The impacts of zebra mussel (*Dreissena polymorpha*) on the feeding ecology and condition of early-stage Striped Bass (*Morone saxatilis*)

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Introduction:

The invasion of zebra mussel (*Dreissena polymorpha*) in the Hudson River in the early 1990s sharply reduced phytoplankton biomass and markedly altered estuarine energy flow (Strayer et al. 1999). While the abundance of benthic organisms living in the littoral zone increased, abundance of native bivalves and benthic organisms living in deeper waters declined (Fig.1). These changes within the estuary resulted in a divergent response in littoral versus pelagic fish species, where littoral species displayed positive changes and pelagic negative changes. Strayer et al. (2004) suggested that abundance and growth of early-stage fishes of several pelagic species were negatively impacted by the invasion. While the mussel invasion in the estuary is well documented, analysis of how feeding ecology of early-stage fishes was altered by mussels has not previously been conducted. One such species that may be affected is the Striped Bass (*Morone saxatilis*). Striped Bass represent a highly important commercial fish and have been exploited in the Hudson River since the 19th century (Daniels et al. 2011). The objective of the present study is to assess feeding success indicated by condition index and to observe changes in diet of bass over multiple years divided into three periods: pre-invasion, post mussel invasion, and recovery years.

Predictions:

- Condition will decrease after the zebra mussel invasion due to reduced feeding success
- Littoral prey items will become more prevalent in the diet due to increased littoral production

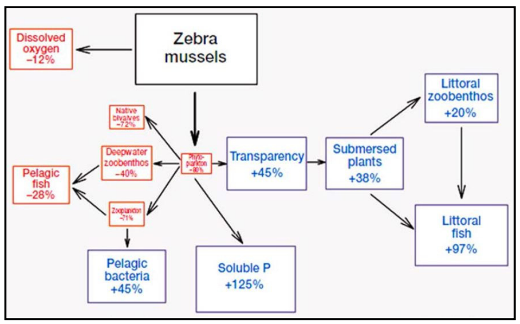

Figure 1. Effects of zebra mussel on the Hudson River ecosystem in the first decade of invasion. Red boxes represent negative impacts, and blue boxes represent positive effects (from Strayer 2009).

Methods:

Fish specimens were collected at night through the Hudson River Utilities Longitudinal River Survey. We obtained archived fish from Normandeau Associates and the New York State Museum from upriver and downriver locations of the estuary in the years 1988, '91, '92, '93, '95, '97, '99, '05, '07, '09, and '11 (n=60/yr). 1988-'92 were considered pre-invasion years,1993-'99 were post-invasion years, and 2005-'11 were recovery years. Samples from each year were spatially partitioned into upriver and downriver categories based on location of collection. Upriver samples represent fish taken from areas of high zebra mussel abundance and downriver areas of no zebra mussels. We measured standard length for all fish using digital software (Fig. 2). Gut contents were removed and identified to the lowest taxonomical level possible (Fig. 2). We obtained a dry mass of each bass.

Acknowledgments:

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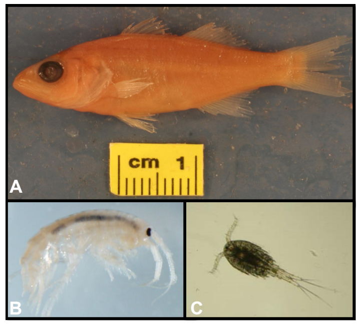

Figure 2. a) Juvenile bass b) Gammarid amphipod c) Cyclopoid copepod.

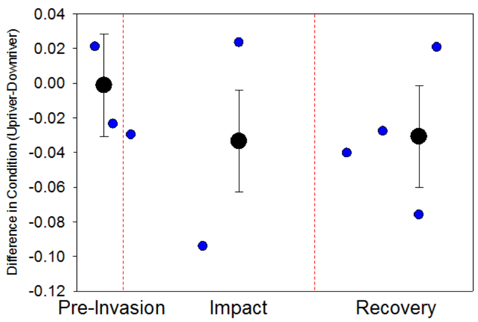

Figure 3. Difference in condition between upriver and downriver samples. Blue circles indicate values for individual years and black circles indicate mean of the period. Effect of period p= 0.7.

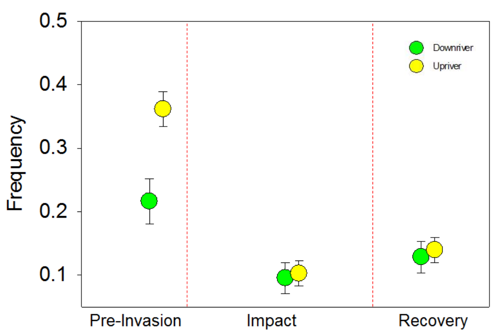

Figure 4. Frequency of amphipods in gut contents of upriver and downriver samples between three invasion periods. Effect of river location and period interaction p= 0.02.

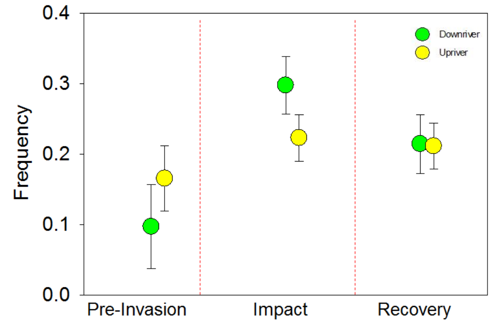

Figure 5. Frequency of cyclopoida copepods in gut contents of upriver and downriver samples between three invasion periods. Effect of river location p=0.7, effect of period p=0.6.

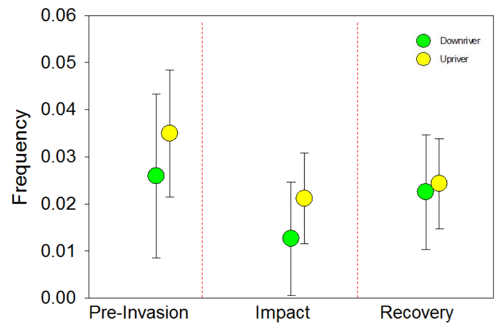

Figure 6. Frequency of bivalves in gut contents of upriver and downriver samples between three invasion periods. Effect of river location p=0.7, effect of period p=0.8.

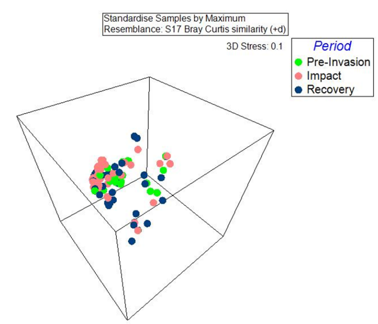

Figure 7. nMDS plot of overall bass diet composition within three invasion periods. Effect of period p=0.7.

Results:

Condition:

Condition of bass varied among years, such that condition was relatively high in some pre-invasion years and relatively low in some post-invasion years. Overall, there was no effect of invasion period on condition (Fig. 3, p=0.7).

Prevalent Prey and Diet Composition:

Amphipods, cyclopoids, and bivalves were the most frequent prey items found within bass guts. There was no effect of location or period on the frequency of amphipods, however their interaction was significant and the frequency of amphipods found within guts decreased after mussel impact (Fig. 4, effect of location*period p=0.01). Cyclopoid and bivalve frequency did not differ between location or period (Fig. 5 and Fig. 6, effect of period p=0.6, 0.8 respectively). The total diet composition, including all prey items, did not differ among periods (Fig. 7, ANOSIM global r= -0.08, p= 0.7).

Conclusions:

The effects of zebra mussel on the feeding ecology early-stage bass is minimal. Contrary to our predictions, we found no evidence for an effect of zebra mussels on bass condition during impact years. There was no clear shift in prey preference with respect to period. Diet composition did not change between invasion periods.

Condition:

Fish condition can be used as an indicator of feeding success. Due to the numerous effects mussels have on the estuary (Fig. 1), we expected to see a decline in feeding success in years of high mussel impact. We found no evidence to support our prediction. While high variation existed on a year to year basis, there was no significant effect of period (Fig. 3).

Prevalent Prey and Diet Composition:

The decrease in amphipod frequency (Fig. 4) and no change in bivalve frequency (Fig. 6) were the opposite of our prediction, where we expected to see a shift towards littoral based prey items during years of high mussel impact. Copepoda's unchanged prevalence throughout the years is consistent with data showing copepod's resiliency to invasion impacts (Pace et al. 1998). Overall, we found no difference in the total diet composition of bass between invasion periods. These results suggest that while zebra mussels may have widespread impacts on the zooplankton and macroinvertebrate fauna, early stage bass diet has not been impacted.

References:

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