# Predator Avoidance Behavior in *Pachygrapsus crassipes* and *Hemigrapsus nudus*

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# Introduction

Predator avoidance is seen throughout many different organisms and in many different ways. The most common predator avoidance among mobile organisms would be to flee or find refuge. The differences in anti-predatory behavior from species to the next could be attributed to the interspecies behavioral constraints and morphological constraints. In my experiment I compared the behavior aspect of predator avoidance using the comparative method of two like species; *Pachygrapsus crassipes*, the line shore crab, and *Hemigrapsus nudus*, the purple shore crab. These two brachyuran crabs are, even at a glimpse, very different in just their overall behavior and make for a good observation in a comparative sense. *P. crassipes* is a more aggressive and faster moving crab than *H. nudus* but they are both found in high rocky intertidal areas. They're both amphibious, tolerating little water for an extensive period of time. They are similar in size and shape but the colors defer noticeably. The *H. nudus* is purple, hence its common name, with spots of reddish brown on its claws (Sept 1999). *P. crassipes* is distinguishable by its black stripes along carapace and its overall color may be any where from red, purple, or green (Sept 1999). They are both preyed upon by gulls and *P. crassipes* is also preyed upon by raccoons which might be important to note (Sept 1999). Their prey preference is similar since they are both herbivores. *H. nudus*, for this experiment, was collected in the rocky intertidal somewhere between Cape Arago and Sunset Bay and *P. crassipes* was collected underneath rocks that were inside the bay, close to OIMB. Once both crabs were caught and placed in an appropriate confinement the experiment and testing was soon to follow.

# Materials and Methods

Before actually performing the experiment both crab species were placed in a large cylinder container that was around 50 to 60 gallons in volume. On the inside of the container, the outside edge was raised about 2-3 cm and it lined all the way around the outline of the container to form a circle. The container was filled slightly to somewhat simulate what both crabs are used to in their natural environment and by this I mean that all crabs had an opportunity to be either submerged in water or mostly out of water, standing on the raised outer ledge of the container. The water was not continually fresh due to the fact that if it was that meant the water would have to be constantly running. For it to be constantly running the water would have to overflow into a drainage system which meant if the water was to be only so high the crabs could crawl or escape through the low drainage system. Instead of doing this the water was changed about every 12 hrs to make sure there wasn't any harmful buildup of toxins. The container was oxygenated by an air tube. Once the crabs' holding area was completed I started the process of constructing a replicated rocky intertidal habitat within a long rectangular water table for my predator avoidance testing. The water table was 180cm by 97.1cm and made from Plexiglas with metal bars that outlined the structure. To mimic a rocky intertidal habitat one would need to get rocks so that is what I did. I gathered rocks from two different

locations and set them up at one end of the container. I had a rock that was as large as a medicine ball, and I had rocks that were close in size to that of soft balls and basketballs. The rocks were sometimes arranged so that one rock was leaning on another and this was done to give the crabs an area of hiding. The table was mostly dry except for a little standing water on the southwest corner but this was not enough for a crab to totally submerge itself.

For the methods and experiment process I basically used two tactics; instantaneous observation and observation by interacting with the animal to get a desired stereotypic reaction such as a predator avoidance response. The instantaneous observation was done by using two crabs from each species with one crab being observed at one time. I would watch for two behaviors, conspicuous and inconspicuous behavior and then record which behavior was being performed at 1min intervals for 15min. Conspicuous behavior would be a crab out in the open away from any rock and inconspicuous behavior would be where a crab was hiding underneath a rock and wedged into a crevice. The 15 minute instantaneous observations were done twice for each species. This type of observation was done to get a base on what type of behavior was likely to be seen from these two crab species. For the interacting with the crabs to get a desired stereotypic predator avoidance response I used the same setup but with a very different approach. I placed one crab of each species into the tank at the opposite end from the rocks as soon as I let it go I would record whether or not the crab immediately ran away, ran away but after waiting a couple seconds, or waited and ran away slowly, or didn't ran away at all in the first 10 seconds. After placing them in the water table and waiting to see their response I stepped back and waited motionless for 2 min so the crab could acclimate to its surroundings. I came back after 2 minutes had expired and moved a cardboard cutout over the crab 5 times, down and back being one. The cardboard was done to simulate a predator such as a gull flying over, in which is a natural predator to both. I observed to see if the crab would; one, flee towards a refuge such as underneath a rock or in between a crevice, two, flee in a direction away from me not near a rock, and three, not move at all or quit moving. This was done 7 times to each species and that would make 14, total, of these types of observations.

# Results and Conclusion

The results were interesting and a little surprising. In figure 1 you will see the purple shore crab's behavior after the presence of a predator. The crab's behavior 86% of the time was to not move at all which wasn't at all surprising. The other 14% of the time the crab randomly dispersed. We also see in Figure 2 that most of the time the crabs initially ran away from my direction when placed into the replicated environment, 2 minutes before the cardboard was waved over the crab to simulate a predator. It is important to note that the purple shore crabs were collected and placed in the large cylinder container a short time before the line shore crabs were, which may affect their responses because they might not be as healthy as the line shore crabs. This might affect the fact that 29% of the time the purple shore crabs didn't move after I placed them in the flow tank, and 14% of the time the crab fled slowly by taking a noticeable longer time to move away from me. In Figure 3 we see that the line shore crab fled toward a rock 14% of the time and the other 86% of the time it didn't move, much like the purple shore crab.

In Figure 4 the line shore crab fled at a normal speed (majority of the speed exhibited by the line shore crabs) 86% of the time as opposed 57% of the time in the purple shore crab which did flee 14% of the time noticeably slower than the majority of purple shore crabs that fled. It is important to note as well that the line shore crab a lot more attentive towards me than the purple shore crab that will turn sideways or with his back towards me over half the time. This is something I didn't quantify but another important fact in deciding the differences in behavior between these two crabs. In table 2 and 3 we see that both crabs showed similar behavior in hiding during the instantaneous observation but the line shore crab was hidden more often, as far as percentages because only one line shore crab was observed for this. If two were observed the percentages could be the same. Overall the main differences in behavior of the line shore and purple shore crab was that the purple shore crab wasn't as keen to my presence or the presence of a predator as the line shore crab. The line shore crab also showed a lot more movement this could be attributed to the fact that the line shore crab's natural predators are more diverse than the purple shore crab.

**Figure 1**

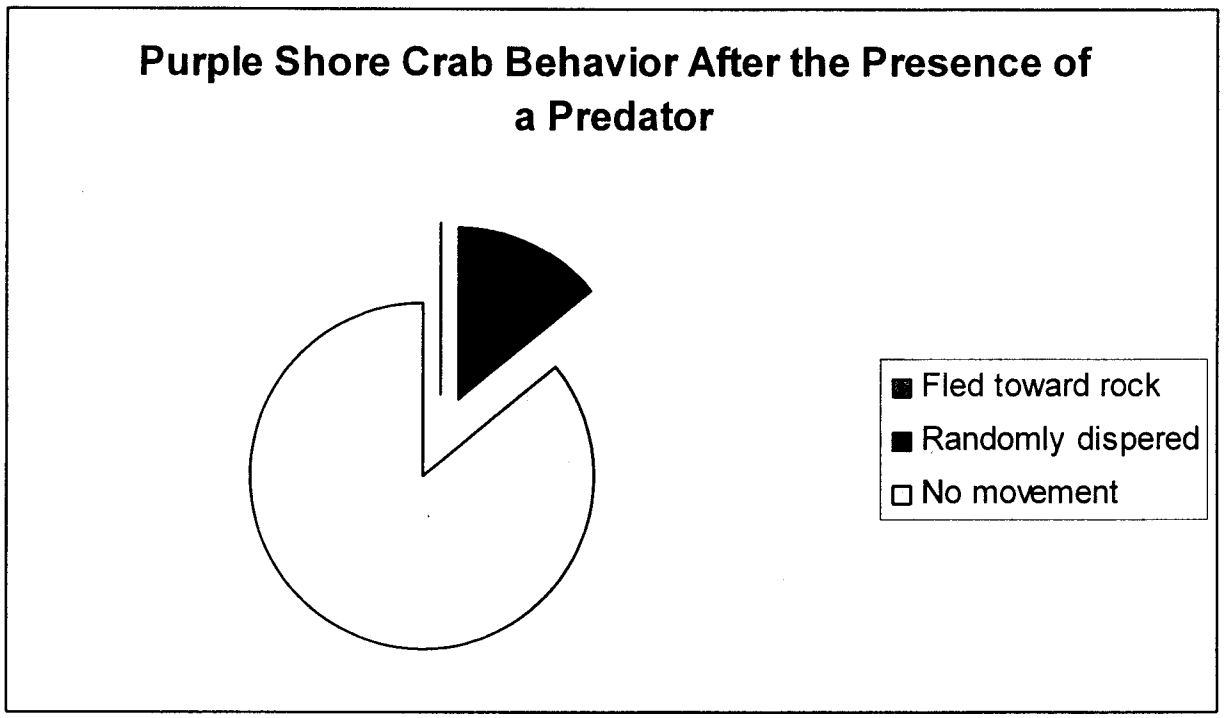


**Figure 2**

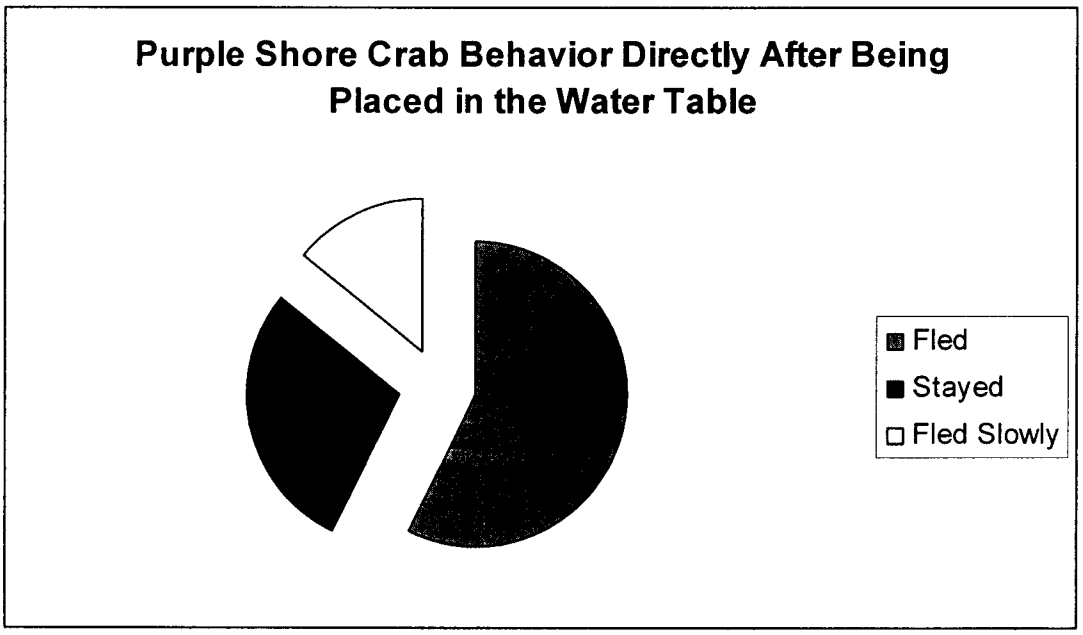

**Figure 3**

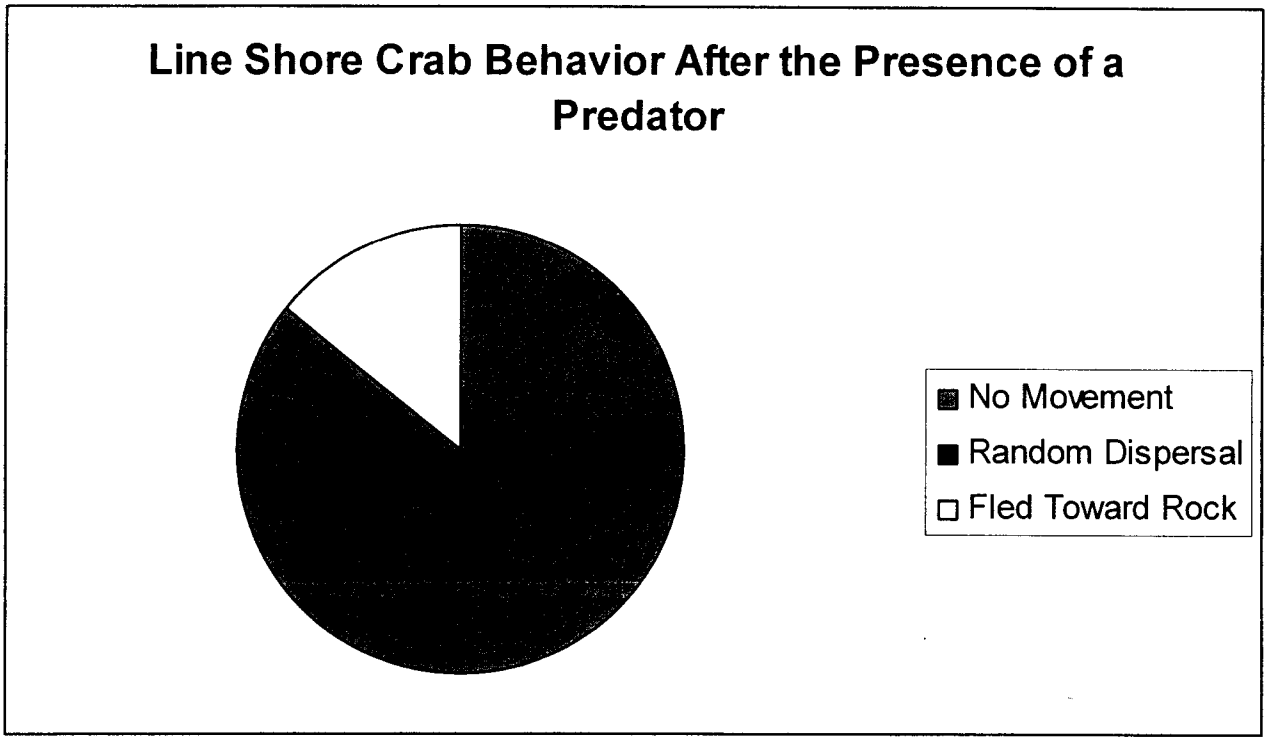


**Figure 4**

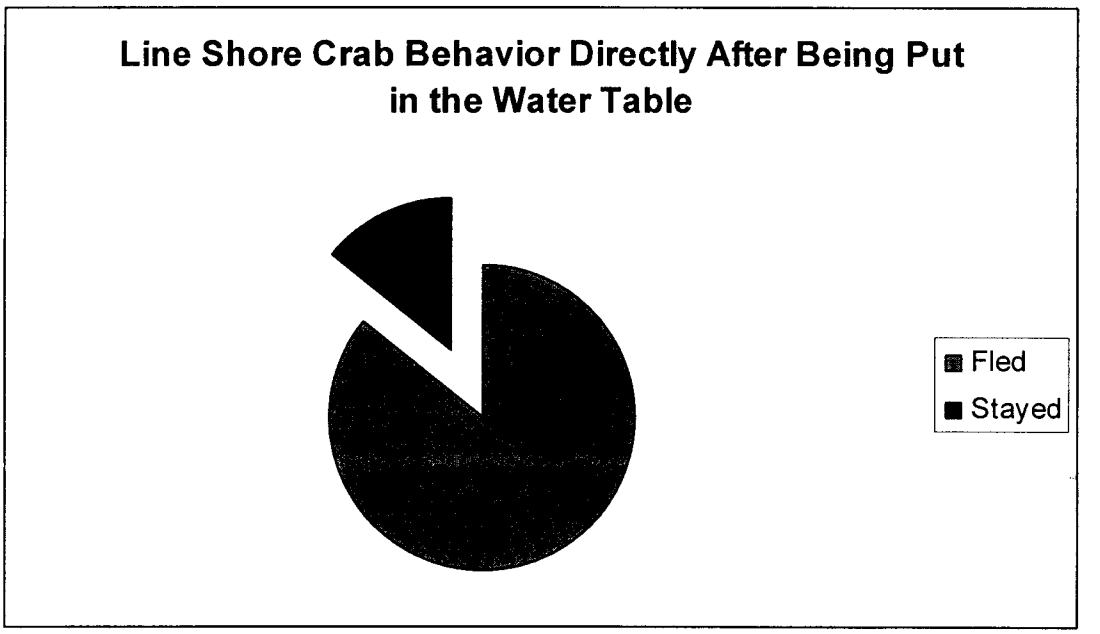


**Table 1**

Two 20 Minute Purple Shore Crab Instantaneous Observations that Includes 2 Different Individuals

| | |
|---|---|
| Conspicuous Behavior | 37 |
| Inconspicuous Behavior | 3 |

**Table 2**

One 20 Minute Line Shore Crab Instantaneous Observation, Consisting of 1 Individuals

| | |
|---|---|
| Conspicuous Behavior | 17 |
| Inconspicuous Behavior On Top of Rocks | 3 |

# Literature Cited

-J. Duane Sept, The Beachcombers Guide to Seashore Life of the Pacific Northwest, (1999) Harbour Publishing, pp 122 & 123

-Charles A. Jacoby, Behavior of the Purple Shore Crab Hemigrapsus nudus Dana, 1851 *Journal of Crustacean Biology*, Vol. 1, No. 4 (Nov., 1981), pp. 531