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AGE DIFFERENCES IN THE FALL DIET OF GREATER SNOW GEESE IN QUEBEC[1]

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During their fall migration from the Canadian High Arctic to the Atlantic coast of the United States, Greater Snow Geese (*Chen caerulescens atlantica*) stop along the St. Lawrence River estuary where they feed in tidal brackish marshes (Lemieux 1959). No detailed information on the plants consumed by geese at this period is available. In this paper, we describe the diet of geese on their fall staging grounds and present evidence that adult and juvenile birds feed on different plant parts.

STUDY AREA AND METHODS

Samples were obtained from geese shot by hunters at Montmagny and Cap St. Ignace, 75 km NE of Québec City. In fall, geese along this shore of the river are

concentrated in two sections of marsh (sanctuaries) where hunting is prohibited. Hunting is conducted from permanent blinds located at the periphery of the protected areas (Giroux and Bédard 1986). The tidal marsh can be divided into two parts according to mean high water. The low marsh is dominated by *Scirpus americanus* with some *Zizania aquatica* var. *brevis, Sagittaria* spp., and *Eleocharis* spp. while the high marsh is covered by *Spartina pectinata* and *Carex paleacea* (Giroux and Bédard 1987). Most of the feeding occurs in the low marsh, the birds resting in the high marsh.

A total of 403 and 1,311 birds were examined in 1982 and 1983, respectively. Geese were classified as adults (including subadults and yearlings) or juveniles based on plumage coloration and were sexed by cloacal examination. Contents of the esophagus and proventriculus were collected, sorted by species and plant parts, dried at 70°C for 48 hr and weighed to the nearest 0.0001 g. Only geese with >0.05 g dry mass of food material were retained for analysis and data were expressed as the average percent dry mass (Prevett et al. 1979). Fiber content of the most important food items was determined by the neutral detergent fiber method (Goering and Van Soest 1970). The effect of age and

TABLE 1. Fall diet of 76 adult and 562 juvenile Greater Snow Geese along the St. Lawrence estuary in Québec, 1982–1983. Data expressed as mean percent dry mass.

Plants consumed	Plant parts	Adult	Juvenile
Scirpus americanus		74.3	74.6
	Seed head	Tr[a]	Tr
	Aboveground stem	11.9	39.7
	Belowground stem	7.4	8.4
	Rhizome	49.1	22.8
	Root	2.2	1.7
	Bud	3.7	2.0
Zizania aquatica		11.0	11.7
	Seed	4.8	4.5
	Stem	5.6	6.9
	Root	0.6	0.3
Sagittaria spp.		5.1	1.7
	Stem	Tr	0.1
	Bulb and root	5.1	1.6
Eleocharis spp.		0.2	5.6
	Stem	Tr	3.7
	Rhizome	0.2	1.9
Carex paleacea	Leaves	1.2	2.5
Juncus spp.		1.3	1.0
	Stem	0.1	0.9
	Rhizome	1.2	0.1
Spartina pectinata		1.9	0.3
	Stems and leaves	1.1	0.2
	Rhizome	0.8	0.1
Others[b]		3.2	1.5
Unidentified material		1.8	1.1

[a] Less than 0.1%.
[b] Included *Equisetum fluviatile, Trifolium* sp., *Avena sativa, Cyperus* sp., *Potamogeton* sp., *Sparganium* sp., *Bidens cernua, Melilotus* sp., *Vicia cracca, Scirpus validus,* and unidentified grasses.
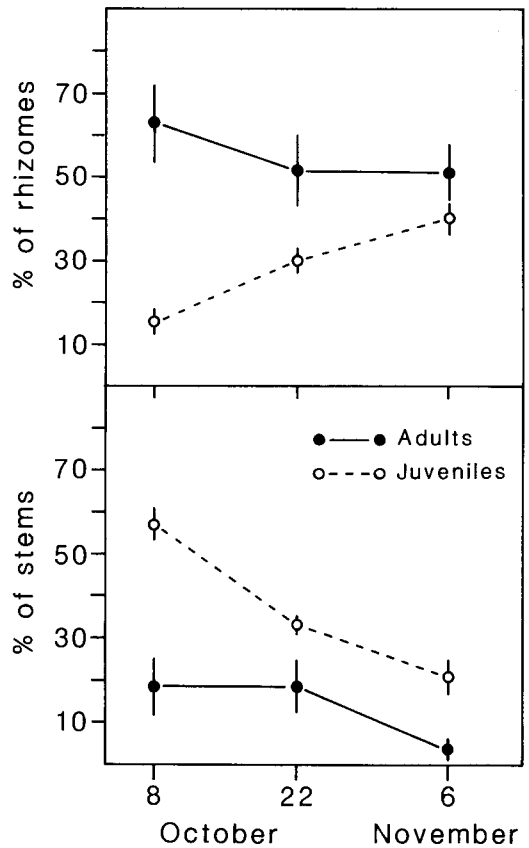

FIGURE 1. Seasonal variation in the average percent dry mass of rhizomes and aboveground stems of *Scirpus americanus* in the fall diet of adult and juvenile Greater Snow Geese along the St. Lawrence estuary in Québec, 1982–1983. Vertical lines represent ± 1 SE of the mean. Sample sizes were 20, 23, and 33 adults for the first, second, and third dates, respectively, while the corresponding figures for juveniles were 194, 290, and 78.

sex of geese as well as year of collection on the proportion of the main food items was tested with three-way analyses of variance while fiber contents were compared with *t*-tests. Angular transformations were applied to percent values.

RESULTS AND DISCUSSION

A total of 638 (37%) geese had >0.05 g dry mass of food material. The sample consisted of 76 adults (28 males, 48 females) and 562 juveniles (262 males, 299 females, and one bird of unknown sex). Age of geese affected the proportion of many food items ($P < 0.05$) while no difference could be detected between males and females ($P > 0.05$). The proportion of some items varied between years ($P < 0.05$; see below) but data were pooled across year of study and sex of geese to simplify presentation of the results.

Scirpus americanus represented >70% of the fall diet

of juvenile and adult geese (Table 1). *Zizania aquatica, Sagittaria* spp., and *Eleocharis* spp. accounted for another 20% while the rest of the diet was composed of several less important species. The relative proportion of the major plants was roughly similar to their availability in the marsh (Giroux and Bédard 1988).

The effect of age on the diet was attributable to juveniles consuming more stems of *S. americanus, Eleocharis,* and *Juncus* and to adults feeding to a greater extent on the rhizomes of *S. americanus* and the bulbs of *Sagittaria* ($P < 0.05$; Table 1). These differences resulted from differential selection of plant parts by each age group and not from selection of different feeding sites. Both adult and juvenile geese fed together in the same parts of the marsh, often as family units. These results contrast with those of Prevett et al. (1979) and Craven and Hunt (1984) who reported no difference in the fall diet of adult and juvenile Lesser Snow

Geese (*A. c. caerulescens*) and Canada Geese (*Branta canadensis*), respectively.

Juveniles consumed more stems of *S. americanus* than adults throughout the staging period ($P < 0.05$) despite a diminution of stems in the diet of both age groups from October to November ($P < 0.05$; Fig. 1). On the other hand, adults fed more on rhizomes of *S. americanus* than juveniles in early and late October ($P < 0.05$) but not in early November ($P > 0.05$).

The proportion of *S. americanus* rhizomes in the diet of adults did not vary significantly throughout the fall ($P > 0.05$), whereas it increased gradually in juveniles ($P < 0.05$; Fig. 1). Upon arrival on the St. Lawrence staging areas, juveniles continued to use the same foraging technique that they had used a few weeks earlier on the arctic breeding grounds where they had grazed on leaves of *Puccinellia* and *Carex* (Giroux et al. 1984). They gradually shifted to grubbing for belowground plant parts as availability of stems diminished following heavy consumption and trampling by geese. Some learning from parents may also account for this switch in feeding behavior. However, the parallel seasonal decrease in the proportion of aboveground stems in the diet of adult and juvenile birds (Fig. 1) underscores the importance of changes in availability in explaining the switch.

In 1983, juveniles consumed more stems of *S. americanus* than in 1982 (42.5 ± 1.8% (SE) vs. 26.3 ± 3.7%; $t = 3.82$; df = 560; $P < 0.001$). A similar trend was observed for adults but the difference was not significant. Breeding success was better during the second year and the proportion of juveniles in the population was 42% compared to only 25% in 1982 (Gauvin and Reed 1987). A greater number of juveniles in 1983 may have attracted a greater proportion of geese to parts of the marsh where aboveground vegetation was still available.

No difference was found in the fiber content of *S. americanus* than in 1982 (42.5 ± 1.8% [SE] vs. 26.3 $n = 5$) and juvenile geese (48.2 ± 1.7%, $n = 11$; $P > 0.05$). Moreover, the proportion of fiber in rhizomes was the same as in one composite sample of green aboveground stems (57.4%; $P > 0.05$).

Several studies have shown that juvenile birds are less efficient than adults in getting their food (Searcy 1978, Quinney and Smith 1980, Greig et al. 1983, Sutherland et al. 1986, Goss-Custard and Durell 1987, and others). This was usually imputed to differences in the proportion of successful dives, handling time, pecking rate, etc. A lower foraging efficiency has also been suggested to account for greater winter mortality of juvenile shorebirds (Goss-Custard and Durell 1987) and delayed maturity in gulls (Searcy 1978, Greig et al. 1983).

The differences in foraging behavior that we have described in this paper may have some bioenergetic components. Grubbing for rhizomes is more demanding than grazing aboveground plant parts (Gauthier et al. 1984) but it may provide more energy to the bird. Although we found no significant difference in the fiber content of stems and rhizomes, we cannot rule out the possibility that the latter yield more carbohydrates, proteins, and minerals than do stems. Most of the plants' reserves have been translocated to the underground

wintering parts by the time geese feed on the plants. In two of the four cases studied by Buchsbaum et al. (1986), geese extracted more energy from soluble carbohydrates than from cell wall polysaccharides. Admittedly, more detailed studies are needed to test our suggestion.

One indirect effect of this differential feeding behavior may be the greater vulnerability of juveniles to hunting. Giroux and Bédard (1986) reported four juveniles for each adult in hunters' bags. We often observed juveniles flying or walking outside the sanctuaries followed by adults, possibly their parents. We speculate that these juveniles were moving to the adjacent marshes to feed on *Scirpus* stems still available there.

Intense removal of rhizomes by geese can reduce subsequent production of *S. americanus* (Giroux and Bédard 1987). Consumption of nonreproductive parts like the stems may thus lessen the potential impact of geese on the marsh vegetation. Because juveniles consumed more stems than adults, it is therefore necessary to consider the proportion of juveniles in a flock when assessing the impact of geese on marsh production.

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NEST-SITE SELECTION BY URBAN MERLINS[1]

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With the exception of studies involving cavity-nesting
birds dependent upon naturally formed hollows in trees
and soil (e.g., Devereaux and Mosher 1984) or cavities
created by other species (e.g., Goad and Mannan 1987),
comparatively few studies of nest-site selection have
considered species for which the actual availability and
properties of potential sites are measurable. In order
to assess these characteristics, most previous studies
have involved random sampling of the surrounding
habitat using criteria selected by the researcher. With
this inherent bias, habitat where nesting is unlikely
might be included or, based on the criteria selected,
atypical sites might be excluded.

Like other falcons, the Merlin (*Falco columbarius*)
does not build its own nest. Although there are some
ground-nesting populations (largely Palearctic; Brown
1976; Newton et al. 1978, 1986; Cramp and Simmons
1980; Bibby and Nattrass 1986), for the most part
Merlins use abandoned corvid or hawk nests, usually
in conifers, over much of their range (Craighead and
Craighead 1940, Lawrence 1949, Beer 1966, Johnson
and Coble 1967, Laing 1985). One exception to this is
Richardson's Merlin (*F. c. richardsonii*), the subspecies

of the North American prairies. Most likely as a re-flection of availability, rural populations of this sub-species predominantly use nests in deciduous trees (Fox
1964, Hodson 1975, Houston and Schmidt 1981, but
see Ellis 1976 and Becker 1984), while urban popu-lations use nests in conifers (Oliphant 1974, Smith
1978, Oliphant and Haug 1985). Because it is an ob-ligate tree-nester restricted to corvid nests in Saska-toon, this Merlin population provided an ideal oppor-tunity to study nest-site selection.

Previous descriptions of Merlin nest sites have been
qualitative. Hodson (1975) provided a detailed de-scription, but gave no indication of the relative avail-ability of the habitat characteristics he described. Bibby
(1986) examined the large-scale selection of major
vegetation communities and land use patterns around
the nest sites of Merlins in Wales. Our objectives were:
(1) to provide information on the characteristics of the
nests and immediate area surrounding the nests chosen
by an urban Merlin population, and (2) to determine
whether Merlins chose a particular subset of the avail-able abandoned corvid nests within the city.

METHODS

We studied Merlins breeding in Saskatoon, Saskatch-ewan, Canada (52°07′N 106°38′W), a northern Great
Plains city of approximately 12,200 ha with a popu-lation of about 180,000 people. The city is bisected by
the South Saskatchewan River; those river bank areas
not used for human habitation are typified by steep