DO CHANNEL CATFISH CONSUME ZEBRA MUSSELS?

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***Abstract*—Channel catfish *Ictalurus punctatus* are a generalized opportunistic feeder with a wide range of diet compositions. In the Midwest, zebra mussels *Dreissena polymorpha* have quickly spread, causing large effects on aquatic ecosystems structures and functions. Channel catfish are known to consume native mollusks, however, little research has been done on the potential predation of zebra mussels by channel catfish. Therefore, the objective of this study was to analyze channel catfish diets to determine if zebra mussels are consumed. The channel catfish were obtained from the Sauk River chain of lakes between the dates of 14 June and 28 July 2023. The stomach contents identified to the lowest classification possible and counted. A total of 4 zebra mussels were found in the 38 stomachs that were sampled. Channel catfish do eat zebra mussels but it is likely done unintentionally when targeting other prey.**

I. Introduction

Channel catfish *Ictalurus punctatus* are a benthic, dwelling species commonly found throughout Minnesota's large river systems and tributaries. Known to be a generalized opportunistic feeder, the species has been shown to have no dominant food source (Braun and Phelps 2016). Their diets consist of an abundance of different fish, aquatic invertebrates, and vascular plants, allowing for the species to thrive in a range of habitats. The wide habitat range can potentially provide a buffer from habitat degradation. In the Midwest, channel catfish are an important species as they provide great sportfish angling opportunities and are important commercially.

Zebra mussels *Dreissena polymorpha* are an invasive species to North America and are spreading throughout Minnesota. Existing as a freshwater bivalve filter feeder, this species can rapidly reproduce. Maturing within a year, females can produce up to a million eggs a year. (Borcherding 1991). Once established, zebra mussels are outcompeting the native filter feeders by feeding on algae, macroinvertebrates, bacteria, detritus, and other organic compounds (Vanderbush et al. 2021). This competition creates large effects on ecosystem structure and functions, as zebra mussels alter habitat, affect food availability for pelagic and benthic species, and affect oxygen availability, sedimentation rates, and mineralization of nutrients (Karatayev et al. 2002).

The introduction of zebra mussels has shown to provide additional prey items to certain species. Magoulick and Lewis (2002) found zebra mussels were the primary prey eaten by 52.9% of blue catfish *Ictalurus furcatus* and 48.2% of freshwater drum *Aplodinotus grunniens*. While channel catfish are known to feed on native mollusks, little research has been done on the potential predation of zebra mussels by channel catfish. However, Bowers and de Szalay (2007) has suggested large bodied molluscivorous fish like channel catfish can limit zebra mussel numbers in coastal wetlands. The objective of this study is to assess the diets of channel catfish to see if zebra mussels are preyed upon within the Sauk River chain of lakes.

II. Methods

Channel catfish were collected using three different methods of capture, angling, hoop nets, and gillnets. All the fish were obtained from the Sauk River Chain of the lakes in Richmond Minnesota during the summer from the dates of 14 June to 28 July 2023. Four locations on the chain of lakes were chosen to account for different densities of zebra mussels. Zebra mussels were first documented in the system in 2017. Historically, the chain of lakes has been considered eutrophic to hyper eutrophic due to excessive nutrient loading. Lake-river ecotones provide good habitat for bivalves like zebra mussels due to easy access of food drifting lake to lake. Zebra mussels also prefer moderately eutrophic or highly eutrophicated lakes, which is likely caused by large amounts of food for zebra mussels in eutrophic systems (Czerniawski and Krepski 2021).

A total of 38 fish were captured by standard fishing equipment, line, and hook, tandem-set hoop nets, and gill nets. Gill nets were set in accordance with the standard survey methods of the Minnesota Department of Natural Resources (MNDNR 2023). Gill nets were set parallel with the shoreline in water 1.2-4.5 m deep. Tandem-set hoop nets were set with coinciding methodology from catch of channel catfish in lentic systems in Nebraska (Richters and Pope 2011). Tandem-set hoops nets consisted of three nets, attached bridle to cod end, with four concreate anchors. Anchors were attached to the cod end and middle nets to mitigate buoyancy and an anchor attached to the bridle end to prevent the hoop nets from collapsing. Nets were baited with powdered soy in a burlap bag with a float connected. The float was used to prevent fish from pulling the bag out of the hoop nets. Hoop nets measured 3.4 m in length, with seven fiberglass hoops. The largest fiberglass hoop measured approximately 0.7 m in diameter, successive hoops incrementally decreased by 3.8 cm towards the cod end of the net. The distance between each fiberglass hoop measured approximately 0.46 m. The netting was made with #15 nylon twine with two finger style attached to the second and fourth hoop. The finger style throats were attached with two 0.47 cm nylon twine that measure approximately 0.55 m. Attached to the cod end of the net were two 12.7 cm draw strings tied around the rear throat to reduce escape from the hoop nets. The hoop nets were set parallel to the shoreline in 1.8-3 m of water.

Once a fish was collected, total length (mm) and weight (g) were measured. Once measured, the stomach contents were removed from the fish, and the stomach contents were placed in a bag containing 70% ethanol. Ethanol was added to prevent decomposition of the stomach matter. The bag was given an identification number with the individual fish's total length and weight attached. The bags were then stored at room temperature to be analyzed in the laboratory at a later date.

In the lab, items found in stomach contents were weighed, counted, and examined under a compound microscope. Stomach contents were then identified to the lowest classification possible. After the stomach contents were classified, diet items were then separated by species for each individual stomach, then put into a drying oven to obtain each stomachs dry weight.

Once all the diets were processed, program R was used to analyze the diets (R Core Team 2022). Frequency of occurrence and prey-specific abundance plot were created.

$$O_i = J_i/P$$

Frequency of occurrence (O_i) was calculated by dividing the number of fish diets (J_i) containing a certain prey item by the total number of fish diets (P).

$$P_i = S_i/Sti$$

Prey-specific abundance (P_i) was calculated by dividing the total number of prey-specific item (S_i) by the total number of prey items in diets that contained the specific prey item (S_{ti}).

The graphical model (Figure 11.3, Chipps et al. 2007) that depicts feeding strategy (specialized or generalized), relative prey importance (dominant or rare), and niche variation (individual or population pattern) was used to access any feeding strategies among the channel catfish.

III. Results

Stomach contents were collected from 38 channel catfish (345-620 mm TL). Across the 38 stomachs processed, a total of nine diet contents were found. Of the 293 diet items processed, four zebra mussels were consumed. Conidae were the most common diet item to be found, as they accounted for 74.40% of the diet items in channel catfish. Crangonyctidae were the second most common prey item found accounting for 16.38% of the diet items, while the third most common was *Lepomis* spp. accounting for 0.04%. Filamentous green algae were also found in the channel catfish stomachs, as 47.37% of stomachs contained algae (Figure 1).

Fig. 1. Channel catfish stomach containing filamentous green algae.

Frequency of occurrence and prey specific abundance plots were used to differentiate the population of channel catfish feeding habits, to an individual level. When channel catfish consumed *Lepomis* spp., it consisted of 86.67% of the stomach content items found across all stomachs sampled

(Figure 2). The data also indicates that when channel catfish grew larger in length, the *Lepomis* spp. that they consumed were also larger.

IV. Discussion

A key finding of this study is that zebra mussels were consumed by channel catfish, however, in very low numbers. Channel catfish are considered to have a generalized opportunistic feeding strategy, in which they are omnivores (Braun and Phelps 2016). Within the stomachs that contained zebra mussels, filamentous algae was also found. Since channel catfish feed upon a variety of prey and in different habitats, the zebra mussels likely consumed unintentionally.

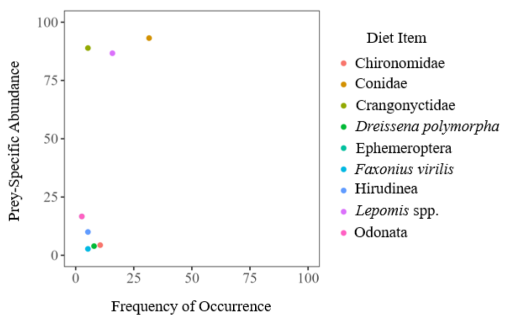

Fig. 2. Prey-specific abundance plotted against frequency of occurrence for each of the prey species in channel catfish.

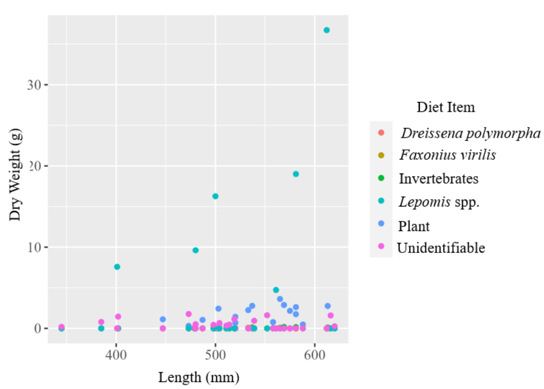

Fig. 3. Dry weight of stomach contents against length of channel catfish.

Another key finding from this study was that 47.37% of channel catfish stomachs contained filamentous green algae. The filamentous green algae had appeared to be important to larger fish (447-613 mm TL). This is similar to a study in California accessing diet contents of channel catfish. Filamentous algae had accounted for 17% of total biomass and had only been found in fish that were greater than 300 mm in total length (Marsh 1981).

The results showed that *Lepomis* spp. made up the bulk of the dry weight when ingested by channel catfish. *Lepomis* spp. consisted of 99% of the biomass of stomachs containing the diet item. In a similar study accessing channel catfish diets, when *Lepomis* spp. was consumed, it consisted of 77% of the diet (Braun and Phelps 2016). In this study, the other 1% of biomass present with *Lepomis* spp. consisted of two Conidae within one stomach. All other stomachs only contained *Lepomis* spp.

The results of this study concluded that channel catfish do consume zebra mussels, however, they are likely consumed unintentionally. Based on the results of this study, channel catfish should not be used as a management action to limit or decrease zebra mussel densities. The data suggests that there are potentially two different feeding styles of channel catfish. The first feeding style is one that feeds on the bottom consuming algae and invertebrates. The second feeding style is one that feeds on *Lepomis* spp., a free roaming prey item not found within the algae. However, it is unknown if individual channel catfish specialize in a feeding style or have a variety styles throughout the year.

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