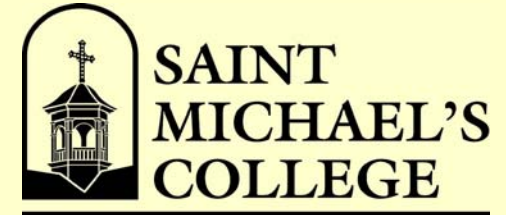


Dietary overlap between invasive white perch and three native fishes in Missisquoi Bay

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Abstract

White perch did not inhabit Missisquoi Bay 10 years ago, but are now one of the most abundant species. We examined the diets of invasive white perch and native yellow perch, pumpkinseed sunfish, and golden shiners, to assess the degree of dietary overlap and to gain a more comprehensive understanding of the food web of the Bay. We collected fishes from three areas in Missisquoi Bay during the spring and summer of 2005 and analyzed the contents of their stomachs. The stomachs contained many of the same items including mollusks, soft-bodied invertebrates, and zooplankton. Schoener's index showed range of dietary overlap, with the highest (0.77) between juvenile white perch and juvenile yellow perch. These results indicate that the diets of these fishes overlapped and suggest that the invasion of white perch into the Bay has the potential to affect the diets of native fishes, and perhaps the ecosystem as a whole.

Introduction

Missisquoi Bay

Missisquoi Bay is a shallow, eutrophic section of northern Lake Champlain that lies on the border of Vermont and Quebec. The Bay covers an area of approximately 77.5 square kilometers, has a maximum depth of about 4 meters, and provides numerous ecological functions, all of which are dependent on a clean lake and a balanced ecological community.

The Fishes

White perch (*Morone americana*), yellow perch (*Perca flavescens*), golden shiners (*Notemigonus crysoleucas*), and pumpkinseed sunfish (*Lepomis gibbosus*) all presently inhabit Missisquoi Bay. White Perch colonized southern Lake Champlain in 1984 (Malchoff et al. 2005) and in more recent years have made their way up to Missisquoi Bay. They were not present in 1995, but by 2003 had become the dominant species in some parts of the Bay (Bilodeau et al. 2004). There is concern that white perch may be competing with native species, and perhaps changing the dynamics of the food web in the community as a whole. In many habitats in which white perch and yellow perch are found together, their diets tend to overlap (Smith 1985). White perch, yellow perch, and pumpkinseed sunfish undergo dramatic ontogenetic diet shifts; juveniles eat primarily zooplankton, and adults eat primarily macroinvertebrates (Bergman and Greenberg 1994, Huckins 1997). Golden shiners are an abundant minnow in Missisquoi Bay and feed largely on zooplankton and other small invertebrates (Ehlinger 1989). There is considerable potential, therefore, for the diet of the invasive white perch to overlap with the diets of the native fishes.

Objective

Our study was undertaken in order to assess the dietary overlap among common fishes in Missisquoi Bay, both native and invasive, and to gain a more comprehensive understanding of the food web of the bay as a whole.



Methods

- We captured fish by seining (late April, late July) or electrofishing (June)
- Captured fish were put on ice, then frozen
- Stomachs were removed from thawed fish
- We identified stomach contents to lowest possible taxonomic groups and counted food items
- We determined the average percent of individuals per stomach for all species sampled, then calculated the average for each species

Results

- In April, chironomids were among the highest average percent of individuals per stomach in the adult white perch, yellow perch, and pumpkinseed sunfish in southern Missisquoi Bay (Figure 1)
- In June in Rock River Bay, chironomids, amphipods and Chydoridae showed the highest percentage of overlap between the white perch other species (Figure 2)
- In June in Goose Bay, the diet of white perch overlapped with yellow perch and pumpkinseed sunfish; all three species ate chironomids, caddisflies, *Hexagenia*, and amphipods (Figure 3)
- There was significant diet overlap (Schoener's index ≥ 0.6 ; Table 1) between
 - adult white perch and pumpkinseed sunfish in southern Missisquoi Bay in April
 - adult white perch and both adult and juvenile yellow perch in Rock River Bay in June
 - juvenile white perch and juvenile yellow perch in Rock River Bay in July
- Ontogenetic diet shifts were noted in white perch and yellow perch, both of which fed primarily on zooplankton as juveniles and larger macroinvertebrates as adults
- An ontogenetic diet shift also was noted in the pumpkinseed sunfish which fed primarily soft-bodied invertebrates as juveniles and primarily mollusks as adults

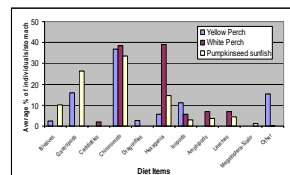


Figure 1. The average percent of individuals per stomach in yellow perch, white perch, and pumpkinseed sunfish collected from southern Missisquoi Bay in April.

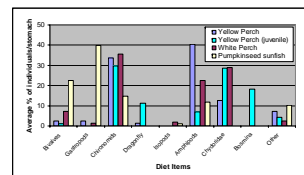


Figure 2. The average percent of individuals per stomach in yellow perch, white perch, and pumpkinseed sunfish collected from Rock River Bay in June.

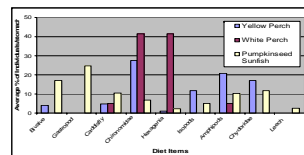


Figure 3. The average percent of individuals per stomach in yellow perch, white perch and pumpkinseed sunfish collected from Goose Bay in June.

Table 1. Schoener's index of overlap in diet between invasive white perch and native yellow perch and pumpkinseed sunfish in Missisquoi Bay

Southern Missisquoi Bay (late April)	adult yellow perch	0.54
overlap with adult white perch	adult pumpkinseed sunfish	0.60
	adult yellow perch	0.75
Rock River Bay (June 8)	juvenile yellow perch	0.69
overlap with adult white perch	adult pumpkinseed sunfish	0.39
	adult yellow perch	0.46
Goose Bay (June 8)	adult pumpkinseed sunfish	0.40
overlap with adult white perch		
	juvenile yellow perch	0.77
Rock River Bay (July 21)		
overlap with juvenile white perch		

Conclusions

- The diets of invasive white perch included many of the same items as the diets of the native fish in both juvenile and adult stages
- There was significant overlap between the diet of white perch and the diets of the native yellow perch and pumpkinseed sunfish in some parts of Missisquoi Bay during some sampling periods
- Similar ontogenetic shifts in the white perch and native species indicate the potential for overlap in all stages of their lives possibly creating a larger impact on the ecosystem as a whole
- This study provides the background information needed to assess both the current and future conditions of the Missisquoi Bay ecosystem



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