

FOOD OF SOME IMMATURE FISH OF MINAS BASIN, BAY OF FUNDY

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Stomach contents of juveniles of 11 species of fish collected in the southern bight of Minas Basin were examined. Most species, including typically planktivorous ones such as smelt (*Osmerus mordax*) and silversides (*Menidia menidia*), exhibited broad food spectra having both planktonic (copepods and meroplankton) and benthic (amphipods, isopods, cumaceans, and sedentary polychaetes) components. Only the blackspotted stickleback (*Gasterosteus wheatlandi*) was primarily planktivorous. The amphipod *Corophium volutator* appears to be a major food item for many juvenile fish in this region of Minas Basin. At times saltmarsh insects were also of considerable importance. The lack of feeding specialization may result from the extensive tidal fluctuations that stir up organisms from the benthos and wash out arthropods from nearby salt-marshes.

Les jeunes de 11 espèces de poissons, récoltés dans la boucle sud du Bassin de Minas, ont eu leur contenu stomacal examiné. La plupart des espèces, y compris des poissons planctivores type tels que l'éperlan (*Osmerus mordax*) et la capucette *Menidia menidia*, ont une gamme alimentaire étendue, d'origine planctonique (Copépodes et méroplankton) et benthique (amphipodes, isopodes, cumacées et polychètes sédentaires). Seule l'épinoche tachetée (*Gasterosteus wheatlandi*) est essentiellement planctivore. L'amphipode *Corophium volutator* semble être un aliment d'importance pour plusieurs poissons juvéniles de cette région du Bassin de Minas. Par moments, les insectes des marais salants ont aussi une importance considérable. Ce manque de spécialisation dans l'alimentation pourrait être le résultat des énormes marées qui soulèvent dans la colonne d'eau les organismes benthiques et y entraînent les arthropodes des marais salants avoisinants.

Introduction

The Minas Basin is a large (805 km²) turbid embayment at the head of the Bay of Fundy noted for having the world's highest recorded tidal range (<16 m). Since 1976, the possibility of tidal power development has focused considerable attention on the area. Although the Basin has a very low production of adult fish (Huntsman 1952), it has been suggested that the region might be an important nursery for several commercially valuable fish, including the herring (*Clupea harengus*), alewife (*Alosa pseudoharengus*), and shad (*A. sapidissima*) (Daborn & Bleakney 1977).

The present study represents the first attempt to define feeding relationships for juvenile fish in the inner regions of the Bay of Fundy, and is part of a larger coordinated investigation of the plankton (Pennachetti 1978; Daborn & Pennachetti 1979a; b; Strong 1979), benthos (Gratto 1978; McCurdy 1979; Strong 1978; Strong & Daborn 1979a; b) and shorebird (Boates 1978; Boates & Smith 1979) associations of Minas Basin.

Methods

Immature fish were collected from Kingsport (45°09'N 64°22'W) between June and September 1978 using 15-m and 30-m beach seines with 6.2-mm square mesh. Fish were preserved in 5% neutral formalin and caudal length (from lip to final

caudal flexure—CL) was recorded for each individual dissected. The gut was removed and contents gently expressed with a dissecting needle. The gut was then cut open and examined microscopically for remaining contents or parasites. Following identification of macroscopic items, the contents were spread on microscope slides, mounted in polyvinyl alcohol (PVA) stained with lignin pink, and examined at 100X magnification.

Results and Discussion

Juveniles of 11 species were collected and examined. Only 4 of these, the smooth flounder (*Liopsetta putnami*), Atlantic silverside (*Menidia menidia*), American smelt (*Osmerus mordax*), and blackspotted stickleback (*Gasterosteus wheatlandi*) were collected in sufficient numbers for quantitative examination. Results are given in Figure 1.

Juvenile smooth flounder (6.6-74.7 mm CL, year class 0—92% year class 1—8%) fed largely upon harpacticoid copepods and the local mysid *Neomysis americana*. Twenty percent of the individuals examined also had faecal pellets in the anterior part of the gut. However, the presence of the calanoid *Eurytemora herdmani*, saltmarsh insects, and meroplanktonic forms such as trochophores suggests that at times juvenile flounder feed in the water column.

Eurytemora herdmani, pelagic eggs and embryos were the predominant items taken by yearling smelt (25-50 mm CL) whereas larger (second-year) smelts (65-105 mm CL) had consumed large numbers of saltmarsh insects also. Benthic organisms such as harpacticoid copepods, mysids, cumaceans and *Corophium volutator* were present in some specimens of both year classes.

The silverside population was dominated by 1-year-old fish, ranging in size from 50 to 75 mm. A single second-year fish was 82 mm long. All 40 silversides examined had been feeding on the benthic amphipod *Corophium volutator* and 16 of these had also consumed saltmarsh and terrestrial insects. In these fish, insect biomass probably exceeded the total biomass of all other food items including *Corophium*.

By contrast with the above, the blackspotted stickleback (10-40 mm; 0—95%, 1—5%) appeared to feed almost exclusively on planktonic organisms, notably *E. herdmani* and meroplanktonic larvae or embryos. The blackspotted stickleback and the seasnail (*Liparis atlanticus*) were the only species recorded that, as juveniles, had ingested diatoms, in both species the large, planktonic *Coscinodiscus*. *Coscinodiscus*, however, was the major food item encountered in larval *Alosa*, whereas the juvenile captured (55 mm CL) had been feeding on *Neomysis americana* (Imrie 1979).

The remaining fish encountered included the little skate (*Raja erinacea*), tomcod (*Microgadus tomcod*), white hake (*Urophycis tenuis*), and longhorn sculpin (*Myoxocephalus octodecemspinosus*). All had been feeding on a broad spectrum of food that included amphipods, nematodes, isopods, euphausiids, polychaetes, copepods, and mysids. In terms of biomass the benthic component was always dominant. None of these latter species apparently utilized terrestrial or saltmarsh arthropods.

Little indication of feeding specialization is thus evident in these results. Except for the blackspotted stickleback, a few specimens of which were examined, most species appear to feed on a great variety of food including organisms both of the benthos and plankton. This is particularly surprising in the case of the silverside, that has a decidedly oblique mouth which would seem to preclude feeding on the bottom. Yet, as noted, all specimens had ingested *Corophium*, presumably when these amphipods were in the water column. Their presence

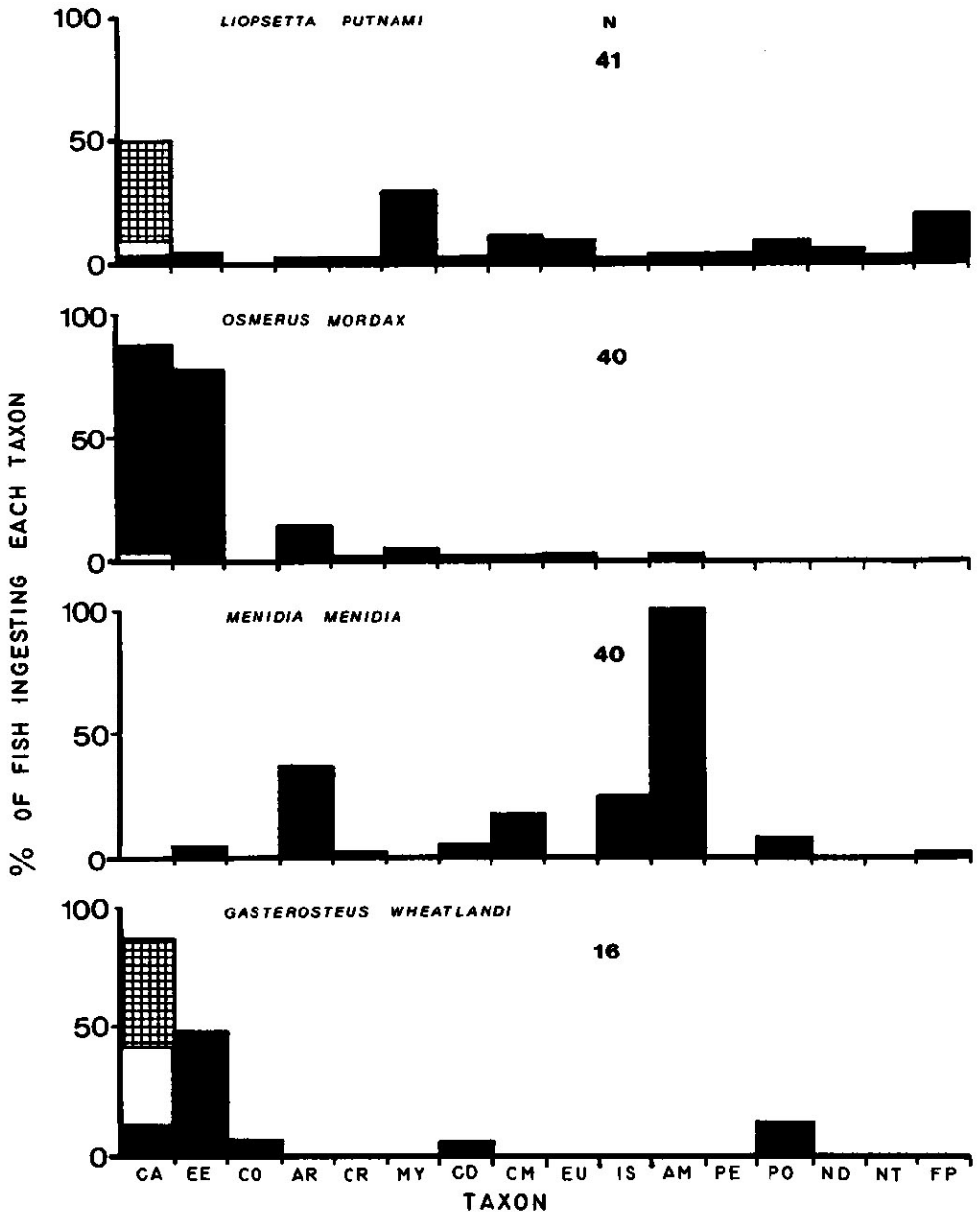


Fig 1. Food spectra of juvenile fish from the southern bight of Minas Basin.

Symbols: CA—Copepoda, including Harpacticoida (cross-hatched), *Eurytemora herdmani* (shaded) and juvenile or unidentified copepods (unshaded); EE—pelagic eggs or embryos; CO—*Coscinodiscus spp*; AR—saltmarsh arthropods; CR—unidentified Crustacea (fragments); MY—*Neomysis americana* (Mysidacea); CD—Caridea; CM—Cumacea; EU—Euphausiacea; IS—Isopoda; AM—Amphipoda (usually *Corophium volutator*); PE—Pelecypoda; PO—Polychaeta; ND—Nematoda; NT—Nemertinea; FP—faecal pellets.
 N = No. fish examined.

above the bottom might be the result of either periodic but infrequent swimming behavior for which *Corophium* is noted (Watkin 1941; Perkins 1974), or tidal disturbance during the flooding tide. It should be noted, however, that *Menidia* also had a number of other benthic components in the gut including the isopod *Chiridotea*, cumaceans, and faecal pellets.

These results also suggest a significant role for saltmarsh arthropods in the nutrition of fish in southern Minas Basin. The collection area is near the extensive Kingsport saltmarsh which, in 1978 at least, supported large numbers of insects, notably delphacids, cicadellids, and ants (Krepinsky, in. verb.) As Cheng and Birch (1978) have suggested, insect "flotsam" is a potentially rich source of food for surface-feeding marine organisms, and one that is frequently overlooked.

Our evidence fails to confirm the proposition that the region is an important nursery area for commercially valuable fish. Except for the alewife and flounder, those species captured are probably best described as forage fish, being potential food for much larger piscivorous species. Obviously, the very restrictive nature of our collecting methods and locality limits the conclusions that can be drawn regarding the role of the Minas Basin in supporting distant fisheries through a nursery function. Nonetheless, the extent of utilization of saltmarsh insects and both benthic and planktonic organisms in the southern bight suggests that the productive local saltmarshes are important for the support of some resident and transient members of the ichthyofauna. The role of tidal movements would also seem to be clear, as high-tide flushing of saltmarshes and flood-tide disturbance of deposited sediments seem to be important mechanisms making these food sources available to fish that otherwise might be unable to use them for morphological reasons.

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