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Feeding Behavior of *C. magister* and *C. productus*

Introduction

Cancer crabs are opportunistic predators showing little evidence of prey selectivity. They eat a representative selection of the most prevalent species in the area they inhabit. The most important groups of prey for *Cancer magister* are juvenile teleost fish, shrimp, and bivalves (Stevens *et al.* 1982). *C. magister* also exhibits a high rate of cannibalism, especially among first year instars (Warner 1977) . Although they feed on virtually any animal available, there is a low rate of predation on animals such as polychaete worms, amphipods, and isopods (Stevens *et al.* 1982).

Although Cancer crabs have little selectivity in their diets, they exhibit ontogenetic changes in their food selection. "*Cancer magister* undergoes a significant dietary shift with age, but the exact mechanisms responsible have not yet been identified" (Stevens *et al.* 1982). The ontogenetic changes in dietary preference are an indicator that Cancer crabs are opportunistic feeders, but prey selection depends on age and size of the crab. The first year instars prey primarily on small bivalves and crustaceans, especially *C. magister*. Second year crabs mostly feed on shrimp (particularly genus *Crangon*) and occasionally prey on small fish. The crabs three years and older preyed less upon shrimp and more on fish (Stevens *et al.* 1982). The size increase in crabs is thought to be the cause of the ontogenetic changes in the crab's dietary preference (Stevens *et al.* 1982). For example, larger crabs have increased size of their mouthparts and chelae, which indicates better handling of the shrimp and fish they primarily prey upon.

I was unable to find any literature about the amount of food crabs eat on a daily basis. The unavailability of literature inspired me to conduct this experiment. I decided to determine the amount of food Cancer crabs need on a daily basis to sustain their metabolic needs. My hypothesis is that crabs will consume similar ratios of food to body weight, regardless of the crabs size or species.

Methods

For this experiment I collected five *C. productus* and five *C. magister* on the boathouse dock at OIMB. Salmon head was placed in several different crab pots to catch the specimens. Each crab was placed in a sea table with constant running seawater and several aeration devices. Using plastic mesh dividers surrounded by wood, the sea table was divided into ten sections. One crab was placed in each of the isolated sections of the sea table. The crabs were then weighed on a triple beam balance and their weights were recorded. Each crab's carapace was measured in centimeters from the indentation of the most anterior horn (shown in figure 4).

The crabs were then fed raw chicken that had been soaked for several days in seawater and refrigerated. The crabs were fed every 24 hours, for a total of 7 days. The chicken was placed in a dish and weighed to the .01 gram. Each crab received a piece of chicken with a known weight. Every 24 hours the remaining chicken was removed with a fish net and placed in a dish to be weighed and recorded. To determine the mass of chicken eaten in 24 hours, the mass of recovered food was subtracted from the mass of food given the previous day. Every day the raw chicken would take on water weight, which affected the preciseness of the results. To deal with the water weight problem, I discovered the approximate rate at which the chicken was taking in water. I tested the rate that the chicken would take in water for every 24-hour period. I averaged the rates that water was taken into the chicken. It turned out that every piece of chicken would take in approximately 5% of its total mass every 24 hours. I applied this approximation to every piece of chicken, so the water weight would not distort the results.

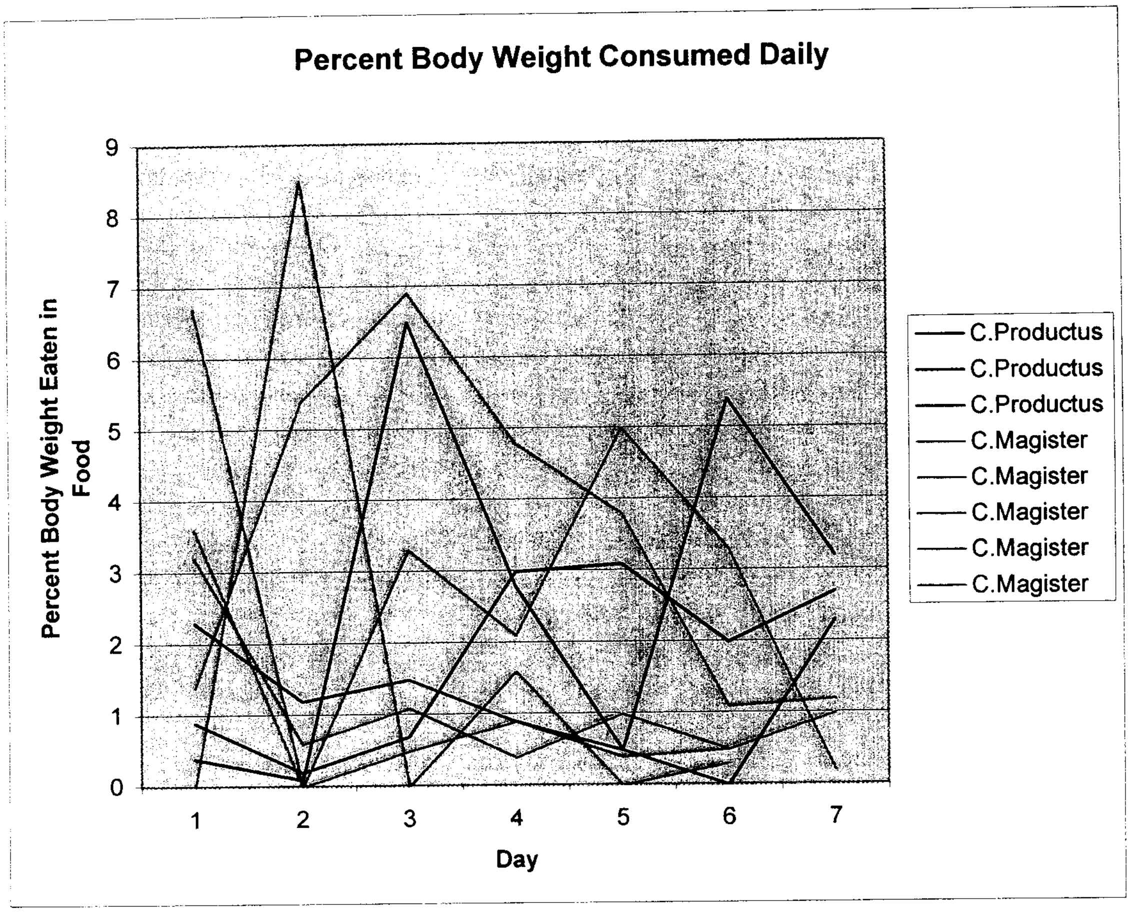
Results

The feeding behavior of C. Productus and C. Magister are peculiar in that they eat sporadically without a rhythm. Some crabs had more sporadic feeding patterns than others. For example, one day a crab will eat as much as 8.5% of its body weight in food, then fast the following day. Some Crabs were more consistent in their daily food intake, eating everyday and never eating more than 4% of their body weight in a day. Essentially there were no noticeable differences between species with respect to feeding patterns. All the crabs had an individual feeding rhythm, independent of their size or species. This data is relatively unrelated to my hypothesis, but it provides solid background informationon the feeding behavior of crabs. The ratio (shown as a percent) of body weight to daily consumption is shown below in table 1 and figure 1.

Table 1

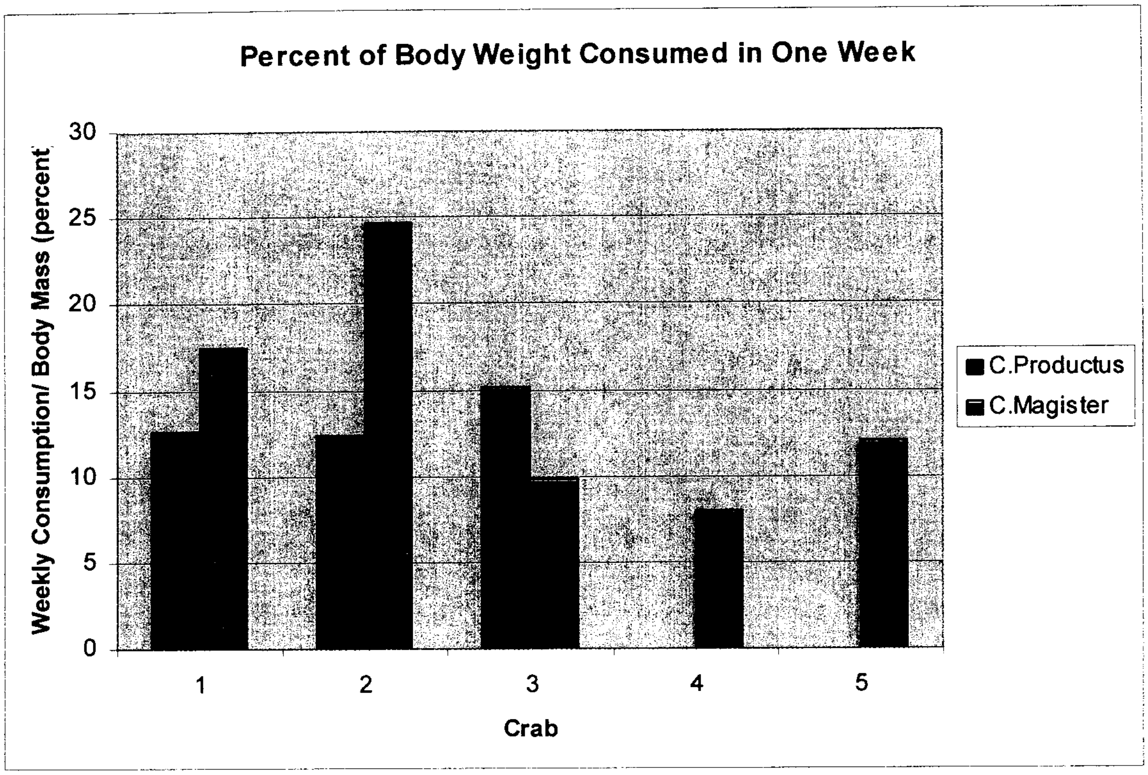
Day	Productus	Productus	Productus	Magister	Magister	Magister	Magister	Magister
1	0.4	0.9	2.3	3.6	1.4	6.7	3.2	0
2	0.1	0.2	1.2	0	5.4	0	0.6	8.5
3	6.5	0.7	1.5	3.3	6.9	0.5	1.1	0
4	2.8	3	0.9	2.1	4.8	0.9	0.4	1.6
5	0.5	3.1	0.5	5	3.8	0.4	1	0
6	0	2	5.4	3.3	1.1	0.5	0.5	0.3
7	2.3	2.7	3.2	0.2	1.2	1		

Figure 1



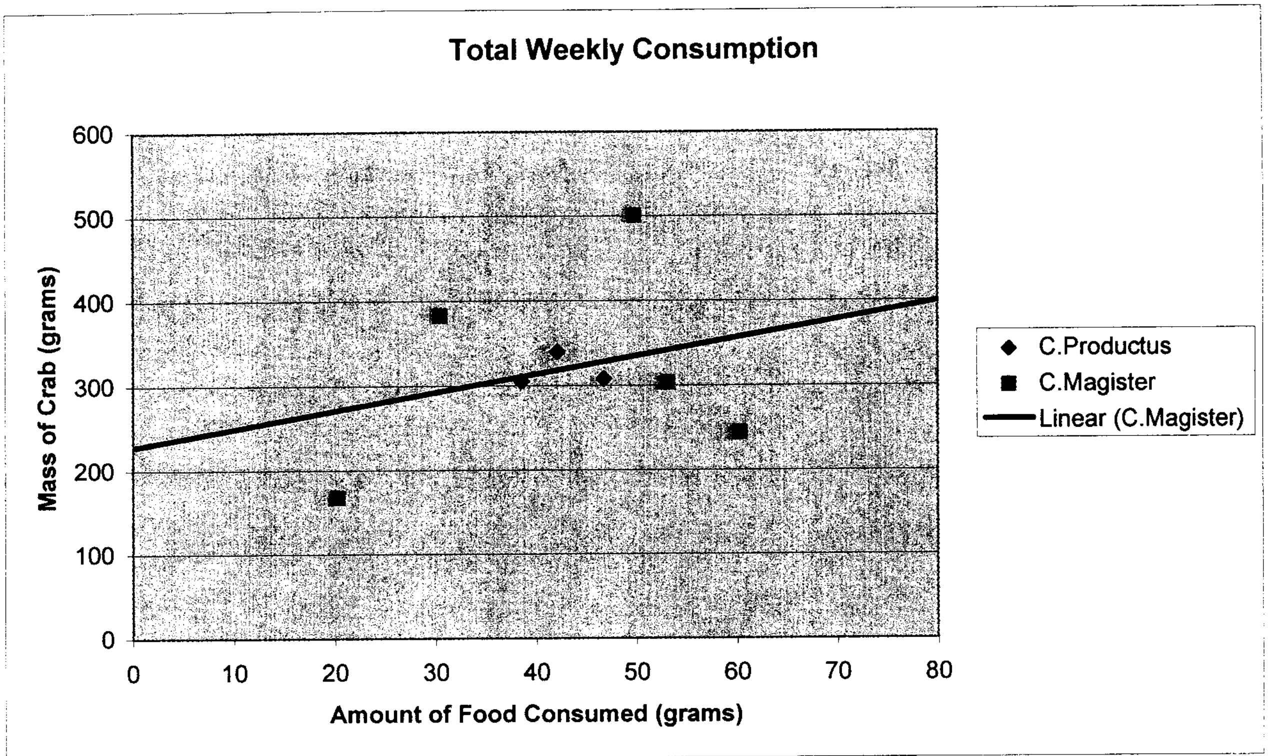
In terms of total weekly consumption, there was a small linear correlation between body mass and the amount consumed. The general trend was that the larger the crab, the more food it ate over the course of a week. There were no differences between species in the amounts of food eaten based on their body mass. The values for *C. Productus* fall in the range of *C. magister* values, showing food consumption similarities between species. This data is shown below in figure 2. In one week, the average *C. Productus* consumed food that weighed 13.4% of the crab's body weight. *C. magister* consumed food that weighed 14.44% of the crab's body weight. These values are similar enough to conclude that there is no difference in food intake between these species.

Figure 2



There was a small correlation between the weight of the crab and the amount of food it consumed. Figure 3 displays the mass of the crab versus the total amount it consumed. The figure shows the trend line for *C. Magister*, which indicates a linear progression; the more a crab weighs, the more food it will consume. The trend line for *C. magister* appears to fit with *C. productus*, indicating both species consume similar amounts relative to their body weight.

Figure 3



Discussion

There appeared to be a linear relationship between the mass of the crab and the amount it consumed. This means that crabs will eat approximately the same ratio of food to body weight (average of 13.40%-14.44%). There was also no significant difference in food consumption between species. Both of these facts indicate that my hypothesis was correct.

Although the data supports my hypothesis, the correlations are rather weak. There was not enough test subjects to precisely determine whether the data was significant. Although there appears to be several trends in the data, there are several outliers in each figure, which makes the results less impressive. Another problem with the experiment was that the food given to the crabs (raw chicken) would take on water weight everyday. Although I ran several tests on the chicken, the calculated average was a gross approximation. I estimated that the chicken would take on 5% of its mass everyday. This approximate value was applied to the chicken daily to account for the added water weight. If I were to conduct further research, I would test about 25 crabs of each species, with a greater range of sizes. I would also monitor the amount of food consumed for a longer period of time for more precise results. It would also be helpful to use a food source that does not take in water. As aforementioned, it appeared that the crabs tested had similar rates of consumption relative to body weight, but there were essentially not enough test subjects for strong data correlations.

Another important point is that in the ocean, crabs would most likely have much greater energy demands than in the lab. This is because crabs must use energy in the benthos to perform tasks such as finding food and cracking bivalve shells. For example, *C. magister* is known to dig pits in the sediment up to 20 cm deep in search of burrowing bivalves (Tegelberg 1972). Performing tasks like burrowing requires more energy and thus requires more calorie intake.

In my experiment, the crabs exerted a lower amount of energy than they would in their natural environment. This was accomplished by feeding the crabs raw chicken, which required no energy spent on foraging or shell cracking. This allowed for little variation in the activity level between the crabs, and thus allowed for relatively constant energy demands for each crab tested. My experiment reflects the minimum amount of food crabs eat, since their activity level and energy demands are lower than in the benthos. My experiment also reflects how much crabs eat when a surplus of food is presented to them. Food may not always be available in the ocean, so crab feeding behavior would most likely be different. Although my experiment does not reflect the type or amount of food crabs consume in their natural environment, it still provides insight to their feeding behavior.

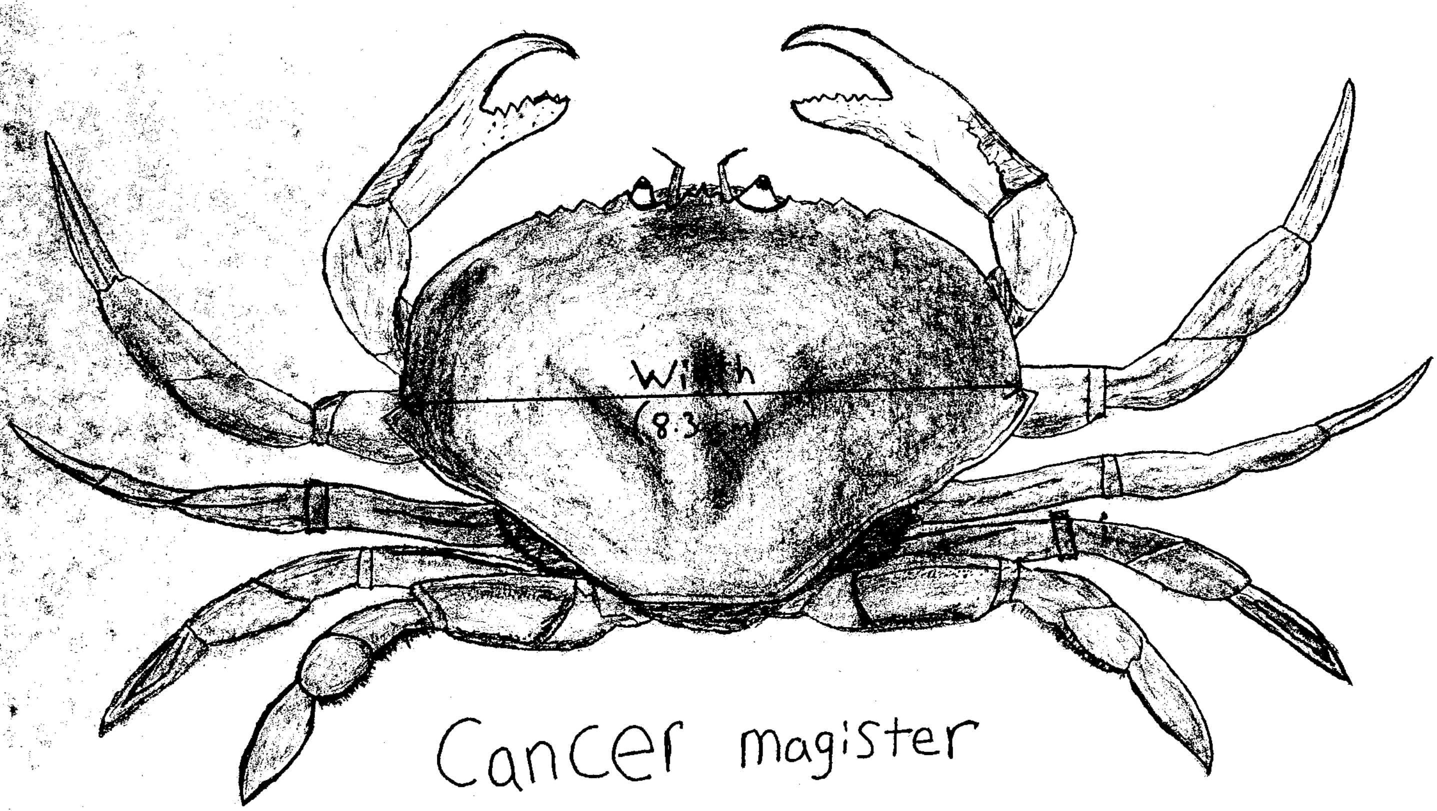
Literature Cited

Stevens, B.G., D.A. Armstrong and R. Cusimano 1982. *Feeding Habits of the Dungeness Crab Cancer magister as Determined by Index of Relative Importance.* Marine Biology 72. pp. 135-145.

Tegelberg, H 1972. *State of Washington Dungeness Crab Study.* U.S. Fish & Wildlife Service Project No. 1-76-R.

Warner, G.F. 1977. The Biology of Crabs. Van Nostrand Reinhold Company, N.Y. pp. 87-89.

Figure 4



Cancer magister