baffin Island. The area is characterized by a 150 km² valley with several rivers that drain into the inlet. A detailed description of the habitat is presented in Giroux *et al.* (1984). Observations were conducted using a 20-60x spotting scope from concealed sites on cliffs bordering the valley. Distances from the birds varied between 500 and 1500 m.

Activity budgets were determined by the instantaneous sampling procedure (Altmann 1974) using an interval of 15 s measured with a metronome. If an observation could not be continued for 15 minutes it was discarded. This time period as well as the 15-s interval were arbitrarily established during preliminary observations. Activities were categorized as feeding (including drinking), resting, alert, walking, swimming, flying, comfort movements (including bathing and preening) and social interactions.

Three categories of geese were recognized based on age and breeding status: adults with young, goslings, and adult-plumaged birds unaccompanied by young. The latter group presumably included subadults (1- and 2-year-old birds), adults that did not attempt nesting and failed breeders. For adult geese with young, we recorded the activity of both parents among a randomly selected family. Our results represent an "average parent" because we were unable to determine accurately the sex of adults from a distance. To establish the time budget of young, we also selected a family and then two young among the goslings. For families with only one young, an additional gosling in a nearby family was observed. Adult-plumaged geese without young, however, could only be observed one at a time. For each observation, random selection of birds was attempted, but we are aware that there is unavoidable arbitrariness when selecting the bird(s) found at a pre-established location in the field of view. Furthermore, some repeated observations on the same geese resulted in non-independence of our samples. For these reasons, we used two non-parametric analyses to compare the data: the Mann-Whitney U and the Kruskall-Wallis tests.

The day was divided into four 6-hour periods starting at 00.00 hrs. For both young and parents, we tallied 64 15-min observations evenly distributed throughout the day. For non-breeders, however, we succeeded in conducting 24 observations with unequal numbers among the four daily periods. We therefore weighted the results of each period by multiplying the percent occurrence of each activity by 0.25 before summing.

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Results

From 1 to 14 August, the number of adult geese in our study area ranged from 300 to 1700 with a mean of 890 ± 130 (± SE, N = 13). Number of young per family averaged 2.8 ± 0.1 (N = 163), and they were 15–20 days old at the start of the study. Groups of adult-plumaged geese without young had a mean of 21.5 ± 5.4 individuals (N = 31).

Non-breeders were regularly seen flying in our study area until 13 August, after which they left the valley (Giroux *et al.* 1984). This means that our observations were conducted after non-breeding geese had completed their moult. Flying accounted for only 1% of their daily activity (Table 1) but this is probably underestimated as a consequence of our sampling procedure. Adults without young spent as much time (P = 0.818) feeding as parents (25–28%). One major difference, however, was that non-breeders spent considerably more time (P = 0.002) in comfort movements than did adults with young (Table 1). They were often seen preening their new feathers for long periods.

One characteristic of the activity budget of adults attending young was the larger amount of time (P = 0.000) spent in the alert position compared with non-breeding geese (Table 1). It should be recalled that our budget is for an "average parent". The true budget for each sex may differ because one of the parents often foraged while the other was in alert position. Resting accounted for the same proportion (P = 0.772) of the daily activity of parents and non-breeders (Table 1) and locomotor activities (walking and swimming) were comparable among the 3 groups (P = 0.497), averaging 12% of the day. Less than 1% of the time was engaged in social interactions and these usually involved parents of different families. Finally, young geese spent most of their time foraging and resting (Table 1).

In general, there was no clear rhythm of activity under the constant light regime (Fig. 1). The only significant difference (P = 0.011) was the greater amount of resting by adults with young between 06.00 and 12.00 hrs. Some trends were also apparent but not statistically significant, perhaps because of the small sample size. For instance, non-breeders spent more time resting between 00.00 and 12.00 hrs and gradually increased their time devoted to feeding between 00.00 and 24.00 hrs. Finally, it was interesting to note that the fluctuation in the proportion of time spent in alert position by parents parallelled the feeding activities of goslings.

Discussion

It has been reported that non-breeding individuals of several species of arctic geese moult at least 2 weeks earlier than breeding geese (Eisenhauer & Kirkpatrick 1977; Owen & Ogilvie 1979; Fox *et al.* 1983). This appears to be true for Greater Snow Geese as well because birds unaccompanied by young were flying while the other adults moulted and attended their young.

One characteristic of post-moulting geese was the considerable amount of time spent in comfort movements. We failed to find reference to such a situation in other studies, but this behaviour can probably be explained by the need to preen the new feathers.

Growing young devoted most of their time to feeding, with some periods of resting, as did goslings of Barnacle Geese *Branta leucopsis* on Spitsbergen (Ebbinge & Ebbinge-Dallmeijer 1977). For adults, however, the situation was different. At Jungersen Bay, Greater Snow Geese with

Table 1. Percentage occurrence of eight activities for Greater Snow Geese during the brood-rearing period at Jungersen Bay, Baffin Island, 1981.

Age or breeding status (N)†	Foraging	Resting	Alert	Walking	Swimming	Flying	Comfort	Social interactions
Non-breeders (24) ‡	28.4	19.1	11.7	1.9	10.2	0.9	27.7	0.1
Parents (64)	24.8	15.8	39.5	1.7	10.3	0.0	7.0	0.9
Young (64)	55.3	24.2	0.8	1.1	11.6	0.0	6.9	0.1

† Number of 15-min observation periods.
‡ Data for non-breeders were weighted for uneven sampling effort throughout the day.

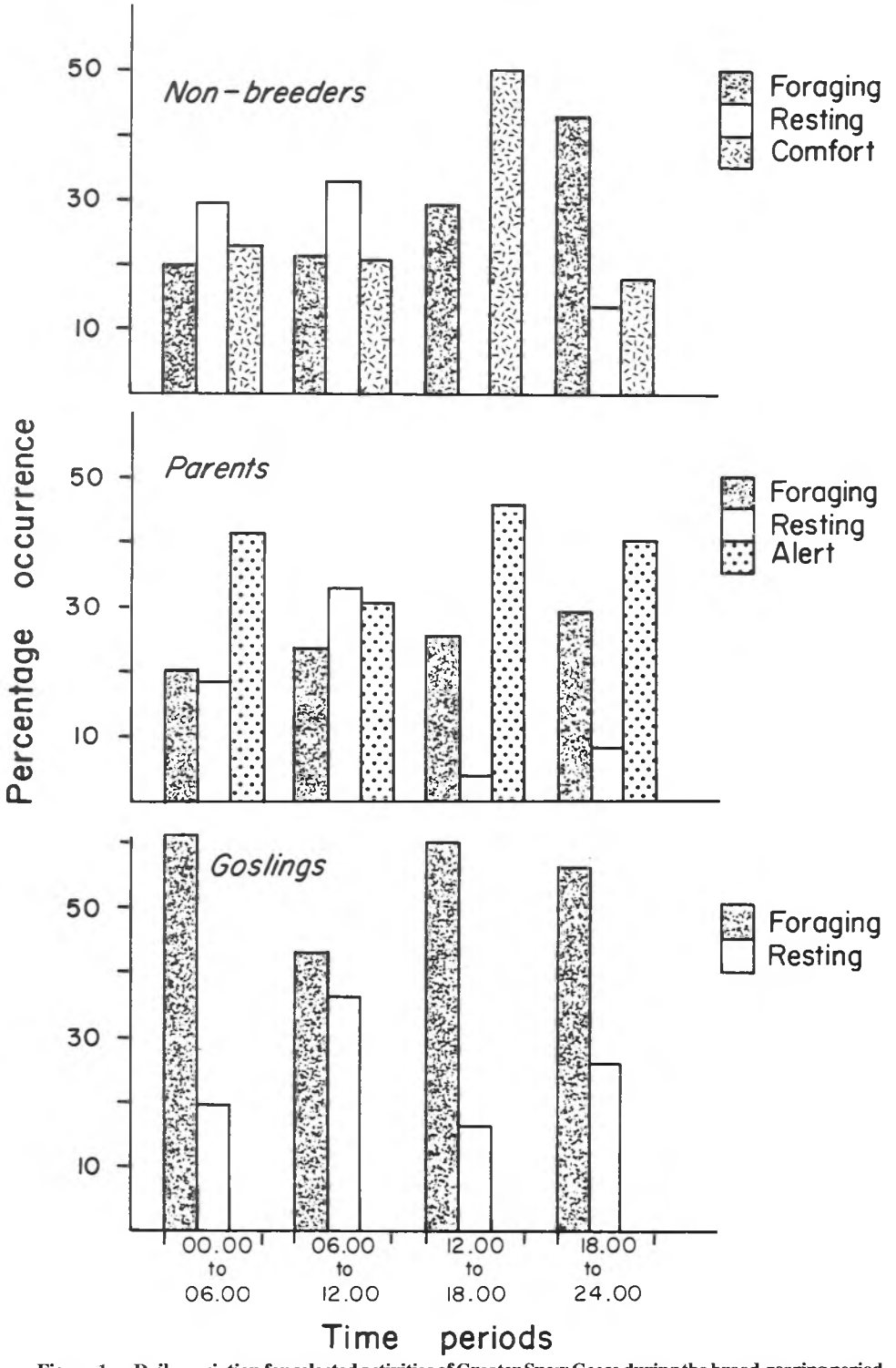

Figure 1. Daily variation for selected activities of Greater Snow Geese during the brood-rearing period at Jungersen Bay, Baffin Island, 1981.

and without young spent respectively only 25% and 28% of the day feeding. This is far less than 37% and 39% by non-breeder and parent Barnacle Geese on Spitsbergen (Ebbinge and Ebbinge-Dallmeijer 1977), or 62.5% by Lesser Snow Geese *Anser c. caerulescens* in the central Canadian Arctic (Harwood 1971). Similar estimates for Black Brant *Branta bernicla nigricans* and Canada Geese *Branta canadensis* on a brood-rearing area in Alaska ranged between 70% and 95% (Dersken *et al.* 1982).

Harwood (1977) found that male Lesser Snow Geese spent nearly twice as much time alert as females at McConnell River. Applying this ratio to our results for an average parent, we calculated that males spent 53% of the time in alert position and only 17% feeding. For females, this amounted to 27% and 33%, respectively. Observations by Ebbinge and Ebbinge-Dallmeijer (1977), Lazarus and Inglis (1978) and Fox *et al.* (1983) confirm the predominant role of the male parent in vigilance and brood predation as well as the predominant involvement of females with feeding at this stage of the breeding cycle. However, the amount of time spent in alert by geese with young at Jungersen Bay is much more than the 20% for parent Barnacle Geese of both sexes on Spitsbergen (Ebbinge & Ebbinge-Dallmeijer 1977).

Our observations were often conducted while the birds were about 1 km away and the geese did not seem disturbed by our presence. Moreover, the time spent in alert position by non-breeders (12%) is much less than for parents (40%) although our methodology was similar for both groups. Arctic fox *Alopex lagopus* were recorded 10 times near families during 49 hours of observation spread over 14 days. The general pattern of the encounters was that at the approach of the predator in the vicinity of several families, geese would congregate into one group and swim towards the centre of the nearest pond. The fox would stand close by and remain motionless for some time. In no instance did we observe a fox actually attempting to capture a bird. Adult geese would remain alert during the entire episode until the fox departed. The presence of one or several foxes at Jungersen Bay may be specific to this brood-rearing area, inflating the importance of alertness in the time budget. However, we consider that presence of a predator is normal. Our budget may not be representative of Greater Snow Geese in general but is representative of the particular situation in which potential predators are present. Under such circumstances, the time spent feeding is reduced and this could delay completion of the moult and even the start of the migration. The importance of sustained feeding has been stressed by Ankney (1979), who established that Lesser Snow Geese meet their nutrient demands of wing moult through their diet rather than through mobilisation of body reserves.

There was no obvious rhythm in daily activity except resting in adults with young and possibly foraging in non-breeders, and this is similar to Barnacle Geese studied by Ebbinge and Ebbinge-Dallmeijer (1977).

Our study was conducted during a single season at one restricted area. One interesting aspect that could be explored further would be to compare the density of potential predators in various brood-rearing areas and to determine if the presence of such predators influences the activity budget of geese to the same extent.

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Summary

The time budget of Greater Snow Geese *Anser (Chen) caerulescens atlanticus* was measured on northern Baffin Island from 27 July to 17 August 1981, during the rearing of young by moulting parents and the post-moult of non-breeding geese. Adults with young spent only 25% of the time feeding and 40% in alert position, probably because of the presence of arctic foxes in the area. Non-breeders spent the same amount of time (28%) foraging as they did preening their new feathers. Daily activity of young consisted mostly of foraging (55%) and resting (24%). No clear activity rhythms could be detected under the 24-hour daylight regime with one exception: adult geese with young rested more during the 06.00–12.00 hrs period.

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