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# Examination of Crayfish Biodiversity and Distribution Within the Grand River, Michigan

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ABSTRACT

Invertebrate animals make up the greater part of the world's biological diversity and are present in about all habitats, where they perform essential ecological functions. Their survival is fundamental to the maintenance of life. Large numbers of invertebrate species are under severe threat of extinction, or are already extinct due to the extreme transformations that habitats have suffered due to human activities. Crayfish are one such important invertebrate under pressure and applying pressure to other organisms in ecosystems. Crayfish are keystone species in most aquatic systems. Keystone species are those species that are most important in shaping the total ecology of a system. Crayfish are often keystone species because they are an important resource for many other animals and can affect species diversity and abundance directly. Specifically, crayfish can adversely affect systems by removing plants from an aquatic system making the water turbid, and prey on fish eggs reducing their numbers (Lodge, 1987). There are over 415 species of crayfish in North America (Hobbs, 1972). It is recognized that at least eight species of crayfish are found in the state of Michigan (Creaser, 1931). For these reasons, crayfish are an important organism to study. We proposed to examine crayfish biodiversity and distribution within the Grand River drainage system.

## INTRODUCTION

There are over 415 species of crayfish in North America (Hobbs, 1972). It is recognized that at least eight species of crayfish are found in the state of Michigan (Creaser, 1931). With crayfish diversity in some states exceeding 100 species, it stands to reason that Michigan may have more species diversity than was examined some 77 years ago by Creaser, especially with Michigan's track record with introductions of invasive species. It is our goal to ascertain the species found in the Grand River system as well as determine the relative health and numbers of crayfish present in the river.

In fact, one species that has been documented to be in Michigan is an invasive species known as the rusty crayfish, *Orconectes rusticus* (Charlebois and Lamberti, 1996). The rusty crayfish has easily identifiable rusty spots on either side of the exoskeleton (carapace) as well as oversized claws. They require permanent bodies of water with cover of rocks, logs, or tree branches (Bergman et al., 2006), which makes the Grand River an ideal habitat for them. This crayfish species is very aggressive to the point of killing local crayfish species. It grows quickly (too big for fish to eat; Mather and Stein, 1994), and reaches high densities (Capelli, 1982). Rusty crayfish are voracious feeders that feast on aquatic plants, invertebrates, aquatic insects, and other crustaceans, including crayfish. They also feed on detritus (decaying organic matter), fish eggs, and small fish complete their diet. Consequently water systems dramatically change when the rusty crayfish moves in and takes over (Momot, 1984).

The rusty crayfish is a native of the Ohio River Basin that has been expanding its range (Lodge et al., 2000). It is considered a threat to Michigan's native crayfish population, and could have environmental and economic impacts on local areas. It is highly likely that this crayfish species is found throughout west Michigan's rivers and streams. In fact it has been documented to be present in Lake Michigan (Taylor and Redmer, 1996). The major threat caused by this crayfish species is the reduction of aquatic plant beds and the species that live in these communities.

Michigan's fishing regulations place several restrictions on the use and sale of rusty crayfish in Michigan. However the release and invasion of the non-native rusty crayfish continues into Michigan waters. A clear indication of their presence or absence would be helpful in determining where resources should be focused to control this potentially devastating invasive crayfish in western Michigan. We could find no evidence for control efforts to curtail this species in Michigan's waterways nor could the DNR supply us with such efforts being performed.

Based on the results of our study, we will be able to make a definitive statement about the identity of the crayfish species found in the Grand River and furthermore comment on the possible impact of the invasive rusty crayfish on biodiversity.

MATERIALS & METHODS

Crayfish traps, which are cages that are baited with food that attract crayfish, were placed at each of our collection sites (N=11). We used passive traps that were anchored into the riverbed and required us to empty them every other day to collect the crayfish that we ensnared. We also did some active collecting at a number of sites north and south of the Grand River drainage system to further quantify the species found elsewhere in Michigan. For active collections, we used dipnets, a small seine and even caught crayfish by hand. These crayfish were not be used for any quantitative measurements because of the variability associated with active collections. Instead these active collections were used to cast a larger capture area. We examined a number of variables from our collection sites that included species, sex, and size of crayfish caught. All crayfish were kept in the laboratory at GVSU to avoid the recapture of previously caught crayfish. When in the field, we also collected various abiotic and biotic measurements relevant to crayfish biodiversity and distribution.

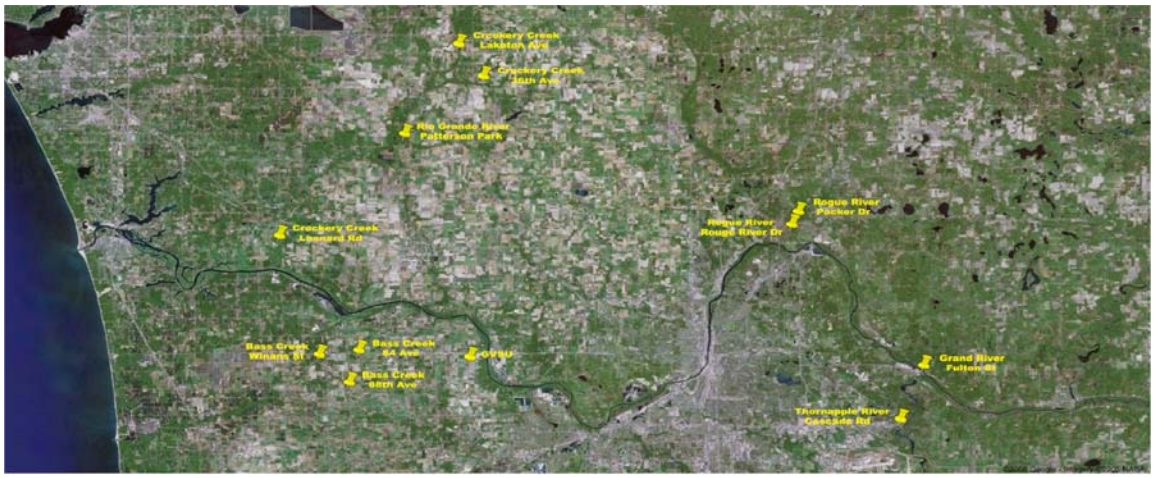


**Fig. 1.** Collection sites in western Michigan along the Grand River and its tributaries.

RESULTS

Over the course of the study we collected a total of 233 crayfish (fig. 2) at 11 sites throughout western Michigan (fig. 1) with a significant difference in sex-ratios at each one (fig. 3).

*O. propinquus,* also known as the "Northern Clearwater Crayfish," is a small species of crayfish that is native to Michigan. In study sites north of the Grand River, very heavy population densities of *O. propinquus* were found. In the Little Rio Grand River and Crockery Creek, we collected 161 *O. propinquus* opposed to 27 south of the Grand River (fig. 2). Size distributions varied in all locations as did sex. *O. propinquus* were also found in northern Michigan in the Maple River sample site (Bergman, 2003).

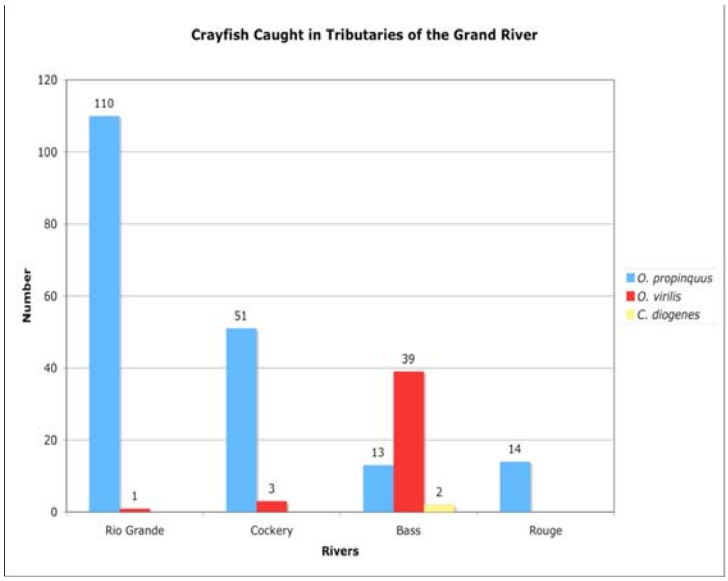


**Fig. 2.** The distribution of species throughout the tributaries of the Grand River, MI.

Another crayfish species native to Michigan that was caught throughout our study was *Orconectes virilis*. Also know as the virile crayfish, it was heavily distributed south of the Grand River, but was rather sparse north of the Grand River.

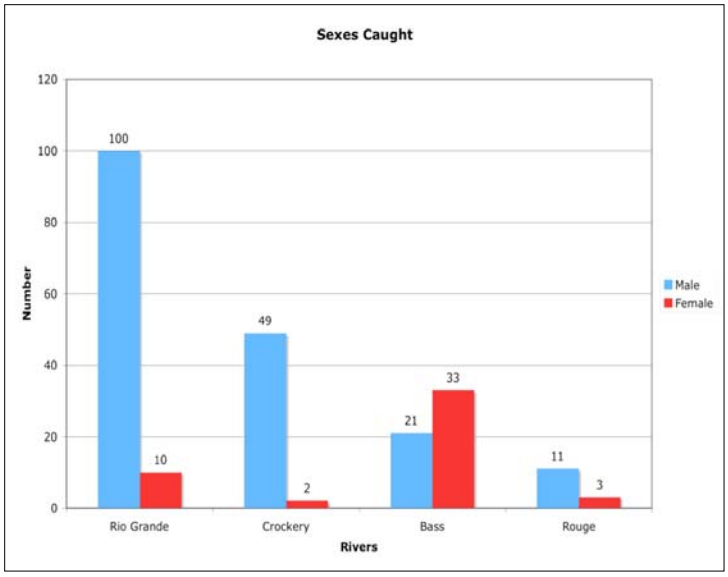


**Fig. 3.** The distribution of sexes in all species.

While south of the Grand River in Bass Creek, we came across a burrowing species known as *Cambarus diogenes*. Also known as the devil crayfish, it is native to Michigan, but was only collected twice in our traps. One large male and one small female were the only two

devil crayfish caught. Fortunately we were able to properly identify the male species using a Cambarus taxonomy key.

## DISCUSSION

Our study supports the conclusion that *Orconectes propinquus* were found in very heavy densities north of the Grand River, whereas *Orconectes virilis* were found in heavy distributions to the south of the Grand River. The reason behind this has yet to be determined; though, it is possible that different aquatic conditions may play a role in their irregular distribution.

Throughout the study, the crayfish traps seemed to have sex-bias and at times a species-bias in that at different times we collected a great number of one sex/species over the other. It appeared that the traps were biased for collecting more male *O. propinquus* and female *O. virilis*. We cannot claim any definitive rationalization as to why this trend occurred for the respective species. We did however make note that the majority of the females collected early in our study were bearing eggs. It is well recognized that crayfish appetite is diminished when bearing eggs, thus our food-baited traps would be less attractive to the point that we collected a diminutive amount. Females release a hormone that suppresses their appetite as they are carrying their eggs under their tail (Little, 1976). As the season progressed the eggs began to hatch, and consequently more females began to appear in our traps.

Given that *Cambarus diogenes* is a burrowing crayfish, they were rarely found within our traps. An active approach to retrieval is typically needed in order to obtain a majority of devil crayfish. This may suggest a sampling bias due to the fact that active collections were not to be documented for data analysis.

Invasive species, such as the rusty crayfish and zebra mussels, are regarded as the most significant threat to biodiversity in aquatic ecosystems (Hein et al., 2006). In fact, they have been documented in many regions in Michigan (Bergman and Moore, 2005). Fortunately, we did not find any invasive rusty crayfish in the Grand River of Michigan or its tributaries. They were however found in southern and northern Michigan. Where rusty crayfish invade, *Orconectes propinquus* populations are decimated. *O. virilis* is a larger species of crayfish that are relatively resistant to *O. rusticus* invasions. This led us to believe that there is no impact on the biodiversity of native crayfish in western Michigan due to the absence of *Orconectes rusticus*.

Although no rusty crayfish have been found so far in western Michigan, we did discover heavy infestations of zebra mussels while examining the upper Grand and Thornapple River. Notably, crayfish were absent on the east side of Grand Rapids where the infestation was the greatest. Crayfish are known to eat mussels (MacIssac, 1994) and could be used as a potential control method for zebra mussels.

Removal of zebra mussels in the Grand River presents an example of an invasive species control method that may be effective. However, further studies with crayfish-mussel interactions would be necessary in order to determine the best crayfish species to properly introduce to the densely populated zebra mussel areas.

By taking an active approach, we may learn more about invasive species and be able to minimize their negative impacts on ecosystems.

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