Predation of larval lake sturgeon by piscine predators in the Black River, MI

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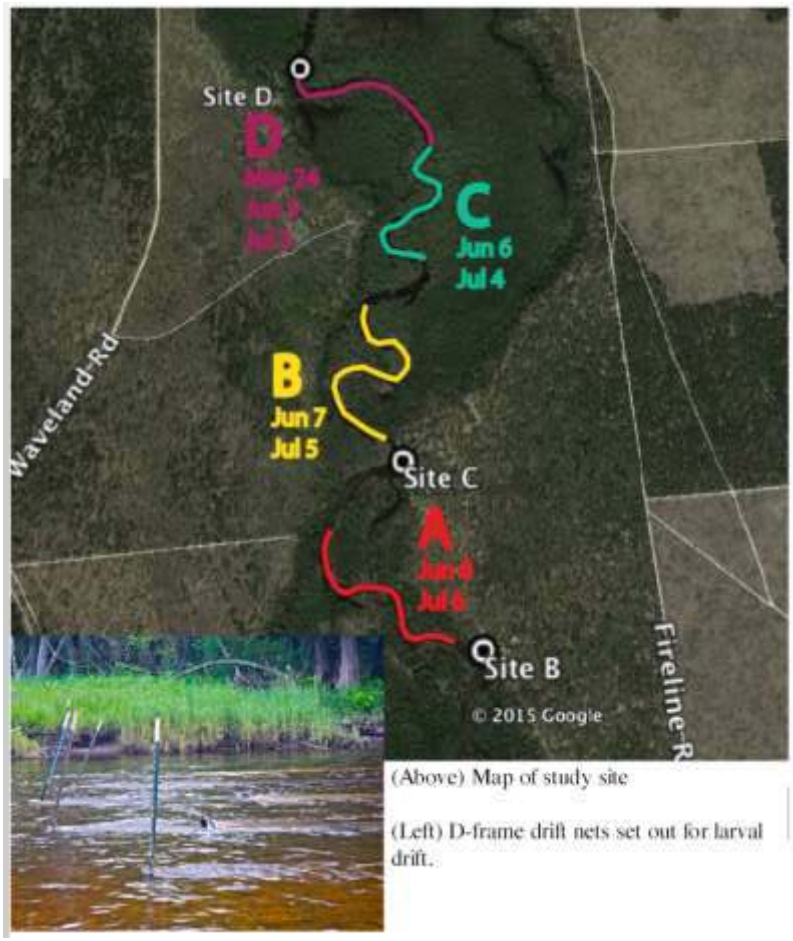
Introduction

Mortality in larval fishes can be a significant factor to population levels of recruitment, especially in species with high early life stage mortality like lake sturgeon (Acipenser fulvescens).

Investigated predation of larval sturgeon through field surveys that focused on estimating larval loss and by quantifying the composition of potential predator communities.

Conducted predation experiments in simulated stream environments to identify potential predators and their preferences for alternative prey.

Study Site and Survey Design



(Above) Map of study site

(Left) D-frame drift nets set out for larval drift.

The Upper Black River in Michigan (45°43'N, 84°15' W) is the primary tributary used for spawning by lake sturgeon population in Black Lake.

Spawning is localized mainly in Sites B & C. An ~2km stretch downstream of spawning sites was broken up into a total of four transects (colored lines on map). Transects A & B had gravel substrate; transects C & D had sand substrate.

D-frame drift nets were set up at the beginning and end of each of the colored transects during the larval drift period. Larval sturgeon were counted on site and released, and a subsample of the co-distributed drift was taken for each hour and preserved in ethanol.

The transect was electrofished the day after drift. Potential predators were enumerated and diet samples were collected.

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Community of Possible Predators

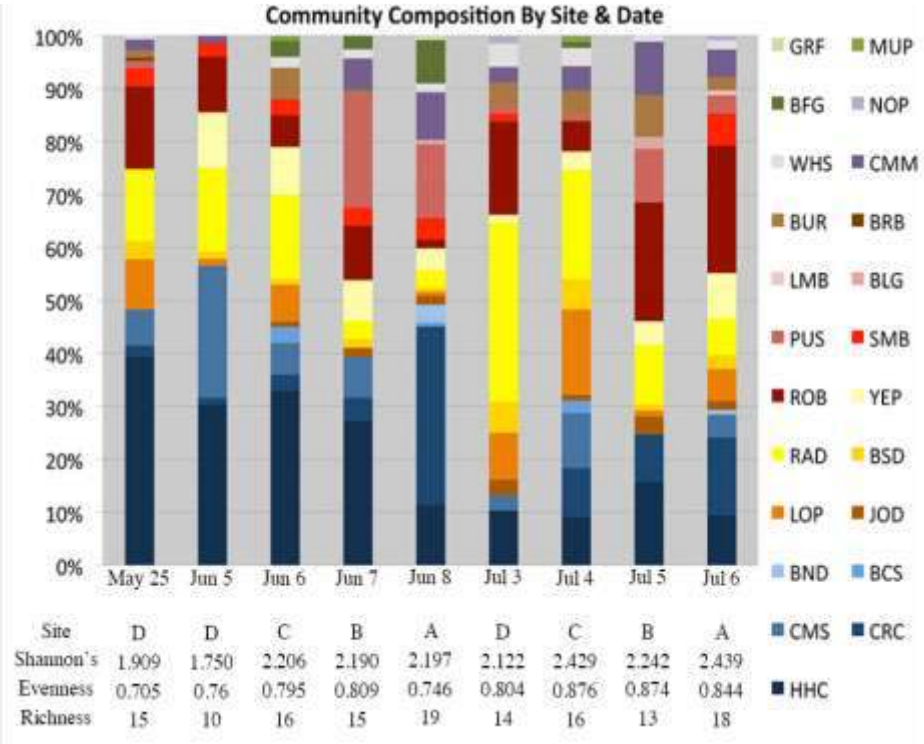


Figure 1 (left). Proportions of predator species from each of the transects in the electrofishing survey.
At the bottom of the graph are the Shannon's index of diversity, evenness of species distributions, and total species richness.

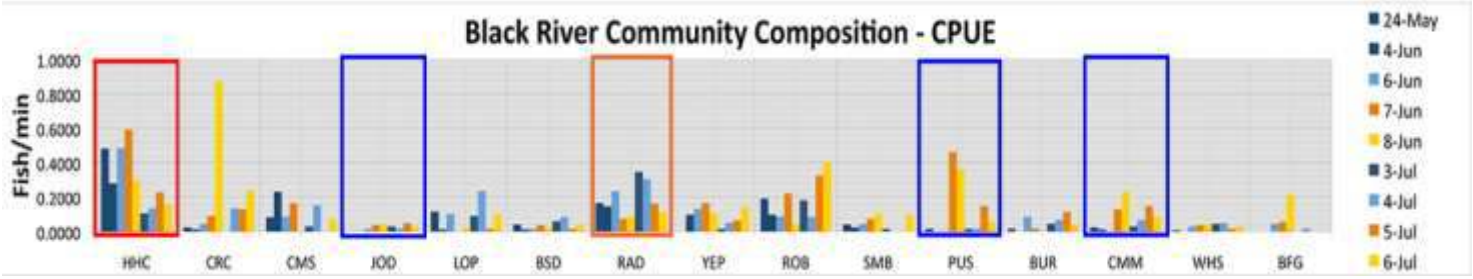
Results. Three families represented the majority of the species observed: Cyprinidae (blues), Percidae (yellows & oranges), and Centrarchidae (reds).

Shannon's diversity increased in July compared to June ($p=0.043$), most likely due to increased evenness ($p=0.008$), rather than species richness.

Figure 2 (below). Catch per unit effort was used as a proxy for the relative abundance of a species between transects. Relative abundances were analyzed to determine if species had significant preferences for certain substrates or time periods.

Hornyhead chub (*Nocomis biguttatus*), decreased in abundance from June to July (red box, $p=0.005$).

Johnny darter (*Etheostoma nigrum*), pumpkinseed (*Lepomis microlophus*), and central mudminnow (*Umbra limi*) preferred gravel substrate (blue boxes, $p<0.05$), while rainbow darter (*Etheostoma caeruleum*) preferred sand (orange box, $p=0.028$).



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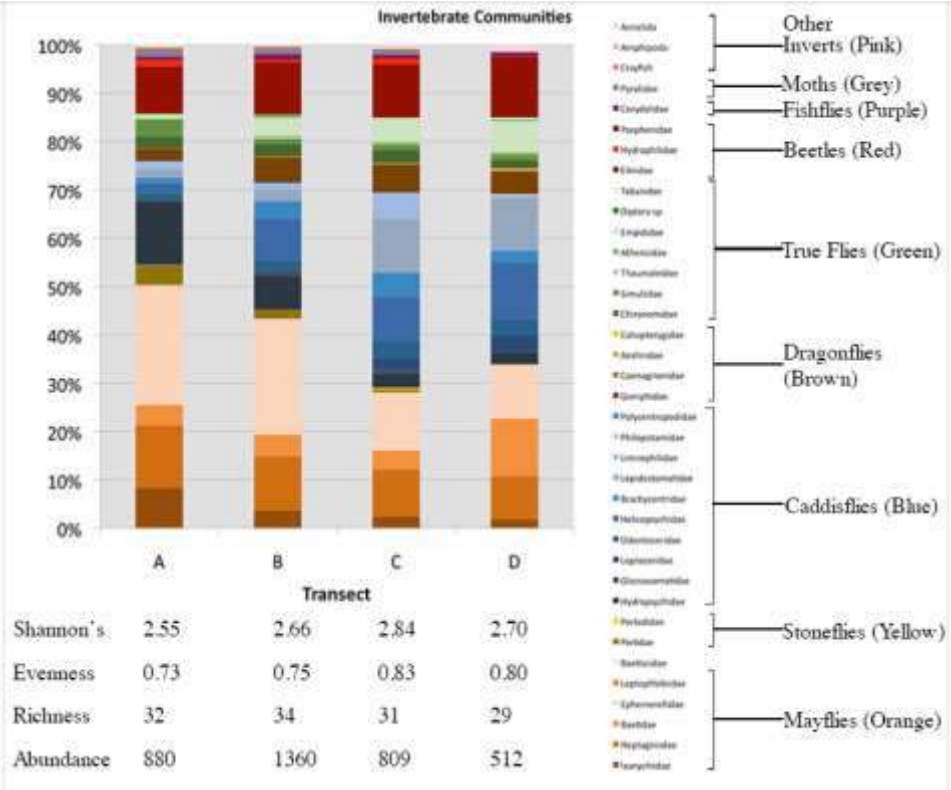
Community of Co-Distributed Prey

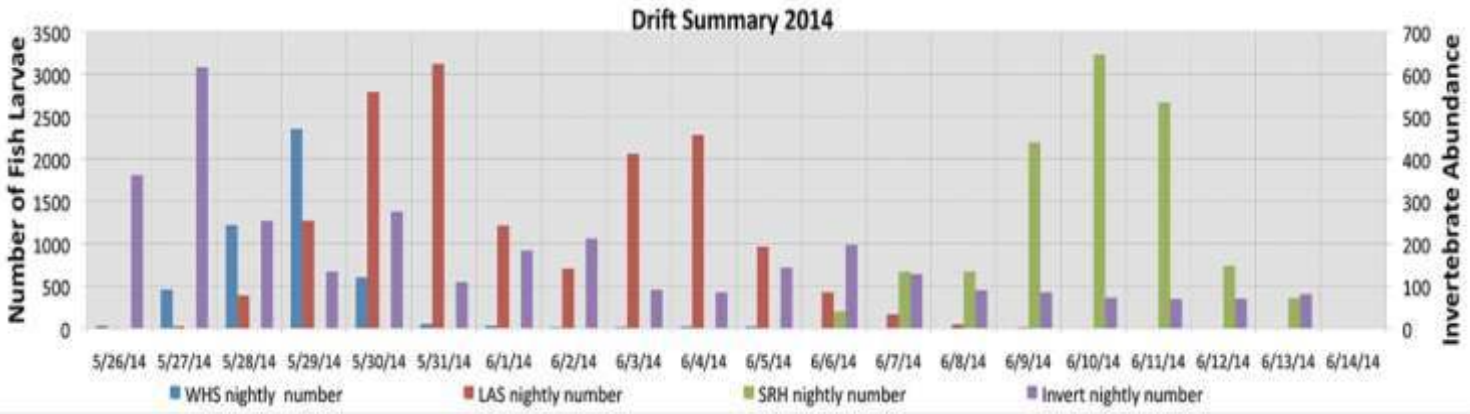


	A	B	C	D
Shannon's	2.55	2.66	2.84	2.70
Evenness	0.73	0.75	0.83	0.80
Richness	32	34	31	29
Abundance	880	1360	809	512

Figure 3 (left). 2014 kicknet survey of the benthic invertebrate communities in the study area broken down by transect.

Gravel transects, A & B, had the highest abundances of invertebrates and the highest family richness, but sand transects C & D had higher values for Shannon's Diversity Index due to greater evenness.

Figure 4 (below). 2014 nightly catch data from the larval drift survey collected at Site D (see map).
In addition to larval sturgeon and invertebrates, larval white sucker (*Catostomus commersonii*) and silver redhorse (*Moxostoma anisurum*) make up a significant portion of the drift.



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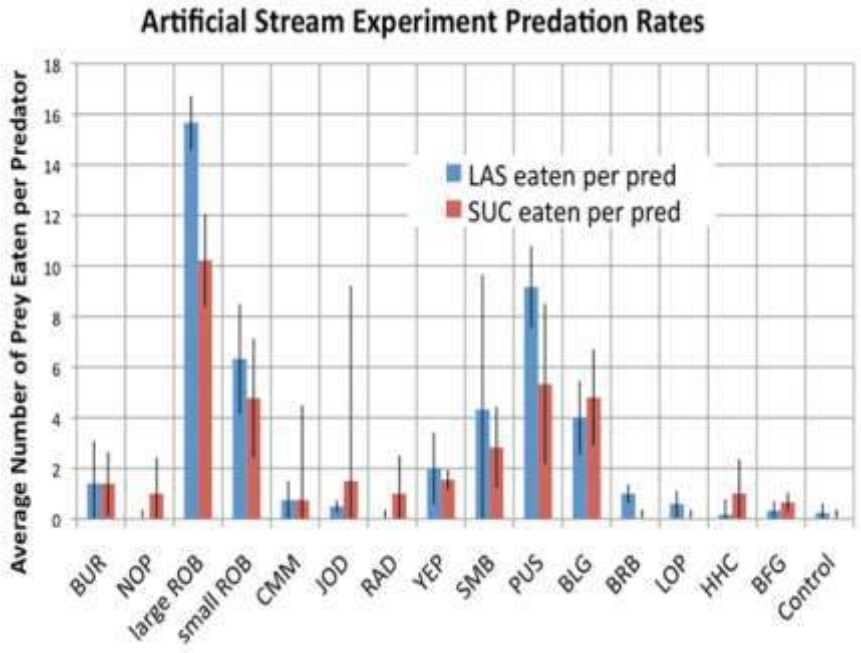
Artificial Stream Experiments

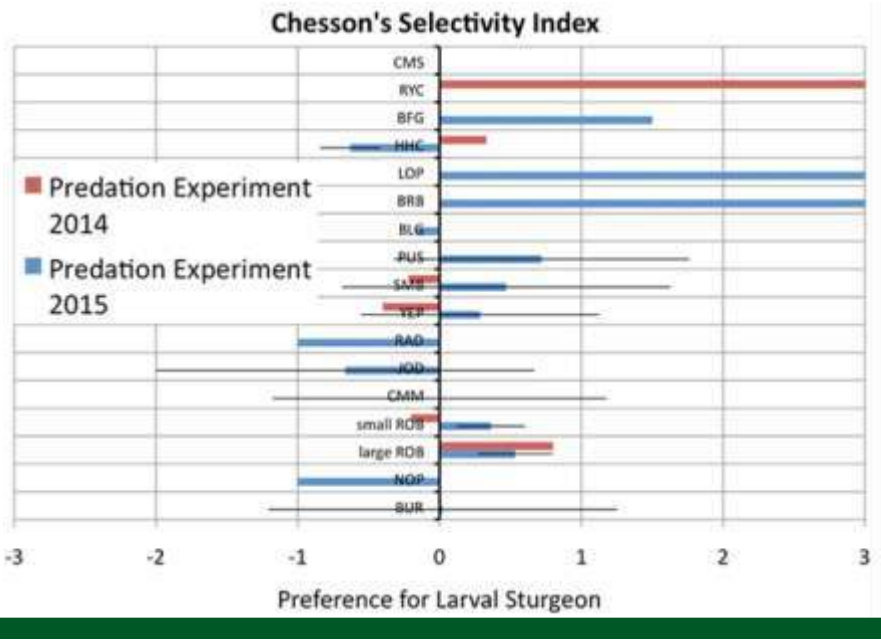


2014 Predation Experiment: single predators offered 4 sturgeon larvae & 4 sucker larvae in 850cm diameter circular tanks. Trials lasted 12h.

2015 Predation Experiment: 3 predators were offered 30 sturgeon larvae & 30 sucker larvae (or equivalent ratio depending on availability of test subjects) in 7.4m long raceways with a recirculating pump to generate a 0.14m/s current. Trials lasted 30min.

Figure 5 (above). Results showing the average number of larval sturgeon and suckers consumed by each predator species. Error bars represent the 95% confidence interval. Rock bass (*Amblopites rupestris*), smallmouth bass (*Micropterus dolomieu*), pumpkinseed sunfish (*Lepomis microlophus*), and bluegill (*Lepomis macrochirus*) were directly observed to prey upon larval fish. Yellow perch (*Perca flavescens*), rusty crayfish (*Orconectes rusticus*), hornyhead chub (*Nocomis biguttatus*), and common shiner (*Luxilus cornutus*) also appear to be larval fish predators.

Figure 6 (right). The Chesson's Selectivity Index for each of the species tested. A positive value represents preference for sturgeon; a negative value indicates suckers were the preferred prey. Error bars represent the 95% confidence interval.



The large size class (TL>150mm) of rock bass and rusty crayfish display the greatest preferences for sturgeon for species known to prey on larval fish.

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Conclusions / Current Research

The synthesis of the predation experiments with the predator survey reveal which species may have an significant role in larval sturgeon mortality.

Example 1. Rock bass (*Amblopites rupestris*): found throughout the Black River, had a significant preference for sturgeon, and consumed the highest number of prey items per individual.

Example 2. Hornyhead chub (*Nocomis biguttatus*): recognize larval sturgeon as prey, and make up >25% of the predator community during the sturgeon spawning season.

Additional data and samples collected during the field season continue to address the question of what species and conditions are important in the predator-prey dynamics of larval sturgeon.

The two-site drift survey data can estimate the larval sturgeon mortality in each transect. That information can be applied to ask what substrate types and communities correlate with higher mortality.

DNA is being extracted from the diet samples collected during the electrofishing survey. Prey-specific primers can provide direct evidence of consumption of the prey items present in the drift.

Acknowledgements

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