Effects of Zebra Mussels, Larval Fish and Nutrients on Density and Diversity of Benthic Invertebrates

Christine Calogero

Faculty Sponsor: Dr. Mark Sanheinrich,
                        Department of Biology/Microbiology

ABSTRACT

I examined the effects of exotic zebra mussels (*Driessena polymorpha*), larval fathead minnows (*Pimephales promelas*) and nutrients (nitrogen and phosphorous) on the density and diversity of aquatic benthic invertebrates in outdoor tanks. A factorial experimental design was used in which each treatment factor was manipulated at two levels (absence and presence) and each treatment combination was replicated 3 times (3 replicates x 8 treatments = 24 tanks.) After 7 weeks, benthic invertebrates were sampled weekly from each tank for two consecutive weeks. Amphipoda, Ephemeroptera, Coleoptera, Gastropoda, Oligochaeta, Chironomidae, Acari, *Dugesiu* sp and Hydra were the most common invertebrates found in the tanks. Samples from control tanks had the greatest number of invertebrates; samples from the tanks with zebra mussels had the fewest and the tanks with fish and nutrients also had lower numbers of the invertebrates than the control tanks. There was little difference in the number of taxonomic groups among the eight treatments.

INTRODUCTION

The introduction of exotic zebra mussels (*Dreissena polymorpha*) into the Laurentian Great Lakes and the subsequent spread throughout many rivers and lakes has caused great concern about the potential changes they may cause in aquatic ecosystems. The overall significance of this invasion has yet to be determined. Filter feeding by zebra mussels removes particles from the water column and shunts particulates to the sediment causing competition for food and habitat. These changes may be far reaching and need to be addressed in order to determine whether zebra mussels are a positive or negative factor structuring aquatic ecosystems.

METHODS

An experimental mesocosm facility located at the Upper Mississippi Science Center (USGS), was used to conduct this study. Twenty-four tanks were used. Each 1100-L tank had a controllable water residence time of one day. A factorial experimental design was used in which each treatment factor was manipulated at two levels, absence and presence, and each treatment combination was replicated three times. Benthic invertebrates obtained from the Black River were added to each tank. The treatments, zebra mussels, larval fish and nutrients were randomly assigned to the tanks. Starting density of the invertebrates was determined through analysis of sub-samples of the original benthos added.

After 7 weeks, benthic invertebrate samples were collected from the tanks. Samples were obtained by vacuuming a 0.1 m_2 area from 6 random locations in each tank. One sample was collected per tank on 2 weekly consecutive dates total of 48 samples). The samples were preserved in 10% formalin solution and stained with Rose Bengal to facilitate sorting. Invertebrates were identifred to the lowest taxonomic level possible and all invertebrates from each sample were counted.

Density, diversity, species richness and species evenness were calculated for each tank. Differences among treatments were determined with repeated measures analysis of variance. Null hypotheses were rejected at $p < 0.10$.

RESULTS

Zebra mussels, larval fish and nutrients had no significant effect on density of the invertebrates.
- Zebra mussels, larval fish and nutrients had no significant effects on species richness or species evenness.
- Zebra mussels and larval fish had no significant effect on diversity of the invertebrates. However, nutrients decreased the number of taxa ($p = 0.049$.)
- With the exception of Dugesia sp., zebra mussels, larval fish and nutrients had no significant effect on the population size of individual taxa.

CONCLUSIONS

- Zebra mussels, larval fish and nutrients (as single factor treatments) had no observable effect on benthic invertebrates.
- Further study is needed to consider the interactive effects of zebra mwssels, larval fish and nutrients on the aquatic food web.

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