Annie Hawkinson

IBS Animal Behavior 2011

Orconectes virilis Body Size and Shelter Preference

Abstract

Environment preference in terms of light and dark was tested on Crayfish (*Orconectes virilis*) from Itasca Lake in north central Minnesota. Twelve crayfish were caught from the lake and noted to be either "large" or "small". Crayfish were individually put into one of two identical enclosures for 5 min. Every 30 sec the location of the crayfish was noted. The enclosures were divided up into four quadrants varying in covered or open and black or white sides/bottoms. Data was analyzed with graphs and chi square tests. Overall, crayfish spent a significant amount of time in the darkest covered quadrant. A significant difference was also found between the frequency of time spent in each quadrant between small and large crayfish; small crayfish remained in the darkest covered quadrant more than large crayfish.

Introduction

Research has shown that maintaining shelter is a prioritized behavior of freshwater crayfish. Cover in the form of rocks and vegetation is a high commodity among crayfish populations because the risk of predation increases in open water where individuals are easy to see. In terms of defense against predators large crayfish use matured cheliped and a tough exoskeleton to prevent consumption. These characteristics are not a part of under-developed juvenile crayfish anatomy. Therefore, large crayfish tend to venture out from shelter more frequently than small crayfish.

Research has shown that in order to efficiently avoid exposed areas crayfish use caudal photoreceptors to sense light. These receptors have a direct neural link to leg movement, and cause crayfish to move in a backwards motion when activated by light; distancing themselves

from an exposed location (Simon & Edwards 1990). This suggests that crayfish have evolved to associate light with danger and cover with protection.

A study done by Antonelli et al. showed that both adult and juvenile crayfish also use their sense of touch to identify shelter. Crayfish exhibited positive thigmotactic behavior when choosing where to occupy an enclosure containing different levels of cover; this means crayfish determined their preference for covered areas by feeling their surroundings. In the study both adult and juvenile crayfish preferred the same covered areas, although the larger a crayfish was the more time it spent outside of these areas.

Common predators of crayfish include fish, wading birds, and wading mammals. Research has found that fish prey on crayfish in deep waters while birds and terrestrial predators prey on crayfish in shallow waters. Large crayfish occupy deep waters because they are rarely eaten by fish. Since small, vulnerable crayfish are unable to defend themselves against both aquatic and terrestrial predators they occupy shallow waters with shade and plant cover (Englund & Krupa 2008).

Laboratory studies have also observed behavioral differences between crayfish of varying sizes. In a natural environment when a predator is present small crayfish can be found inactive and buried beneath sand while large crayfish can be found above the sand. Within a controlled enclosure that offers no substrate to hide beneath crayfish activity can be found to decrease as the size of the crayfish decreases (Magnuson & Stein 1976). This correlates with the previously stated observations collected on the vulnerability of small crayfish.

We attempted to observe the previously stated behaviors associated with shelter using Crayfish (*Orconectes virilis*) from Lake Itasca. By placing crayfish in an enclosure varying in

shade and color we were able to assess whether or not body size had an effect on activity and location preference. We hypothesized that overall crayfish would prefer shaded areas with a dark surrounding over un-shaded areas with a bright surrounding. We also hypothesized that small crayfish would stay in the darkest quadrant of the enclosure while large crayfish would move throughout.

Methods

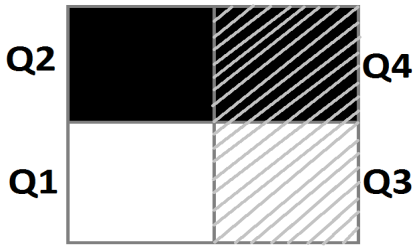
Specimens and Collecting

Crayfish were collected from the northeast shore of Lake Itasca. Moving roughly 10 m off shore and walking inland two researchers wore waders and, using a seine, scraped along the bottom of the lake. Approximately one to four crayfish were caught each time and placed in a neutral holding enclosure. Twelve crayfish were caught in total. In the lab crayfish were numbered and ordered in terms of size. Individuals larger than 5 cm were recorded first; this totaled five "large" crayfish, varying in gender. Individuals smaller than 5 cm were recorded afterwards; this totaled seven "small" crayfish, also varying in gender. Before being tested each crayfish was placed in a bowl and photographed to better document physical characteristics.

Enclosure

Two plastic containers with dimensions 34 x 50 x 27 cm were converted into testing enclosures by taping construction paper to the outside. Each enclosure had four quadrants. Quadrant one had a white bottom and sides with no cover. Quadrant two had a black bottom and sides with no cover. Quadrant three had a white bottom and sides with a black cover. Quadrant four had a black bottom and sides with a black cover. The two enclosures were set up facing opposite directions in order to control for the presence of the experimenters on the crayfish's

behavior; one had the shaded area at the end closest to the experimenters and one had the shaded area at the end furthest from the experimenters. Each enclosure was filled 1/3 with lake water. See the image below for reference.



Crayfish testing enclosure.

Procedure

In order of how they were numbered, crayfish were individually tested within one of the two enclosures. Experimenters set a crayfish in an enclosure facing quadrant one, the lightest and hypothesized least preferred quadrant. A stopwatch was started as soon as the crayfish was set beneath the water. Every 30 sec for 5 min the quadrant the crayfish was occupying was recorded. If a crayfish was in the middle of two quadrants the quadrant it was facing was recorded. This information was later analyzed using two chi squared tests.

Results

The data was collected and analyzed to determine relationships between the frequencies spent in each quadrant for all crayfish and for crayfish in terms of size. The null hypothesis comparing frequency and quadrant stated that the frequencies of time spent in each quadrant would be equal. The alternative hypothesis stated that the frequencies of time spent in each quadrant would be different. A graph was made to show the overall frequency of time spent in

each quadrant (Fig. 1), and a chi square test was done to determine statistical significance. The outcome of this test rejected the null hypothesis (χ^2_3=196.8, p=0.05).

The data was also organized in terms of large and small crayfish. The null hypothesis stated that the frequencies of time spent in each quadrant for large and small crayfish would be equal. The alternative hypothesis stated that the frequencies of time spent in each quadrant for large and small crayfish would be different. A graph was made to show the comparison of frequencies between these two categories of size (Fig. 2), and a chi square test was done to determine statistical significance. The outcome of this test rejected the null hypothesis (χ^2_3=31.54, p=0.05).

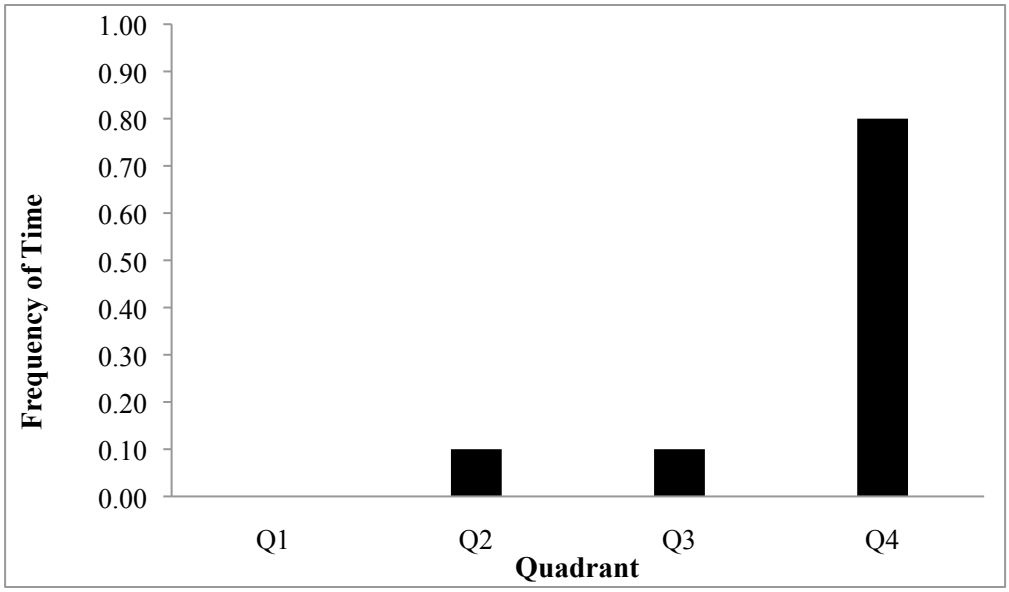


Fig. 1. Overall frequency of time spent in each quadrant. Overall time span was 5 min with quadrant recorded every 30 sec. The difference in frequencies was statistically significant (χ^2_3=196.8, p=0.05).

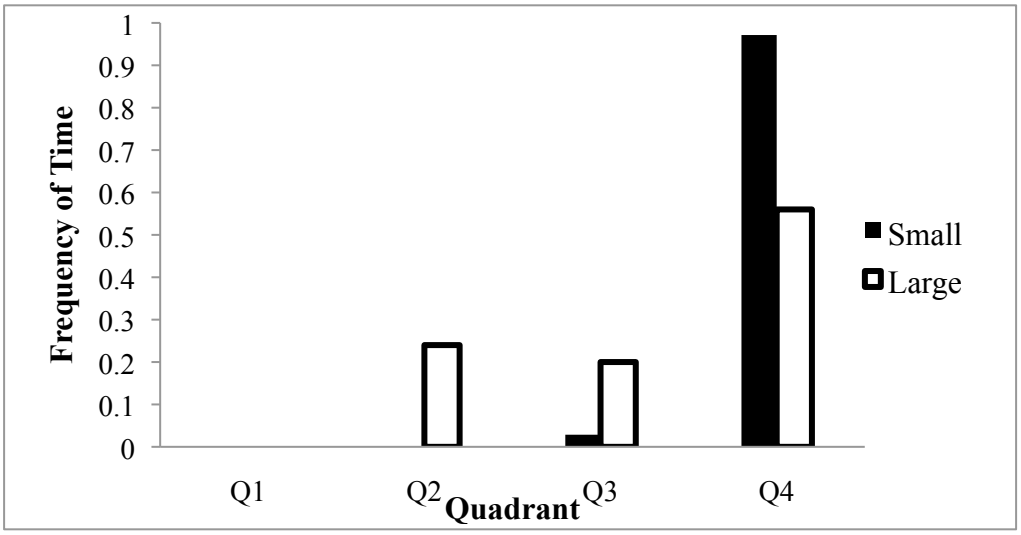


Fig. 2. Comparison of frequencies of time spent in each quadrant between small and large crayfish. Overall time span was 5 min with quadrant recorded every 30 sec. The difference in frequencies between small and large was statistically significant (χ^2_3=31.54, p=0.05).

Discussion

The results show that *O. virilis* prefer a dark sheltered environment over an uncovered, bright environment. This correlates with previously done research and observations about freshwater crayfish; sheltered environments are preferred in order to avoid detection by predators (Magnuson & Stein 1976). Quadrant four was preferred over all others within the enclosure. This quadrant had a cover as well as black sides and bottom. In the wild this would be similar to a shaded shoreline with plants and rocks abundant for shelter.

Although all crayfish avoided the uncovered, white sided environment there was still a significant difference between the quadrant preference of small and large crayfish. Small crayfish rarely strayed from the covered black quadrant four, but large crayfish were found in quadrants two, three and four. This shows that large crayfish either wandered throughout the

enclosure or didn't directly go to the darkest region. This supports previous research stating large crayfish are able to risk spending time away from shelter; they are physically developed enough to defend themselves from predators (Englund & Krupa 2008).

Further research could be done using the same enclosures and crayfish specie to observe how crayfish act in groups. By putting three crayfish in an enclosure at a time observations could be made to see whether or not they group together. The relationship between gender differences and size could also be compared with how they group.

References

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