

FEEDING BY ESTUARINE AND MARINE FISH LARVAE

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Fish larvae are basically selective plankton samplers. They select plankton according to size and type, where type refers to different taxa or species with varied shapes, colours and/or behaviours. The diets of an assemblage of fish larvae in an area will probably reflect the plankton composition within a certain size range in that area. So, differences in the diets of larval fish between two areas can be expected if the two areas have different zooplankton communities. This also applies to a single area in which zooplankton communities change through time. Moreover, since various species and sizes of fish larvae may select different types of prey, diets may differ between two areas which have similar zooplankton communities but different fish larval assemblages.

When diet items are described to the species level, comparisons between areas do indeed often show considerable differences. However, when broader taxonomic categories are used, the diets of fish larvae between different areas are often very similar. This includes comparisons between different estuaries and between estuarine and marine systems. Hence, copepods are an important prey type of most marine and estuarine fish larvae (see listed references marked *), and dietary differences at the species level of copepods between areas reflect (1) the differences in occurrence of these copepod species and (2) prey preferences of the individual species of fish larvae in each assemblage.

Despite the predominance of copepod prey for most fish larvae there are some which concentrate on other food sources. Regardless of where they occur, fish larvae can be divided into three broad categories based on their preferred prey types (Figure 1). These are (1) copepodivores, the largest group, (2) chordativores and (3) others. Each of these categories can then be further subdivided.

Copepodivores include those that (1) concentrate only on copepods and (2) those that also regularly eat other plankton taxa such as tintinnids, bivalve larvae, polychaete larvae, invertebrate eggs and phytoplankton. Copepodivores form the largest category because copepods are usually the numerically dominant form of zooplankton in the size range suitable for fish larvae to eat.

Chordativores are the main non-copepod eating group and can be divided into those that eat (1) appendicularians, (2) fish larvae, and (3) a combination of appendicularians and fish larvae. This group provides the main difference between estuaries and oceans since appendicularians and piscivorous fish larvae are not common in estuaries. I found only one example of an estuarine fish larva which predominantly ate larval fish, a cottid, *Hemitripterus americanus* (Laroche 1982); and none which ate appendicularians. Larvae of a marine *Hemitripterus* sp. from the Japan Sea are also piscivorous (Okiyama and Sando 1976, *cit.*

Laroche 1982). The scombrid, *Scomber scombrus*, mainly eats copepods until 6-7 mm in length and then eats larval fish. This pattern was evident both in the estuarine Long Island Sound (Peterson and Ausubel 1984) and in the Gulf of St Laurence (Ware and Lambert 1985), which is marine.

Most of the marine examples of chordatiformes are larvae of scombrids or pleuronectiforms (Shelbourne 1957; Last 1978; Gadomski and Boehlert 1984; Jenkins *et al.* 1984 and references therein). The pleuronectiforms in this category concentrate their feeding on appendicularians rather than larval fish. Of the scombrids, some mainly eat larval fish and others eat a combination of larval fish and appendicularians. Note that for both the pleuronectiforms and the scombrids there are also species, sometimes co-occurring with the chordatiformes, with diets based on copepods or other invertebrate plankton (Gadomski and Boehlert 1984; Last 1978; Young and Davis 1990).

The third category (others) consists of fish larval species which prey heavily on a suitably sized zooplankton taxon which is more abundant than copepods at the time. Examples of important non-copepod types of prey include bivalve larvae, barnacle larvae, cladocerans, polychaete larvae and tintinnids (e.g. Last 1980; Rajasilta and Vuorinen 1983; Jenkins 1987; Watson and Davis 1989). Many fish larvae in this category are probably "closet" copepodivores and are eating the most abundant suitably sized zooplankton which, contrary to typical marine and estuarine systems, are not copepods. Several studies, both in estuaries and in the ocean, have found larvae which were feeding primarily on copepods until these decreased in abundance and then another taxon became the dominant food (Marak 1960; Laroche 1982; Rajasilta and Vuorinen 1983).

In an area of the Baltic Sea, cladocerans were the main prey type only when the abundance of the preferred copepod was low (Rajasilta

and Vuorinen 1983). Laroche (1982) found that copepods dominated the diets of three species of cottids for two months and then in the following month barnacle nauplii became the main food. Several authors have concluded that variations in the abundance of plankton, either seasonal or spatial, play an important role in determining the diets of larval fish (e.g. Marak 1960; Rajasilta and Vuorinen 1983; Whitfield 1983; Ware and Lambert 1985).

In conclusion, when differences in the diets of fish larvae between different estuaries and between estuarine and marine waters occur, they are due to (1) differences in the abundances and types of suitable sized prey and (2) differences in prey selection by the species of fish larvae which occur in each system.

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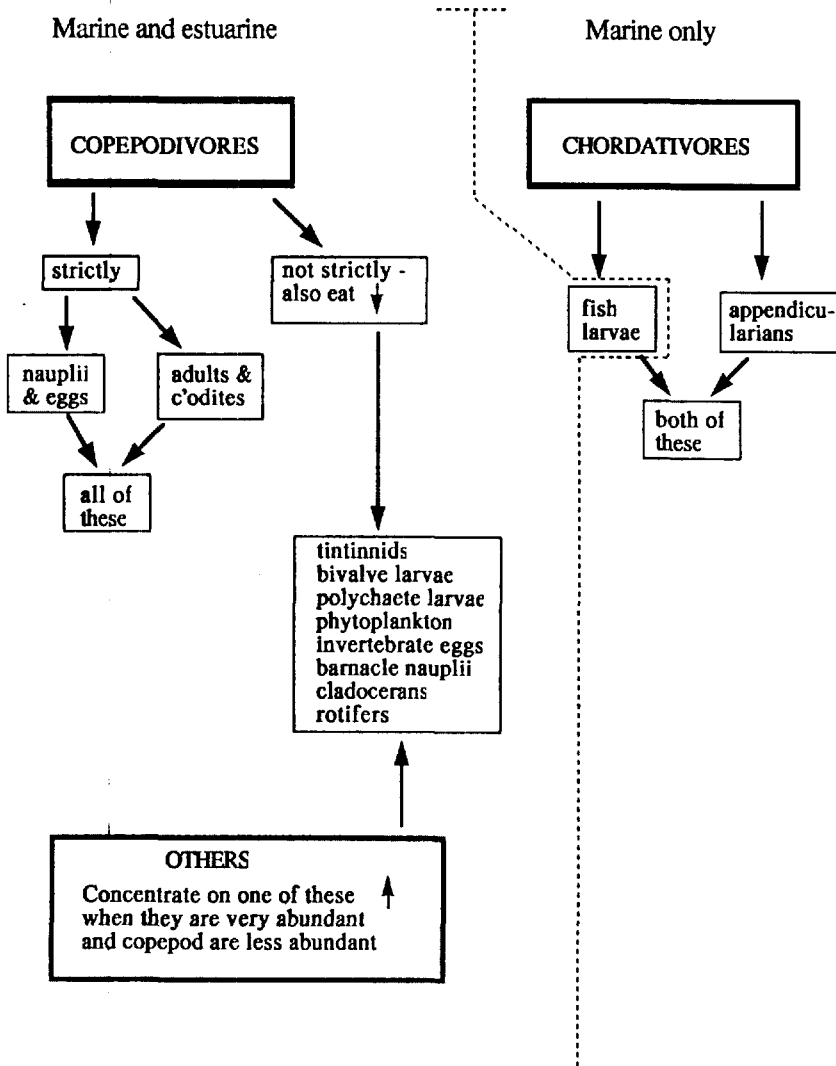


Figure 1. Diet categories of fish larvae based on predominant prey types.