<u>**Size Competition for Shelter in *Oligocottus maculosus***</u>

Thomas Peterman
8/01/05
Adaptations of Marine Organisms

Introduction:
Competition plays an important role in the distribution and stability of populations. There are many methods with which an organism can out compete another. Many organisms have evolved specific structural adaptations, i.e. claws or feathers, which have given them a competitive advantage within their specific habitat. However, competition between individuals of the same population results in contests between organisms with the same adaptations. In cases such as these, resource experience and size generally becomes the determining factors. The goal of my experiment was to investigate size competition for shelter in the tidepool sculpin (*Oligocottus maculosus*). While size is not the sole determinant for competitive success in the intertidal habitat, it might play an important role in distributions within populations. In a previous study on *O. maculosus*, younger and smaller juvenile sculpins were underrepresented in lower tidepools along a vertical population gradient (Green, 1971). Food resources were thought to be the driving force behind the population's internal dispersal. Generally prey items such as amphipods and isopods become more available in the lower intertidal due to the availability of algae (Nakamura, 1971). While shelter is not a necessary resource like food for *O. maculosus*, through field observations I have noted they will very frequently take cover as a fright response to predators. I had also noticed through field observations that more than one individual would take shelter in the same space. The null hypothesis was that as the weight differences increased between two *O. maculosus*' there would not be a significant increase in larger individuals out competing smaller individuals for shelter. It is the goal that through studying competitive interactions among specific populations that we will gain a better understanding of broader ecological patterns.

Methods:

The tidepool sculpins for this experiment were collected from various pools in the middle cove of Cape Arago in mid July. A total of sixteen *O. maculosus* of varying weights and lengths were used in lab tests. All subjects were kept in a wooden aquarium with running seawater and were allowed to intermingle. Fish that were weighed were padded with a paper towel to prevent excess water from effecting their true weight. They were weighed using the lab's digital scale. For size competition tests, two subjects were weighed and then placed in a plastic container approximately forty by fifteen centimeters. Within the container was a shelter made from a beaker found in the lab. The entire beaker was taped to provide a dark enclosed space of refuge. Larger beakers were used when sculpins of greater length could not adequately fit in smaller volume beakers. The plastic container was filled with seawater to a depth of approximately six centimeters. Both individuals were placed in the container at the same instance and allowed to acclimate for ten minuets before observations were recorded. After ten minuets the positions of both fish were recorded every five minuets for a thirty minuet period. Recordings were made whether fish were inside the container, outside, or if both inhabited the shelter. Other than the presence of the author's head appearing every five minuets the fish were kept relatively isolated from outside distractions. Statistical analysis was done using Excel.

Results:

A correlation between size differences and frequency of shelter use in larger individuals produced a negative coefficient of approximately -.45. An ANOVA: single factor gave a p-value <. 0001 with a critical F=3.55 when comparing size difference increases and the frequency of shelter use between large, small, or both *O. maculosus* subjects. This result makes sense because in every test the smaller individual never inhabited the shelter alone.

The frequency with which smaller individuals inhabited shelter alone was consistent at zero throughout while the frequency with which larger individuals used shelter in comparison to size changes was not significant using a two tailed t-test (p-value > .05).

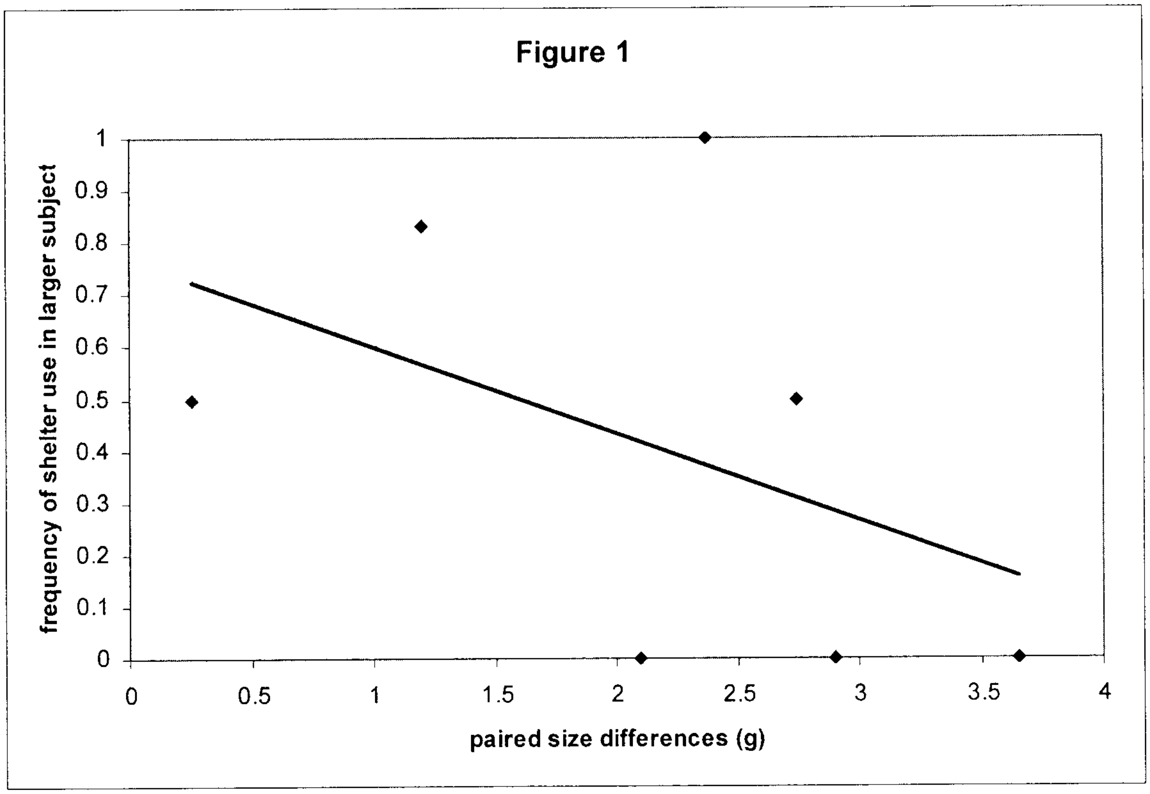

Fig.1: negative correlation between frequency of shelter use in larger individuals and increases in size differences among paired test subjects.

Discussion:

Overall the frequency with which larger individuals inhabited the shelter did not positively correlate with increases in differences of weights of paired *O. maculosus*. The results from the present study indicate that my null hypothesis was incorrect. However, the notion that larger individuals will out compete smaller ones for shelter is still reasonable considering the data. In every test there was not one instance where the smaller individual would inhabit the shelter by itself. Additionally, tests were performed where the larger fish in one trial was then used as the smaller test subject. In each case the larger fish that was converted to the smaller subject exhibited inferior behavior despite having inhabited the shelter in the previous test. Behavior such as this clearly indicates the importance of size dominance on individual distribution. In a previous study on homing behavior of juvenile tidepool sculpin it was shown that home ranges were adopted at specific sizes, generally 3.0-3.5cm (Craik, 1980). Perhaps the reason they haven't established a home range is because of competitive exclusion by larger fish in areas where prey is in greater abundance. In another study regarding *O. maculosus* it was shown through experimental tests that larger fish had a competitive advantage over smaller fish in the acquisition of food (Szabo, 2002). Conclusions such as these along with my own observations are good indications that size among tidepool sculpins is a strong distributional determinant among populations. Obviously other factors such as tidepool geography, prey abundance, population sizes, etc. are important factors as well when considering individual's locations within a larger group. However, our growing knowledge of intra-species competition gives us better insight into densities and distributions of local ecology.

References:

Craik, G.J.S. 1980. The effects of age and length on homing performance in the intertidal cottid, *Oligocottus maculosus* Girard. *Canadian Journal of Zoology.* **59** 598-604

Green, J.M. 1971. Local distribution of *Oligocottus maculosus* Girard and other tidepool cottids of the west coast of Vancouver Island, B.C. *Canadian Journal of Zoology.* **49** 1111-1128

Nakamura, R. 1971. Food of two cohabitating cottids. *Journal of Fish Research.* **28** 928-932

Szabo, A.R. 2002. Experimental tests of intercohort competition for food in the tidepool sculpin (*Oligocottus maculosus* Girard). *Canadian Journal of Zoology.* **80** 137-144