

Territoriality of Northern Crayfish (*Orconectes virilis*) in Itasca State Park

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ABSTRACT

In general, it has been shown that large crayfish will tend to win aggressive, territorial conflicts against small conspecific opponents (Figler et al. 1999). Size is not the only factor that can affect the outcomes of territorial interactions however. The “prior residency effect” suggests that the initial resident in a given area will have a dominance advantage over intruders (Peeke et al. 1995). This investigation explores the effects of territorial residency and size on the outcomes of territorial conflicts. We hypothesized that interactions between crayfish with large percent size asymmetries would result in higher eviction rates of the smaller resident by the larger intruder than interactions between crayfish with small size asymmetries. We tested this hypothesis by observing the outcomes of territorial conflicts between crayfish of various sizes in controlled environments. We found that average percent size asymmetries of interactions resulting in evictions of residents were statistically greater than the average percent size asymmetries of interactions resulting in non-evictions of residents by larger intruders. We determined that the level of percent size asymmetry with the highest likelihood of eviction ranged from 67 to 109%. These data support the proposed trend where the likelihood of successful evictions of smaller prior residents by larger intruders increases as the size differences between the two individuals increases.

INTRODUCTION

There can be high costs involved in maintenance of territories, such as energy expenditure of fending off rivals. However, there are also advantages, such as decreased risk of inter- and intraspecific predation, that come along with maintaining territories (Braddock 1949). For many organisms, the benefits outweigh the costs of territory maintenance. One such organism is the crayfish. Previous studies have proven that crayfish are generally aggressive and will assert their dominance, forming hierarchies, which can determine the outcomes of territorial conflicts (Bovbjerg 1953). Other studies have gone further, investigating the effect of size on the outcomes of these conflicts. In general, it has been shown that large individuals will tend to win

aggressive encounters against smaller opponents (Figler et al. 1999). Size is not the only factor that can affect the outcomes of territorial interactions however. Previous studies have demonstrated a theory called the “prior residence effect” (Peeke et al. 1995). This theory suggests that the initial resident in a given area will have a dominance advantage over a subsequent intruder (Peeke et al. 1995). We decided to investigate how territorial residency and size would affect the outcomes of territorial interactions. We wanted to determine the level of percent size asymmetry that would have the highest likelihood of eviction. Our hypothesis was that interactions between crayfish with large percent size asymmetries would result in higher eviction rates of the smaller resident by the larger intruder than interactions between crayfish with small size asymmetries.

MATERIALS

We began our research by catching crayfish specimens from Lake Itasca in Itasca State Park. Crayfish were caught near shore using handheld nets. Only Northern Crayfish (*Orconectes virilis*) were used in this experiment to control for potential differences in aggression between heterospecifics. A total of 21 females were collected and measured. Eighteen of these were selected for use based on their size. Crayfish who were in the process of molting or who had recently molted were not used. Relative sizes were assigned based on carapace length. We kept the crayfish together in a single container with fresh water, food (dog food), rocks, algal masses and flowerpot shelters. Four experimental tanks were fashioned from circular buckets (28.5cm in diameter). We fashioned 2.9cm high, 6cm wide, 6.4cm deep, semi-cylindrical shelters from Styrofoam© cups and taped one to the bottom of each tank. We then filled the tanks inch-deep with water. For each trial, a single crayfish was introduced to an experimental tank and allowed to take residency in the shelter (labeled “resident”). Immediately after it had taken residency, we

introduced a second crayfish (labeled “intruder”) and recorded the outcome of the interaction. There were three different outcomes observed: eviction of the resident by the intruder, joining of the intruder with the resident in the shelter, or resistance of the intruder by the resident. In total, we observed and recorded the outcomes of 51 interactions. The outcomes of the interactions were re-categorized into two groups: eviction (of resident by intruder) and non-eviction (e.g. joining and/or rejection of intruder). These outcomes were then analyzed.

RESULTS

We found that eviction rates of smaller crayfish by larger crayfish were statistically greater in pairs where the intruder was on average 63.7% larger than when the intruder was 45.3% larger ($t = 2.01$, $df = 49$, $p = 0.043$, Fig.1.).

Fig.1. Average percent asymmetry according to eviction status.

Our data were compiled into cumulative sums of resident evictions. The rate of this accumulation was graphed as seen in Figure 2.

Fig.2. Cumulative eviction rate according to percent asymmetry.

DISCUSSION

These data support our hypothesis that interactions between crayfish with large percent size asymmetries result in higher eviction rates of the smaller resident by the larger intruder than interactions between crayfish with small size asymmetries. We found that the average percent size asymmetry of evictions was 63.7% and the average percent size asymmetry for non-evictions was 45.3%. Our data showed that the range of probable non-evictions was from 0 to 21% asymmetry. The cumulative eviction rate increased steadily from 21 to 67% asymmetry. The range of probable evictions was determined to be from 67 to 109%. These data support previous findings that larger individuals tend to win aggressive encounters against smaller individuals unless size difference is minimized (Figler et al. 1999). However, large crayfish were not guaranteed to win territorial competitions, which supports the “prior residence effect” theory (Peeke et al. 1995; Blank et al. 1996). Previous studies have found that the effects of prior residence lessen over the course of the interactions while the strength of true territoriality strengthens as the time spent by the resident in the territory increases before conflicts (Braddock 1949). Therefore, further research could involve longer time spans for territorial interactions.

Further research could also be done contrasting the interactions between males and females.

Heterospecific interactions, particularly between northern crayfish (*Orconectes virilis*) and rusty crayfish (*Orconectes rusticus*), an invasive species affecting the Great Lakes region of North America, would be useful in conservation efforts to protect native crayfish species.

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