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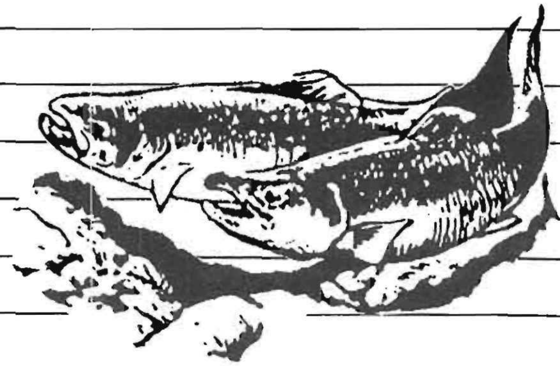

Study in a Mesocosm Reveals Discrepancy Between the Relative Abundance of Zooplankton in Fish Guts and in the Environment

Lake whitefish (*Coregonus clupeaformis*) larvae selectively feed on larger members of the zooplankton community. We were able to accurately document food preferences and selection by the larvae in relation to the prey community because we conducted our study in a mesocosm, which is an enclosure of an ecosystem larger than 1 m^3.

Food habits of fishes have long been determined by examination of gut contents. Comparison of gut contents with the relative or actual abundance of food items in the surrounding environment can be revealing about the species-specific degree of food-type preference. Sampling bias often limits the utility of comparisons of gut and environment because not all species of prey organisms are equally vulnerable to sampling gear. Therefore, data on the occurrence of types of food organisms in gut samples are often used as an indicator of what a fish prefers to eat.

Mesocosm Permits Controlled In Situ Sampling

We placed a mesocosm in a small, mesotrophic lake in southeastern Michigan to investigate the food preferences of larval lake whitefish. Each of four floating net-cages (2-m^3, 0.8 mm mesh) was stocked with 500 newly hatched larval fish. Zooplankton from the surrounding waters could pass into and out of the cages. We sampled the fish and zooplankton weekly for 8 weeks from 5 April to 24 May 1989. Two replicate samples were taken from each of the four cages with lake whitefish (fish cages) and from four cages without fish (control cages).

Gut Contents Indicate Feeding Is Not Random

Analysis of gut contents revealed little change in the mean length of zooplankton that were eaten (Fig. 1). Lake whitefish routinely ate prey larger than the average-sized prey in the cages. They preyed mostly on cyclopoid copepods (primarily *Cyclops* species), the only prey group that was significantly selected at levels higher than neutrality (Strauss' electivity index). Small prey such as copepod nauplii were negatively selected, and larger prey such as large cladocerans (primarily *Daphnia, Eurycercus*, and *Simocephalus*) and calanoids (primarily *Skistodiaptomus*) were neutrally selected in proportion to the low abundance in the fish cages.

Zooplankton Community Structure Changes

Throughout the 8-week study, the mean length of zooplankton in the fish cages slowly decreased (Fig. 1). The mean length of zooplankton in the control cages changed little and was consistently and significantly higher than that in the fish cages. We believe that the decline in the mean size of zooplankton in the fish cages was due to selective predation by the fish on the larger zooplankton.

In the fish cages, large zooplankton became reduced early in the study. The abundance of large cladocerans was always higher in the control cages than in the fish cages (Fig. 2). The abundance of calanoids was also lower in the fish cages than in the control cages. In contrast with large cladocerans, calanoids actually increased in the control cages throughout the study. Large cladocerans and large calanoids were almost absent in the fish cages during the last 3 weeks of the study.

Gut Contents Conflict With Changes in the Zooplankton Community

Gut contents and electivity indices from our study suggested that only cyclopoid copepods (moderately sized prey) were important in the diet because these species not only dominated the diet but also were eaten in excess of their proportional abundance in the experimental cages. However, the pattern of decline in the abundance of large cladocerans and large calanoids in the fish cages suggests that lake whitefish ate these species almost to depletion. We conclude from these data that the larger zooplankton were preferred and devoured almost as fast as they entered the fish cages.

Study in a Mesocosm Provides Unique Information About Diet Preferences

Traditional studies of the diet of wild fishes and food samples from the natural environment reveal the significance of cyclopoid copepods in the diet of lake whitefish but not the significance of larger zooplankton in the diet if these species are heavily cropped from the population and therefore encountered only occasionally by either fish or samplers. Our study in mesocosms allowed us to quantify the available food for the experimental fish and the food that the fish ate with much greater accuracy than the usual field study. The control cages revealed that numerous large zooplankton were available. Although the electivity indices showed that the fish only randomly ate large zooplankton (in the proportion that they occurred in the cages), these large species of zooplankton were quickly and effectively removed from cages with fish and must therefore have been highly desired by these fish. Large zooplankton were probably eaten as soon as they entered the cages and were digested rapidly. Predictions about the effect of lake whitefish predation on a zooplankton community are biased if only data from gut contents and electivity indices are used.

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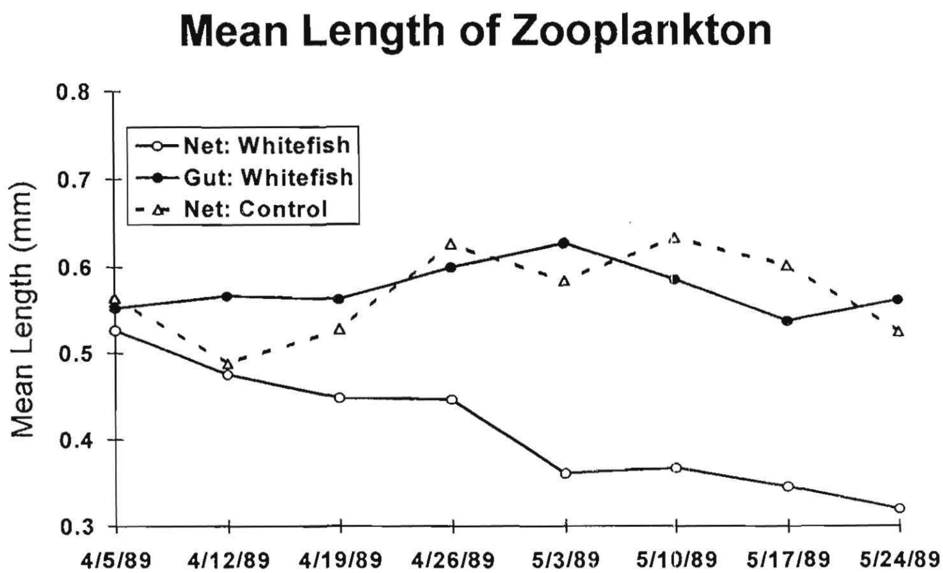

Figure 1. Mean length of zooplankton in samples from net-cages with lake whitefish (*Coregonus clupeaformis*), net-cages without lake whitefish, and lake whitefish guts, 5 April–24 May 1989.

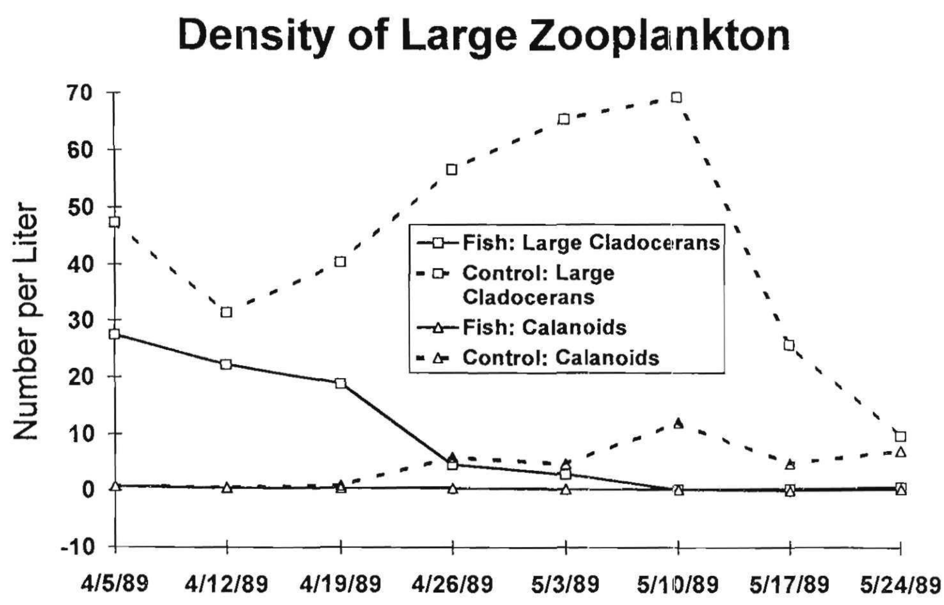

Figure 2. Density of large cladoceran (primarily *Daphnia, Eurycercus*, and *Simocephalus*) and calanoid copepods (primarily *Skistodiaptomus*) in net-cages with lake whitefish (*Coregonus clupeaformis*) and in net-cages without lake whitefish, 5 April–24 May 1989.