MANGROVE TREE CRABS (*ARATUS PISONII*): OPPORTUNISTIC FEEDERS IN MANGROVE FORESTS

By: Crab Nation Team

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ABSTRACT

Mangrove ecosystems are important habitats for many animals, which may use living and dead mangrove leaves as food. However, mangrove forests are being destroyed world-wide, potentially threatening feeding relationships in mangroves. In order to better understand mangrove food webs, we conducted surveys and a lab experiment to evaluate the feeding behavior of one of the most abundant mangrove animals in south Florida, the mangrove tree crab (*Aratus pisonii*). A variety of plant matter and animal matter were used in a feeding assay to test the preferences in an artificial environment. We also conducted surveys in red mangroves (*Rhizophora mangle*) on the FIU Biscayne Bay campus to compare findings from the lab experiment. The results from our feeding assays demonstrated that mangrove tree crabs preferred to eat live crickets followed by dead mangrove tree crabs, however, in field surveys the crabs were seen feeding on red mangrove tree leaves more frequently than animal matter. Over 2.5% of the crabs found in the survey were observed eating mangrove tree leaves as compared to .69% found eating other crabs. This demonstrates that mangrove tree crabs may be opportunistic feeders, eating what can be found and supplementing their diet with red mangrove tree leaves. This study supports other scientific findings that mangrove tree crabs favored the more nutritionally-rich animal matter, when possible, over plant matter.
INTRODUCTION

Mangrove forests are important coastal ecosystems, providing habitat for many terrestrial and aquatic species, including insects, fishes, crabs, and shrimp. Perhaps most importantly, mangrove forests serve as nurseries for many different types of animals, including reef fish, which help maintain healthy coral reefs (WWF report 2015). In addition to being an important habitat for a number of species, mangrove leaves and decaying mangroves provide the basis for mangrove food webs. For instance, juvenile mangrove snapper (*Lutjanus griseus*), a commercially important species associated with red mangroves (*Rhizophora mangle*), often consume small shrimp and crabs that eat mangrove detritus. Snapper are then preyed on by larger fishes, linking multiple trophic levels (Starck 1971).

While there are many different species of animals living in the mangrove forests, one of the most abundant species is the mangrove tree crab (*Aratus pisonii*) (Feller and Chamberlain, 2007) (Figure 1). The mangrove tree crab is often considered herbivorous because its diet is mainly made up of red mangrove tree leaves and the mangrove tree crab is the only crab in the world that actually feeds on living leaves, even though the leaves are their least nutritious food supply (Erickson et al., 2003). Although these crabs eat a lot of plant matter, in studies it is shown that they also eat animal matter, such as other crabs. So even though the common misconception is that they are herbivores, they may actually be opportunistic omnivorous creatures.

Mangrove tree crabs are of particular importance in mangrove food webs, as they provide a critical link between mangrove-derived nutrients (e.g., crabs eating mangrove leaves) and nearby aquatic ecosystems (e.g., fishes eating crabs that fall into the water). For our research project, we evaluated what mangrove tree crabs prefer to eat so we could better understand how these crabs contribute to mangrove food webs. We conducted field surveys to evaluate what
mangrove tree crabs prefer to eat in the wild, and then conducted a lab experiment to evaluate what mangrove tree crabs will prefer to eat if given a choice between plant matter (red mangrove leaves), wood, or animal matter (dead mangrove tree crabs or living crickets). Our overall hypothesis was that crabs would have a food preference, and our alternative hypothesis was that crabs would red mangrove tree leaves over wood, crickets, and other dead mangrove tree crabs. Our null hypothesis was that the mangrove tree crab would not prefer red mangrove leaves to other food types.

**METHODS**

*Field survey methods* - We conducted our field surveys during high tide in a red mangrove stand on Florida International University’s Biscayne Bay Campus (25.902480° N, 80.142031° W). Surveys were conducted on four separate days for 30 minutes to assess mangrove tree crab behavior (such as feeding behavior), crab location on the tree, and the height (in meters) on trees where crabs were located. During surveys, students with binoculars were located at three separate red mangrove trees, and recorded crab behavior ~5 meters away from each designated tree (Figure 2). Mangrove tree crab behaviors that were recorded included: resting, crawling, wetting gills, interacting with other crabs, or feeding. If mangrove tree crabs were feeding, we would specify what they were eating, if the food item was identifiable.

*Experimental methods* - We conducted a multiple feeding choice lab experiment in the Cox Science Building on the University of Miami Coral Gables Campus. We used 16, small plastic containers in this experiment. Eight containers were designated as our ‘treatment’ containers which contained four food items (1 red mangrove leaf, 1 piece of mangrove wood, 1 dead crab, and 1 live cricket) and 1 living mangrove tree crab with a carapace width ranging between 2.5-
5cm in width, and 8 containers were designated as controls (i.e., all food items were present except for living crabs) to assess weight loss of food items not related to consumption. At the start of the experiment, we used scissors and double-sided tape to cover up the plastic containers with black construction paper in order to keep the living crabs protected from any outside movement, which may influence their feeding behavior. Dead crabs, red mangrove leaves, live crickets, and pieces of wood were weighed and the initial weight was recorded. After that, we put a small plastic tray in each tank filled up with salt water for the living crabs to wet their gills. After two days, we checked on the tanks and re-weighed everything to assess if the crabs preferentially consumed any food items. We calculated total percent of food consumed, which compares the weight loss of food in the control tanks without crabs present to the experimental tanks using the following equation:

\[ T_i \left( \frac{C_f}{C_i} \right) - T_f \times 100 \]

Where \( T_i \) is the initial food mass, \( T_f \) is the final food mass, \( C_i \) is the initial control food mass, and \( C_f \) is the final control food mass.

We then ran a one-way ANOVA on crab food consumption across our four food treatments (crabs, wood, red mangrove leaves, and dead crabs) to see if crabs had a food preference.

**RESULTS**

In this project, a total of 434 mangrove tree crabs were surveyed in the wild at Florida International University - Biscayne Campus. Surprisingly, crabs were infrequently observed feeding, and instead, were most commonly observed exhibiting other behaviors. Specifically, we found that 54% of mangrove tree crabs were observed crawling, 39% of the crabs rested, 4% of the crabs were wetting their gills, 1% of the crabs were interacting with one another, 1% of the
crabs were rubbing their legs, and 1% of the crabs showed other behaviors, including feeding (Figure 3). Crabs were most commonly observed in lower parts of the tree, and the mean height (± standard deviation) where the mangrove tree crabs were found was 0.5 ± 0.39 meters. Crabs were most abundant on the prop roots or tree trunks of mangroves: 49.5% of mangrove tree crabs were found on prop roots, 41.4% were found on tree trunks, 3.2% were found on tree branches, 2.0% were observed on mangrove leaves, 1.6% were in the water, 1.6% were on muddy ground below prop roots, and 0.46% were observed in midair, while jumping (Figure 4).

Though crabs were not observed to feed in the wild often, when they did feed, the majority of crabs preferred to eat mangrove leaves. Over 2.5% of the mangrove tree crabs surveyed preferred to eat red mangrove tree leaves, 1.8% preferred to eat unidentified food, 0.92% preferred to eat wood, 0.92% also preferred to eat algae, and 0.69% preferred to eat other crabs (Figure 5). In our lab experiment, we found that there was a significant difference in food consumed by crabs across the four different food types ($F_{3, 24} = 6.4$, $P = 0.002$). Specifically, we found that crabs consumed crickets the most, followed by dead crabs. Red mangrove leaves were consumed the least, followed by wood (Figure 6).

**DISCUSSION**

Flora and fauna living in mangroves rely on mangrove plants, both living and dead, as the first link in mangrove food webs. Our research focused on gaining a better understanding of the diet of mangrove tree crabs in the wild and in the laboratory to see if they choose certain food types. Although we hypothesized that mangrove tree crabs would prefer to eat red mangrove tree leaves over other food sources, we found that mangrove tree crabs may eat a wide array of food choices. In the wild, we saw that the mangrove tree crabs would eat red mangrove leaves the most, which supports our alternative hypothesis. However, in the lab experiment, we found that
crabs ate crickets more than any other food option. Our lab results are similar to previous findings. According to Beever et al. (1979), animal matter is significantly preferred over plant matter and the mangrove tree crab will opportunistically feed on animal resources that are available. A study conducted by Wolcott and Wolcott (1987) also found that land crabs (Cardisoma guanhumi) preferred animal matter because of its high nitrogen and protein content, both of which are important for crab growth and reproduction.

We were puzzled by the fact that in the wild, the crabs would eat leaves, but in the experiment they preferred not to eat leaves. The possible explanation is that in the wild, mangrove leaves are an abundant food source and easy to reach. If a crab was hungry, all it had to do was climb up a tree and start eating a red mangrove leaf. However, it is a lot harder for a mangrove tree crab to catch a live animal to eat. But when the crab gets an opportunity to choose just like our lab experiment, it will try to eat the animal.

In conclusion, mangrove tree crabs prefer animal matter, such as other crabs and crickets over plant material when given a choice of food items. In the future, more studies should be conducted to test if single and mixed diets influence a crab’s eating habits as well as its growth. Our research findings are important because they help us better understand how mangrove food webs may function in south Florida, which may be negatively affected by mangrove forest destruction.

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Figure 1- Mangrove tree crab (*Aratus pisonii*). A) Crab clasping white mangrove leaf, B) Crab crawling on mangrove tree trunk
Figure 2- Image of Florida International Biscayne Bay field survey locations. Surveys were conducted in Red Mangroves, at three different trees (located with red stars).

Figure 3- Crab behavior from field surveys.
Figure 4- Crab habitat use during surveys on three red mangrove trees

Figure 5- Food that crabs were observed consuming during field surveys
Figure 6- Percentage of total food consumed by crabs in the lab experiment based on our total food calculation. Note that there was a negative amount of red mangrove leaves and wood consumed; this reflects the amount of weight lost over time in the control tanks, which was substantial in this experiment.