

Diet Selectivity of White Perch (*Morone americana*) in Lake Champlain

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Introduction

White Perch (*Morone americana*) are invasive to Lake Champlain. They were first discovered in southern Lake Champlain in the mid 1980's, have expanded northward, and were first documented in Missisquoi Bay during the mid 1990's (Crawford 2005). They have become abundant throughout the lake and have a reputation of being opportunistic, voracious predators. Couture and Watzin (2008) found that White Perch in the bay selectively fed on *Daphnia* and other cladocerans through June and July. White and Facey (2009) reported that White Perch fed mainly on zooplankton during the early summer, switching to small fish and benthic macroinvertebrates later in the season.

The establishment of invasive Alewife (*Alosa pseudoharengus*) in Lake Champlain, including Missisquoi Bay, may have changed the ecosystem once again. In other areas, the Alewife's major prey tends to be zooplankton except during early summer when insects are heavily abundant. An extensive study by Wells (1970) determined that the Alewife's populations drastically affected zooplankton populations, specifically *Leptodora*, *Daphnia*, and large copepods, some of the same species eaten by White Perch (Couture and Watzin, 2008; White and Facey, 2009).

We investigated the diets of White Perch in Missisquoi Bay during the summer of 2009 to (1) determine if White Perch preferentially fed on some zooplankton, and (2) look for evidence of change in diet since Alewife have become more abundant.



Missisquoi Bay, is located in Vermont and the province of Quebec. The bay is a large, shallow (<4.5m) body of water in the northeastern section of Lake Champlain. The water in the highly eutrophic bay can get quite warm during the summer, promoting blooms of cyanobacteria.

Methods

- We collected White Perch by hook and line about once a week from early June to mid August, 2009 between the hours of 10am and 3pm; fish were killed by cranial concussion (in accordance with IACUC review), put on ice, and frozen when returned to the lab.
- Two vertical plankton tows per sampling date were taken in the area where the fish were collected; zooplankton were preserved in 70% ethanol.
- Fish were later thawed, measured, weighed, and stomachs were removed.
- We identified zooplankton to genus or species from each tow and stomach until at least 100 individuals or the entire sample was recorded.
- The Manly-Chesson Index (Chesson 1983) was used to test for prey selectivity of each fish; index values were averaged for each sampling date. Stomachs absent of zooplankton were not included in the analysis.

$$\alpha = (r_i / p_i) / \sum (r_i / p_i)$$

where r_i = proportion of item in diet, and p_i = proportion of item available in environment.

$\alpha > 1$ /(# food categories available) indicates positive selection
 $\alpha < 1$ /(# food categories available) indicates negative selection

Results

- Over the first three weeks of sampling in June, *Daphnia* comprised >60% of the zooplankton assemblage (Figure 1).
- Daphnia* were consistently the most common zooplankton in the stomachs of White Perch and were positively selected for throughout the months of June and July (Figure 2, Table 1).
- Calanoids were the only copepods that were positively selected for among the assemblage (Table 1, June 5).
- Bosminids were not found in the stomachs of White Perch on July 25 when they comprised >50% of the zooplankton assemblage.
- Other prey items, including chironomids, were found in the stomachs during the months of June and July, but on average were < 1% of stomach contents.
- Two sampling dates in August were not included in figures or table because fish stomachs did not contain any zooplankton. There were zooplankton in the environment, but much fewer than in earlier samples. Instead of zooplankton, fish consumed cyprinids, chironomids, ephemeropterans, and other macroinvertebrates.

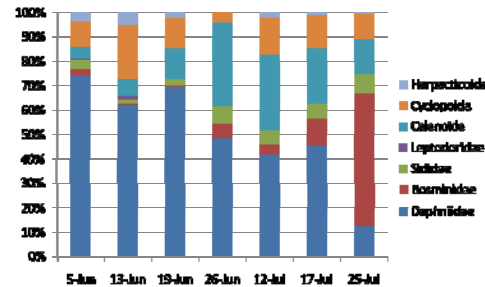


Figure 1. Average distribution of zooplankton collected in Missisquoi Bay, Lake Champlain during the summer of 2009.

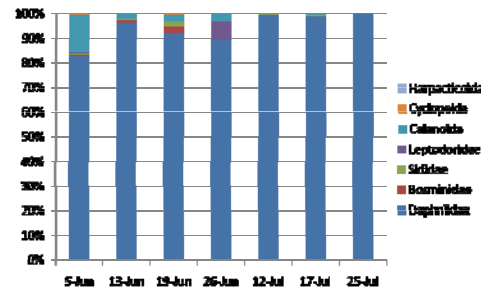


Figure 2. Average distribution of zooplankton in stomach contents of White Perch in Missisquoi Bay, Lake Champlain during the summer of 2009.

Table 1. Average Manly - Chesson (MC) selectivity index values for White Perch (*Morone americana*) feeding on zooplankton. If the MC index is greater than the MC reference for the sampling day, this indicates positive selection. If the MC index is less than the MC reference, this indicates negative selection. (*) indicates prey item found in some stomachs but not in plankton samples.)

Zooplankton	Sampling Dates						
	5-Jun	13-Jun	19-Jun	26-Jun	12-Jul	17-Jul	25-Jul
(MC reference)	(0.143)	(0.143)	(0.200)	(0.200)	(0.167)	(0.167)	(0.167)
Cladocera							
Daphniidae	0.206	0.561	0.551	0.947	0.950	0.903	0.978
Bosminidae	0.027	0.237	*	0.000	0.016	0.000	0.000
Sididae	0.015	0.095	0.343	0.000	0.035	0.021	0.000
Leptodoridae	0.184	0.000	0.000	*	0.000	0.000	0.000
Copepoda							
Calanoida	0.553	0.099	0.080	0.053	0.000	0.076	0.000
Cyclopoida	0.015	0.005	0.027	0.000	0.000	0.000	0.022
Harpacticoida	0.000	0.003	0.000	0.000	0.000	0.000	0.000

Discussion

- White Perch ate primarily *Daphnia* on all sampling dates, even on July 25 when they were not the most abundant type of zooplankton available. The abundance of *Daphnia* in the environment was high at the beginning of June but never reached the same level throughout the summer.
- White Perch may be selectively feeding on *Daphnia* because they are generally much larger zooplankton than bosminids and some copepods.
- It is possible that White Perch become almost exclusively focused on feeding on *Daphnia* early in the summer when the *Daphnia* are plentiful (>60% of assemblage) and become fixated with feeding on them even when they are not the most readily available in the environment.
- The overall diet of the White Perch was not similar to that found three years earlier by White and Facey (2009), when *Leptodora* were abundant in the diet of White Perch in late June and mid July. Couture and Watzin (2008) found positive selection for *Leptodora* in mid-late July. Perhaps the presence of Alewife has led to changes in zooplankton availability and assemblages.
- In further studies it would be valuable to study the stomach contents of Alewife to determine diet overlap between these two planktivores in Missisquoi Bay. The relative abundance and impact of Alewife on Missisquoi Bay is unclear, but the diet of White Perch has changed.
- The cause of the switch in White Perch diet from zooplankton late in the summer was most likely due to declining populations of zooplankton. Decreasing zooplankton populations could be one of the causes for earlier and larger cyanobacteria blooms in Missisquoi Bay. The change in the perch's diet over the summer was similarly found in the studies by Couture and Watzin (2008) and White and Facey (2009).

Acknowledgements

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Literature Cited

- Chesson, J. 1983. The estimation and analysis of preference and its relationship to foraging models. *Ecology* 64: 1297-1304.
- Couture, S.C. and M.C. Watzin. 2008. Diet of invasive adult white perch (*Morone americana*) and their effects on the zooplankton community in Missisquoi Bay, Lake Champlain. *J. Great Lakes Res.* 34: 485-494.
- Crawford, M. 2005. Hostile takeover? New species of fish could be detrimental to Lake Champlain. *Burlington Free Press*, 27 March 2005. Available online at <<http://www.burlingtonfreepress.com/Columnists/Mat0327043905.htm>>.
- Wells, L. 1970. Effects of alewife predation on zooplankton population in Lake Michigan. *Limnology and Oceanography*. 15: 556-566.
- White, J.D., and D.E. Facey. 2009. Diet overlap between native yellow perch and invasive white perch in Missisquoi Bay, Lake Champlain, Vermont. *Verh. Internat. Verein. Limnol.* 30: 1189-1192.