Aquaculture is the farming of seafood. Multi-trophic aquaculture is the use of species from various trophic levels to create a mini-ecosystem (Figure 1). This system has an input of food for the main species in the culture, commonly a fish such as salmon, tuna, or cod – a local example. Surrounding the cages or nets, a series of boxes hold up lines which allow filter feeding organisms, such as mussels, to grow. These filter out the wastes out of the water from the fish, such as excess food and excreted wastes and are then utilized for organic growth. Following the mussel lines, seaweed filters dissolved nutrients such as ammonias and nitrates from the water.

This method of feeding reduces nutrient loads on the surrounding environment and the excess nutrients are utilized for the growth of the surrounding species. Overall, the use of food input three or more potentially economically beneficial species can be grown. However, there are still limitations with the method, similar to traditional aquaculture, with issues such as water flow and biofouling.

### The Caribbean Spider Crab

The Spider Crab *Mithrax spinosissimus* (Figure 2) was chosen for use in biofouling because it is:

- Herbivorous
- Nocturnal
- Short Larval period (Baeza et. al., 2012)
- Continuous reproduction (Baeza et. al, 2012)

It has the potential to be very marketable as a food as it is the largest crab in the Caribbean and it supposedly tastes like Alaskan King Crab. However, it has not yet been marketed because it is difficult to catch, if it hides in cracks and crevices and cannot be caught in traps.

### Study Sites

![A graphic representation of multitrophic aquaculture (IMTA)](image)

Biofouling can be found on aquaculture cages and is when algae and other settling organisms cover an underwater structure. Some issues include reduced water flow, harboring pathogens, extra competition for food and overall reduced health.

### Fisheries Implications

Lobster, conch and stone crabs are three commercially harvested species in the Bahamas. If in the future these species become overexploited, spider crabs have the potential to fill the market gap.

- In order to prevent overharvesting, regulations must be put in place.
- Currently there is limited knowledge as to the size at which a crab reaches sexual maturity as well as reproduction capacities.

Knowing the size at which a species reaches sexual maturity can be useful in informing fisheries regulations as these individuals have contributed to the population before they are harvested.

### Results

The distribution of the carapace widths in 10 mm size increments (Figure 6) allows us to see the males reach a larger size, but females are more abundant.

At around 97 mm carapace width (Figure 7), male chela length to carapace width ratio increases. When compared to females of a similar carapace size, males have significantly larger claws.

At around 102 mm carapace width (Figure 8), female abdomen width to carapace width ratio decreases.

### Discussion

Our results show that male crabs reach sexual maturity at around 97 mm carapace width, based on the change in their claw size. The change in claw size is a display of sexual dimorphism (Figure 9A and 9B), where the two sexes of the same species show a distinct morphological difference. Males, in this case, use the claws for display purposes. It is unclear whether these are used for fighting or display only, more research is needed on this topic.

Female crabs show a slight decrease in the rate at which their abdomen grows in relation to their carapace. This may be due to the production of egg or occurring at this point. Overall, these crabs should only be harvested after they have reached sexual maturity or larger in order to ensure that they have had the chance to reproduce. A 5-10 mm size buffer on potential harvesting regulations would be beneficial as there is some size variation when the crabs reach sexual maturity.

Future studies would suggest:

- A more in depth study for better comparison between the three sites.
- A similar study at different latitudes. These crabs are found throughout the tropics, and as temperatures vary with distance from the equator, the size at which the crabs reach sexual maturity may change.
- In addition, our study did not find crabs smaller than 62 mm carapace length. It would be interesting to find where the juveniles reside, as our numerous trips did not find any small individuals.

### Conclusions

Since there are currently no size regulations on spider crab harvesting, we hope that the Bahamian government will take our research information and apply regulations for the catch of spider crabs to ensure they will only be caught when they are sexually mature.

In addition, for use in biofouling removal:

- Use crabs for their larger overall size, likely consuming more fouling, and their more marketable meat yield.
- Set up a broodstock facility for future proofing the use of spider crabs in aquaculture.

### Future Recommendations

Following in our research we would suggest:

- A more in depth study for better comparison between the three sites.
- A similar study at different latitudes. These crabs are found throughout the tropics, and as temperatures vary with distance from the equator, the size at which the crabs reach sexual maturity may change.
- In addition, our study did not find crabs smaller than 62 mm carapace length. It would be interesting to find where the juveniles reside, as our numerous trips did not find any small individuals.

### Works Cited


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