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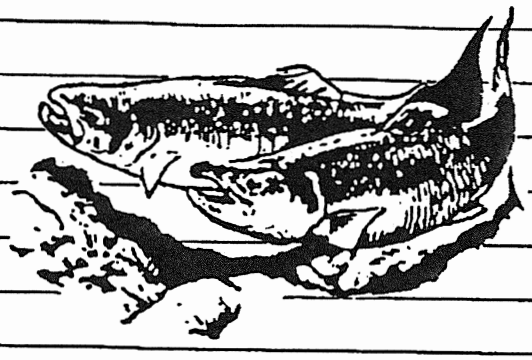

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Zebra Mussels Affect Growth of Juvenile Fathead Minnows

Zebra Mussels Colonize the Upper Mississippi River Drainage

The exotic zebra mussel (*Dreissena polymorpha*) recently invaded the upper Mississippi River, and populations of this filter-feeding organism are expected to expand rapidly. Evidence from the Great Lakes suggests that zebra mussels adversely affect some native species while benefiting others. Physical habitat characteristics, such as current speed and substrate, differ between lotic and lentic habitats in the upper Mississippi River, and habitat-specific variation in the colonization success of zebra mussels seems probable. The success of the zebra mussel colonization may differ between lentic and lotic habitats in the river. Zebra mussels can adversely affect zooplankton by predation, and they may compete with larval and juvenile fish. Zebra mussels held in the laboratory reduced the growth of juvenile fathead minnows (*Pimephales promelas*), presumably because of exploitative competition.

Experimental Approach to Evaluating Mussel Effects

A 4 × 2 factorial design was used to evaluate the effects of zebra mussel density (0, 100, 1,000, and 3,000 per m^2) and water retention time (12 and 24 h) on the growth of juvenile fathead minnows in 38-L aquaria. There were three replicates (aquaria) of each treatment combination, and the experiment ran for 30 days. Zebra mussels were obtained from Lake Michigan and transported to the National Fisheries Research Center in La Crosse, Wisconsin. Mussels were allowed to acclimate in a holding tank for a minimum of 1 week. Wet weights, measured before the experiment, were used to estimate the mass of zebra mussels required to achieve each treatment density. Juvenile fathead minnows (mean total length, 18.6 mm; standard error, 1.5 mm), cultured at the center, were acclimated to test conditions for 4 days. Thirty-five fish were randomly assigned to each treatment combination.

During the experiment, each tank daily received 0.16 g (9.3% of fathead minnow body weight) of Biokyowa fry feed dispensed in thirds at 0800, 1200 and 1500 h. Each tank also received 240 mL (about 200 million cells) of a solution containing live *Ankistrodesmus* spp. and dried *Chlorella* spp., dispensed daily, half at 0830 h and half at 1530 h. The fry feed, provided primarily for the fish, was within the size range (i.e., 250–400 µm in diameter) that zebra mussels can ingest; the algal solution was provided for the zebra mussels. Temperature, dissolved oxygen, and pH in the test aquaria were monitored daily, and ammonia was determined weekly. No fathead minnows died during the 30-day experiment.

All fish in each aquarium were measured at the end of the test. Relative growth was calculated by dividing the increase in mean total length of fish by their mean initial length. Differences in the relative growth of fishes among treatments were evaluated with two-way analysis of variance.

Growth of Fish Was Reduced by Zebra Mussels

The mean relative growth of fathead minnows in this study ranged from 59% to 65% of initial total length. In the treatment with the highest density of zebra mussels (3,000/m^2), mean relative growth was 59%, significantly less ($P < 0.05$) than growth in the lowest-density treatment (0 per m^2). Relative growth of the fishes was marginally affected in the 1,000/m^2 treatment ($P = 0.08$), and might have been evident in a longer test. Reduced growth did not differ between the 12- and 24-h hydrologic retention times.

Implication for Fish in the Upper Mississippi River

The slower growth of fish in the high-density treatment was probably because of reduced food availability, in response to the intense filtering activity of zebra mussels. These results indicate that zebra mussels, at densities of 3,000/m^2 or greater, can reduce the growth of juvenile fish held in confinement. In the upper Mississippi River, the growth of certain larval and juvenile fish could be adversely affected by zebra mussels if populations attain densities of 50,000 to 100,000 per m^2, densities now commonplace in some areas of the Great Lakes and the Illinois River, a tributary stream.

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