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THE DIETS OF FIVE SPECIES OF MIGRANT SHOREBIRDS IN THE BAY OF FUNDY

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Semipalmated Plover *Charadrius semipalmatus,* Black-bellied Plover *Pluvialis squatarola,* Short-billed Dowitcher *Limnodromus griseus,* Semipalmated Sandpiper *Calidris pusilla,* and Least Sandpiper *Calidris minutilla* were collected in the southern bight, Minas Basin,Nova Scotia. The digestive tracts were removed for analysis of gut contents. In 4 of the 5 species studied, most of the prey volume was occupied by the burrowing amphipod *Corophium volutator.* The fifth species, Black-bellied Plover, fed mainly on large polychaetes and nemertean worms.

Introduction

Studies on the feeding ecology of shorebirds have been undertaken primarily on European species over-wintering on coastal estuaries of the British Isles (Goss-Custard 1977) and the Netherlands (Wolff 1969). Similar studies have been conducted on arctic breeding grounds in North America (Holmes & Pitelka 1968) and on South American over-wintering areas (Baker & Baker 1973). Few studies on shorebird feeding ecology have been undertaken at staging areas in North America during migration, except for the work by Recher (1966) in California and Couch (1966) in western Washington.

The mudflats around the head of the Bay of Fundy are probably the most important staging area for migrant shorebirds in eastern North America for 6 to 8 weeks during late summer and autumn (Morrison 1976a; b). During this time, the birds deposit large reserves of energy-rich fat. Semipalmated Sandpipers, *Calidris pusilla* (L.), almost double their weight while in the Bay (unpubl.). This is the final foraging area at which birds can replenish their fat reserves before undertaking a non-stop, transoceanic flight to their South American over-wintering grounds, a distance of some 4,000 km (McNeil & Cadieux 1972). No account of their diet has been published.

Materials and Methods

A total of 102 birds of 5 species—Semipalmated Plover *Charadrius semipalmatus* Bonaparte, Black-bellied Plover *Pluvialis squatarola* (L.), Short-billed Dowitcher *Limnodromus griseus* (Gmelin), Least Sandpiper *Calidris minutilla* (Vieillot), and Semipalmated Sandpiper *Calidris pusilla* (L.), were collected in the southern bight of

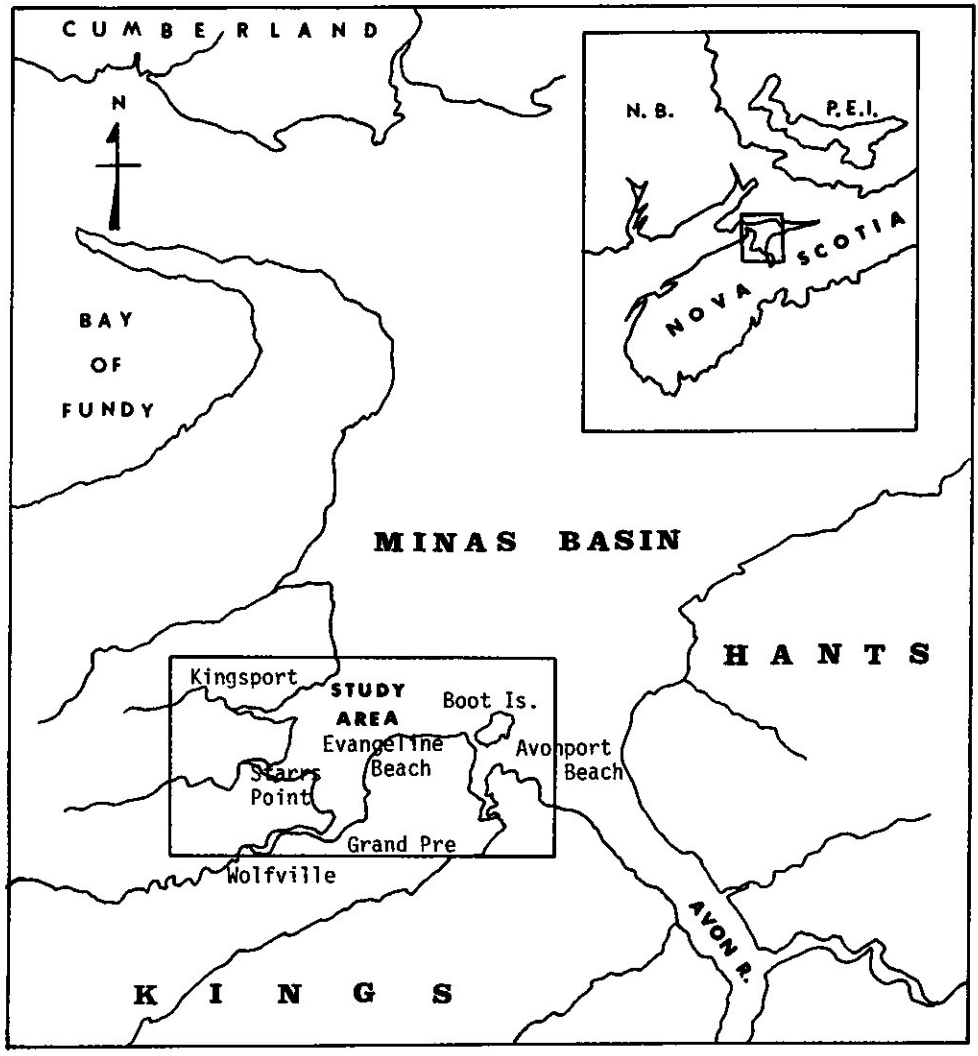

Fig 1. The study area.

the Minas Basin. Collecting sites were Kingsport, Starrs Point, Evangeline Beach, and Avonport Beach (Fig 1). The birds were shot while they actively foraged on the mudflat. The entire digestive tract of each freshly killed bird was removed in the field and placed in a 4 oz. jar containing full strength (40%) formaldehyde. In the laboratory, the contents of the esophagus, gizzard, and intestines were removed and identified as far as possible. Most of the prey were recovered from the gizzard.

The relative proportions of the prey were calculated by displacement in ethanol using a 10 ml graduated cylinder. The results are expressed as percent by volume for each prey species relative to the total prey volume. Polychaete jaws were not included in these calculations as they are known to remain in the gizzards for long periods (Smith 1975), and thus may not have been taken in the study area.

Results

1. *Black-bellied Plover*

Two Black-bellied Plover were collected on 11 May 1976 and 12 August 1977. Their stomach contents differed greatly, presumably reflecting the different seasons when they were collected. Invertebrate densities in the intertidal sediments are low during May owing to severe ice scouring during the winter months (Yeo 1977). Consequently, in spring, Black-bellied Plover forage mainly in the salt marshes.

Larvae of soldier and horseflies (Order Diptera) comprised 95% by volume of the prey recovered from the gizzard of the spring bird (Table I). Exoskeletal fragments of beetles (Order Coleoptera) accounted for a fraction of the prey. Seventy-eight polychaete jaws (*Nereis* sp) were also found.

The gizzard of the bird collected on 12 August was nearly filled with large body fragments of the polychaete *Nereis diversicolor* Müller (Table I), probably from a single individual, and of the nemertean *Cerebratulus lacteus* (Leidy). Other prey taken were the amphipod *Corophium volutator* (Pallas) and 2 gastropods.

2. *Semipalmated Plover*

Five adults were collected on 12 July, 12 and 14 August 1977, and 2 immature birds on 9 September 1977. Five of the birds had recently consumed large numbers of *Corophium volutator* (Table II). On the average, *Corophium* made up almost half of the prey volume. Exoskeletal fragments of insects (Diptera and Odonata) were found in 2 adults and the 2 immatures. In the latter, these included undigested wings, suggesting that insects were recently consumed probably at the roost site. Jaws of the polychaetes *Nereis* sp and *Glycera* sp were found in 4 birds and 6 intact specimens of *Heteromastus filiformis* (Clarapède) (Polychaeta) were recovered from 1 digestive tract. Remains of the bivalve *Macoma balthica* (L.) and the gastropods *Hydrobia totteni* and *Turbonilla elegantula* were also present.

3. *Least Sandpiper*

Nine adult birds were collected on 15, 29 July, and 9 September 1977. The diet (Table III) consisted almost entirely of *Corophium volutator* (88.6%) except for one

Table I. Average percent volume of prey species taken by Black-bellied Plover, 11 May 1976 and 12 August 1977 (listed in order of magnitude).

MAY		AUGUST	
Prey	Percent volume	Prey	Percent volume
Insect larvae (Tabanidae)	54	Polychaeta	65
Insect larvae (Stratiomyiidae)	41	*Cerebratulus lacteus*	20
Coleoptera	3	*Turbonilla elegantula*	5
Hydrobia totteni	1	*Lunatia heros*	4
Dermacentor sp.	1	*Corophium volutator*	4
		Diptera	2

Table II. Average percent volume and frequency of occurrence (%) of prey species taken by semipalmated Plover (n = 7).

Prey	Percent volume	Frequency of occurrence
Corophium volutator	47.6	71.4
Insects	26.9	57.1
Heteromastus filiformis	12.7	14.3
Macoma balthica	7.1	28.6
Hydrobia totteni	5.6	71.4
Turbonilla elegantula	0.1	14.3

Table III. Average percent volume and frequency of occurence (%) of prey species taken by Least Sandpiper (n = 9).

Prey	Percent volume	Frequency of occurrence
Corophium volutator	88.6	77.7
Chiridotea caeca	10.2	11.1
Oxyurostylis smithi	0.9	11.1
Insects	0.3	22.2

Table IV. Average percent volume and frequency of occurrence (%) of prey species taken by Short-billed Dowitcher (n = 15).

Prey	Percent volume	Frequency of occurrence
Corophium volutator	70.3	100.0
Polychaeta	24.9	40.0
Buccinum undatum	2.5	6.7
seeds	1.7	6.7
Hydrobia totteni	0.3	6.7
Chiridotea caeca	0.1	6.7
Macoma balthica	0.1	6.7
Insects	0.1	6.7
unidentified	0.2	-

bird that had ingested 71 of the isopod *Chiridotea caeca* (Say) and 5 *Oxyurostylis smithi* Calman (Order Cumacea). Two other birds contained insect fragments.

4. *Short-billed Dowitcher*

Fifteen adults were collected on 14 and 23 July 1977. *Corophium volutator* were present in all the gizzards examined, and made up the bulk of the prey (Table IV). Six had jaws of polychaetes (*Nereis* sp and *Glycera* sp) and 6 others contained body fragments from those genera, comprising most remaining prey volume. Other minor food items consisted largely of seeds and the gastropod *Buccinum undatum* L.

5. *Semipalmated Sandpiper*

Sixty-eight birds were collected on 12, 14, 15, 23, 29 July and 1, 12, 14, 17 August, and 9 September 1977. All were adults except 6 birds collected 9 September.

Sixty-six birds fed almost entirely on *Corophium volutator,* which comprised 86.3% of the prey volume recovered (Table V). The shrimp *Crangon septemspinosa* (Say) was an item not found in other species.

Discussion

The amphipod *Corophium volutator* is a main prey for 4 of the 5 shorebird species studied. Black-bellied Plover appeared to feed mainly on large polychaetes and nemertean worms. This impression is based on only 2 specimens, but field observations (unpubl.) also indicate that Black-bellied Plover on the mudflats feed mainly on large polychaetes.

Semipalmated Plover and Short-billed Dowitcher fed mainly on *C. volutator* and, to a lesser degree, also ingested polychaetes. The small calidrine sandpipers fed mostly on *C. volutator.* Immature birds took the largest proportions of insects. This behaviour may be carried over from the breeding grounds, where, a few weeks earlier, they would have fed mainly on insects (Holmes & Pitelka 1968). Goss-Custard (1977), in his study on the feeding ecology of Redshank *Tringa totanus* (L.), suggested that a preference for *Corophium* "may simply reflect a systematic variation in the availability of prey that was associated with prey density." Yeo (1977) found a maximum density of 63,000/m² for *Corophium* in Cobequid Bay. In the

Table V. Average percent volume and frequency of occurrence (%) of prey species taken by Semipalmated Sandpiper (n = 68).

Prey	Percent volume	Frequency of occurrence
Corophium volutator	86.3	97.0
Chiridotea caeca	2.9	4.4
Oxyurostylis smithi	2.1	10.3
Insects	0.9	13.2
Polychaeta	0.8	10.3
Hydrobia totteni	0.1	5.8
Crangon septemspinosa	0.1	1.5
unidentified	6.9	-

southern bight of the Minas Basin, Hicklin (unpubl.) recorded a maximum density of 47,000/m^2 with a mean density of 20,000/m^2. Polychaetes are generally found below the mud surface of exposed mudflats whereas *Corophium* emerges from its burrow to feed. Therefore, the high density and availability of *Corophium* in the Bay of Fundy make it an important prey for shorebirds.

In Europe, *Corophium volutator* occurs in saltmarsh ponds and estuarine mudflats in high densities. It is found in a wide range of sediments from almost fresh to near marine conditions (Crawford 1937 *in* Gratto 1977). The species is not as widespread in North America where it has been reported only in the Bay of Fundy and along the coast of Maine (Shoemaker 1947). Hence, their high densities in the Bay of Fundy appear important in ensuring the rapid weight gain in migrant shorebirds during their short stay in the Bay of Fundy and thus provide the necessary fuel for their successful migration to the over-wintering grounds in South America.

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