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SNOW BUNTINGS FEEDING ON LEAVES OF SALT-MARSH GRASS DURING SPRING MIGRATION[1]

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Key words: Snow Bunting; spring diet; grass leaves; Hudson Bay.

Snow Buntings (*Plectrophenax nivalis*) are considered to be granivorous birds (Parmelee 1968, Custer and Pitelka 1975) although their diet shifts to insects during the breeding season (Nethersole-Thompson 1966). There are few references to their feeding ecology during spring migration. In this paper I report on Snow Buntings eating newly grown leaves of salt-marsh grass (*Puccinellia phryganodes*) while on spring migration at La Pérouse Bay, Manitoba, Canada (58°04′N, 94°03′W). To my knowledge the observations reported here are the first indicating widespread feeding by Snow Buntings on plant leaves as well as seeds. I also compare the period of availability of this food source with that during which birds were present in 1984 at La Pérouse Bay.

Observations on Snow Buntings "grazing" on grass leaves were collected during a study of the response of *Puccinellia* to grazing by Lesser Snow Geese (*Chen caerulescens caerulescens*) which breed in willow tundra slightly inland at La Pérouse Bay. *P. phryganodes* and a sedge, *Carex subspathacea,* are the dominant plant species on the extensive coastal and estuarine salt-marsh flats, often forming pure stands. A sample of 133 *Puccinellia* shoots in four sites protected from Lesser Snow Geese by chicken wire exclosures (0.8 m × 0.8 m × 1 m high), was examined between 7 and 9 June 1984, 7 to 12 days after melt. Each shoot was examined once during this period. The exclosures were erected in June 1983 and the mesh size of the wire was

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2.5 cm. Before spring thaw (27 to 31 May 1984), the marsh was snow covered up to 1 m in depth. All of the grass shoots had produced at least one new live leaf in the period following thaw ($\bar{x}$ = 1.6 live leaves/shoot). Live leaves were approximately 10 mm long and 2 mm wide. Of the 218 new leaves produced, 33 (14.2%) were missing, having been specifically removed. It was possible to detect that newly produced leaves were missing because the leaf sheath remained attached to the shoot.

The removal of live leaves from shoots inside exclosures was entirely unexpected. No live leaves were removed from ungrazed shoots within the chicken wire exclosures from mid-June to early September 1983, the previous year of the study, although Lesser Snow Geese grazed live leaves of *Puccinellia* outside the exclosures (Bazely 1984).

The source of this removal became apparent when small (< 1 cm) bird droppings, bright green in color, were observed on the sward surface within the exclosures. Between 7 and 10 June 1984, on six occasions Snow Buntings were observed in the exclosures feeding on the salt-marsh grass sward and removing live grass leaves. They were able to enter them because the tops were open. Other Snow Buntings fed outside the exclosures on swards of *Puccinellia.* Birds were also observed defecating and their droppings comprised plant fragments of a bright green color similar to that of the *Puccinellia* leaves and to the droppings initially observed. A small sample of these feces were examined and found to contain only *Puccinellia* leaves.

There are few records of Snow Buntings feeding on plant matter other than seeds, although some has occasionally been found among stomach contents. A few leaves of *Ranunculus* in addition to moss fragments were found in the stomach of a Snow Bunting in Spitsbergen (Løvenskiold 1964). Unidentified shoots and leaves were found in the stomach of a bird collected on Wrangel Island on 2 May 1939 (Portenko 1973), while the stomachs of two birds collected on Baffin Island contained a leaf of *Dryas integrifolia* and several leaves of *Vaccinium uliginosum* (Watson 1957). Nethersole-Thompson (1966) mentions that in Iceland, Snow Buntings eat grass as well as grass seeds in autumn and winter but does not expand on this.

The demand for energy and protein by birds migrating to their breeding grounds is likely to be high (Robbins 1983). Nitrogen accumulation in particular, is a problem for herbivorous birds because this element occurs at extremely low levels in plants compared with animals (Mattson 1980, Cargill and Jefferies 1984). The nitrogen content of *Puccinellia* leaves immediately after melt in 1980 was 3% total nitrogen on a dry weight basis (Cargill and Jefferies 1984), which is well in the range of levels of nitrogen content that have been observed for seeds (Mattson 1980). These leaves may also be rich in other nutrients. In arctic plant species there is often a rapid translocation of below ground resources such as carbohydrates to above ground parts immediately after melt (Miller et al. 1980). Since *Puccinellia* leaves do not have a hard seed case, they would probably be rapidly digested by Snow Buntings.

Both Løvenskiold (1964) and Parmelee (1968) state that Snow Buntings arriving at their breeding grounds in early spring have to live on seeds while there is still snow cover. It is probable that birds present before thaw in 1984 were feeding on the seeds of various grass species that grow further inland, which were visible on the surface of the snow. The rapid growth response of salt-marsh grass following melt provided an abundant additional food supply by late May/early June when there were still substantial numbers of Snow Buntings migrating through the marsh. Although the level of feeding on *Puccinellia* leaves probably increased during the week following 9 June 1984, it is unlikely that all birds fed exclusively on leaves. Seeds of less common marsh plants such as Cinquefoil (*Potentilla egedii*), Chickweed (*Stellaria humifusa*), and Sea Plantain (*Plantago maritima*) were probably available in the sediments. *P. phryganodes* does not produce seed because its flowers are sterile (Polunin 1940) and flowering is rare in *C. subspathacea* (Kotanen and Jefferies, in press), so few seeds of the two dominant plant species would have been available. I do not know whether Snow Buntings were also feeding on new leaves of *C. subspathacea.* At this time there were few insects to be found amongst the *Puccinellia* swards.

TABLE 1. Periods of spring thaw and dates of last spring sightings of Snow Buntings at La Pérouse Bay, Manitoba 1980 to 1984.

Year	Spring thaw	Last sighting
1980	15–19 May	21 June
1981	29 May–1 June	21 June
1982	27–31 May	25 June
1983	7–11 June	19 June
1984	27–31 May	19 June

In order to demonstrate that migrating Snow Buntings are present on the marsh during the post thaw flush of *Puccinellia* leaf growth in most years at La Pérouse Bay, the dates of spring thaw were compared with those of the last spring sightings of the birds (F. Cooke, pers. comm.) between 1980 and 1984 (Table 1). Birds were present for up to five weeks after melt in some years. Although there has been no rigorous census of the numbers of migrating Snow Buntings at La Pérouse Bay, casual observations suggest that they were similar in all years, except in 1983 when thaw was exceptionally late and they fell considerably (F. Cooke, pers. comm.). During early June 1984, two to three flocks of at least 300 Snow Buntings were present each day, feeding on the marsh flats and the willow tundra further inland within a 1.0 km radius of the research camp. Interestingly, while the date of the thaw varied by over three weeks, the day of the last sightings of Snow Buntings varied by not more than six days, suggesting that the short breeding season further north puts an additional constraint on the time that birds have to exploit food at La Pérouse Bay and other subarctic stopovers.

P. phryganodes is the dominant plant along many subarctic coastlines (Jefferies 1977). The production of new leaves that are high in nitrogen shortly after melt, and the relatively high level of "grazing" at La Pérouse Bay by Snow Buntings suggests that this grass may be an important, previously unrecognized food source for these birds during their spring migration through the subarctic and arctic. In addition, these results indicate that Snow Buntings migrating through coastal areas in the subarctic where spring melt has occurred are not only granivores, but also herbivores.

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THE POSSIBLE SIGNIFICANCE OF LARGE EYES IN THE RED-LEGGED KITTIWAKE[1]

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Key words: Arctic gulls; kittiwakes; vision; eye size; adaptation; sclerotic rings.

The Red-legged Kittiwake (*Rissa brevirostris*) differs conspicuously in leg color and bill length from its congener, the Black-legged Kittiwake (*R. tridactyla*). These well known characters serve as the bases for the species' English and scientific names, respectively. In contrast, a third difference, the much larger eye and opening in the sclerotic ring of the former species has not, to my knowledge, been reported in the literature.

This difference can be seen by comparing skulls of the two species (Fig. 1), but is more conspicuous when comparing the sclerotic rings (Fig. 2). The mean diameters of the openings within the sclerotic rings are 11.8 mm and 10.0 mm in the Red-legged and Black-legged kittiwakes, respectively. (For distribution of measurements, see Fig. 3.) This difference is even greater proportionally because the former species is smaller than the latter. (Mean humerus length of 6 Red-legged Kittiwakes is 81.3 mm as opposed to 88.6 for 10 Black-legged Kittiwakes—sexes equally represented.)

Large eyes are considered an adaptation for noctur-

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