Factors Influencing Crayfish Distributions in Streams

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INTRODUCTION

Crayfish are important to study because they are ecosystem engineers that are often an invasive species and that are pivotal in predator-prey interactions (Townsend 2004, Olden et al. 2005). Calcium levels along with substrate size have been shown to be important factors influencing crayfish distributions in Wisconsin lakes (Capelli and Magnuson 1983). They showed two things, that lake calcium levels below 2.5 parts per million (ppm) resulted in an absence of crayfish, and that crayfish preferred larger substrates. Much is known about the physio-chemical factors impacting crayfish distributions in lakes, but less is known about factors influencing crayfish in streams.

We were interested in examining how physio-chemical factors in stream, such as calcium levels, substrate size, stream flow and stream size, affected crayfish distributions.

HYPOTHESIS:

We hypothesized that distributions with crayfish preferring large substrate and calcium levels of at least 2.5 ppm.

METHODS

- 25 m stream sections were sampled with mesh nets.
- Sampling involved 20 mins disturbing the bottom and collecting crayfish with nets.
- Captured crayfish were then measured, sexed, and identified.
- Stream width was measured at the beginning, middle, and end of the 25 meter sample area.
- Current velocity and stream depth were taken at 50 cm intervals and stream flow was calculated.
- The Wolman pebble count method was used to analyze substrate size (Wolman 1954).
- Using Microwave Plasma-Atomic Emission Spectroscopy (MP-AES) was used to analyzed calcium and magnesium from sampled streams.
- We used a variety of laboratory techniques to measure conductivity and turbidity.

RESULTS

Figure 1. This graph shows number of crayfish caught as a function of substrate size. Large substrate sizes accounted for higher numbers of crayfish caught (p=0.05). Sixty three percent of the variation in the crayfish density was explained by substrate size.

DISCUSSION

Our hypothesis that crayfish would prefer larger stream substrate sizes and calcium levels of at least 2.5 ppm was partially supported. In our study, substrate size was the most important factor influencing crayfish density (Figure 1). These results coincide with Capelli and Magnuson (1983), which found substrate size to be important in determining crayfish abundance.

Stream calcium levels and other chemical factors did not have an impact on crayfish abundance, presence, or size. There were no relationships between calcium levels and crayfish. Stream chemical factors did not capture great amounts of variation in crayfish abundance (Figure 3). These results are different from what Capelli and Magnuson (1983) found in lakes where crayfish were not present in lakes with calcium levels below 2.5 ppm. In our study calcium levels ranged between 0.002 and 0.56 ppm. However, crayfish were still present and abundant in some of these streams with relatively low calcium levels. This leads to a hypothesis that crayfish may be able to more efficiently uptake nutrients such as calcium in flowing streams; allowing them to live in water with lower calcium concentrations.

Our results suggest that a stream’s physical factors, not its chemical makeup, are a better predictor of whether a stream will support abundant crayfish populations. Larger streams with greater substrate size tended to support crayfish while smaller streams did not (Figure 2). Stream size also had direct and indirect effects on crayfish densities; stream size positively influenced crayfish density and substrate size (Figure 4). Our results taken as a whole show that a multitude of factors must be considered when predicting whether a stream will hold crayfish.

Future studies involving crayfish administered to high and low amounts of necessary hard water nutrients with high and low amounts of water flow in a laboratory apparatus would be a great way to further our understanding about the minimum requirements these crustaceans need.

REFERENCES

- Olden JD, McCarthy JM, Mawdsley JT, Fetscher WW, Vander Zanden MJ. (2006). The rapid spread of rusty crayfish (Orconectes rusticus) with observations on native crayfish declines in Wisconsin (U.S.A.) over the past 130 years. Biological Invasions, 8(8): 1621-1628.