Does Stream Current Influence Crayfish Impacts on Macroinvertebrate Communities?

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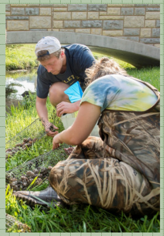
Introduction

Crayfish are considered "ecosystem engineers" because they manipulate environments and can profoundly affect the aquatic ecosystems in which they live (Creed & Reed 2004). Crayfish also affect the composition of benthic stream communities by altering habitats (Hansen 2013) and modifying trophic relationships and food web structure (Bobeldyk & Lamberti 2010, Larsen 2013). They can directly affect benthic macroinvertebrates through predation (Keller & Ruman 1998) and indirectly through resource competition (Jackson 2014).

The extent to which crayfish impact macroinvertebrates may be dependent on environmental factors in the stream, such as current velocity (Creed 2004). Current velocity is a particularly important factor as it defines stream ecosystems and many benthic organisms respond to its influence. For example, Clark et al. (2008) found decreasing crayfish activity with higher current velocity. Although the impact of current velocity on crayfish has been investigated, no studies have examined how stream current influences crayfish effects on benthic macroinvertebrates.

If fast current velocity limits crayfish activity, we predict they will consume fewer macroinvertebrates. In addition, predators have less impact on prey in areas where exchange rates are higher (Cooper et al. 1990), such as those experiencing fast current. Thus, we would expect crayfish in fast current to have less impact on macroinvertebrate communities than in slow current.

Methods



Twenty-four cylindrical cages were partially filled with gravel and assigned to 3 treatments – closed cage with an *Orconectes rusticus* crayfish, closed cage without crayfish, and an open cage control – and distributed among 8 sites of different current.

Current velocity was measured at each site, and after 3 weeks, cages were removed from the stream and sampled for macro-invertebrates, which were identified and counted.

Data were analyzed using a General Linear Model and community composition was examined with NMDS.

Works Cited:

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Results

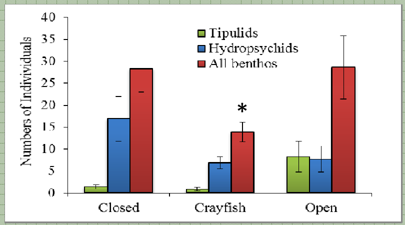

Figure 1. Mean (± SEM, n=8) abundance of all benthic macro-invertebrates and the two most common taxa from the cage experiment. Crayfish significantly reduced overall macro-invertebrates, but not the numbers of hydropsychids or tipulids.

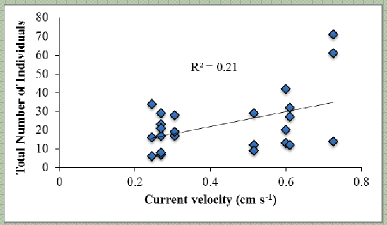

Figure 2. Total macroinvertebrate abundance in cages increased with current velocity (n= 24, p=0.005).

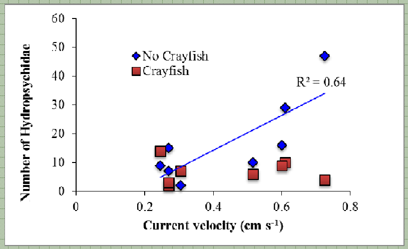

Figure 3. There was a significant crayfish X current interaction whereby hydropsychid numbers increased with current, but this occurred only when crayfish were absent (p=0.009).

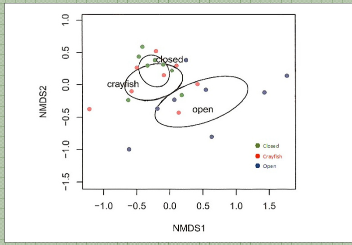

Figure 4. Ordination plot showing dissimilarity in community composition between treatments with ellipses showing the 95% confidence interval. Open treatments were dissimilar from crayfish and closed cage treatments.

Discussion

We hypothesized that crayfish effects on macroinvertebrate abundance would be greater in slow than fast current. We predicted the lower exchange rates in slow current would cause crayfish predation effects to increase and fast current would decrease crayfish foraging and subsequent impacts. What we found was that crayfish lowered benthic macroinvertebrates abundance across current (Fig. 1), and current had a positive effect on overall macroinvertebrate numbers (Fig. 2). Our hypothesis was falsified by the response shown by the most common macroinvertebrate, the net-spinning caddisfly (Hydropsychidae).

Hydropsychids are sessile filter feeders that adhere to substrates and capture drifting food particles with their silken nets. Faster current means more food for hydropsychids, and their numbers were greater in fast current (Fig. 3). However, there was a significant current X crayfish interaction such that hydropsychid abundance was lower in faster flows when crayfish were present. Charlebois and Lamberti (1996) found that crayfish dislodge macroinvertebrates when scavenging, and we speculate that hydropsychids were unable to achieve densities seen in crayfish controls because they were knocked free by crayfish foraging.

Despite the large impact crayfish had on the benthic macroinvertebrates, community composition in closed cages – whether with or without crayfish – were more similar to each other than they were to open cage communities (Fig. 4). This difference might be the result of open cages collecting a large amount of detritus that may have altered the community composition. If there is a preference for detritus, then the open cages might have attracted certain macroinvertebrates (e.g., Fig. 1, Tipulids) that the other cages would not, thereby increasing the compositional variety.

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