The Potential Habitat Displacement Between the Caribbean Spiny Lobster, *Panulirus argus,* and the Invasive Lionfish, *Pterois volitans,* in South Eleuthera, The Bahamas.

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Introduction

The lionfish invasion (Fig. 1) was an unanticipated result of poor handling in the aquarium trade. Lionfish were first sighted in The Bahamas in 2004 (Morris *et al*. 2009). Their rapid invasion spread as a result of their frequent breeding and lack competition (Morris *et al*. 2009). Lionfish are gape-limited predators, which means that they will eat anything that fits in their mouth (Morris *et al*. 2009). They can consume prey that is up to half the size of their bodies and consume about 2.5-6% of their body weight every day (Morris *et al*. 2009). Lionfish are consuming the economically and ecologically important species on the reefs, like parrotfish and grouper (Morris et al. 2009).

The Caribbean spiny lobster (Fig. 2) is the largest industry in all of the Caribbean particularly in The Bahamas. A study conducted by Henderson and Cotê (2011) found a relationship between the number of lionfish and number of lobster in lobster traps (condos see Fig. 4). Where there were no lionfish in the condos there was a high abundance of lobster, but in condos with some lionfish there was significantly less lobster (Fig. 3). The Henderson and Cotê (2011) study highlighted the need to examine this relationship further because if lionfish are displacing lobster, then this could have a huge impact on the lobster industry and the entire economy in The Bahamas and the Caribbean.

Fig 1. Invasive lionfish in The Bahamas.

Fig 2. Native Caribbean Spiny Lobster .

Aim

To investigate how the presence of lionfish in The Bahamas affects the artificial habitat use of spiny lobster.

Hypothesis

The presence of a lionfish will result in the displacement of the lobster from its habitat.

Fig 3. Lobster guarding habitat.

Fig 4. A 2011 study by Henderson and Cotê investigating lobster condos and lionfish occupation.

Methods

Field Work

Patch reefs were surveyed by snorkeling and free diving to assess total abundance and location of lionfish and lobster; this data will be analyzed alongside the historical data set of abundance (Fig 7). Patch size was measured taking the length, width and height of each reef (Fig. 6). A total of 16 patch reefs were surveyed. Lionfish and lobster were also from captured from patch reef for lab testing (Fig 5).

Fig 5. Free divers collecting lobster and lionfish from patch reefs using nets.

Fig 6. Patch reef size were measured and recorded.

Fig 7. The abundance of lionfish and lobster were recorded at each patch reef.

Lab Work

The interactions and behaviors between lionfish and lobster were tested in the lab. Shelters were constructed to resemble lobster condos with 2 cinder block sides and plastic roofs (Fig 9). There were two control groups to observe normal behaviors: a lobster alone in a tank, and a lionfish alone in a tank (Fig. 8). The experimental group was a lobster and lionfish together in a tank (Fig. 8 and Fig 11). Each treatment was recorded with infrared cameras and run 3 times for 48 hours (Fig. 10). A list of common behaviors was generated (ethogram) to assess behaviors. The video recordings were analyzed second by second documenting behavior and shelter use.

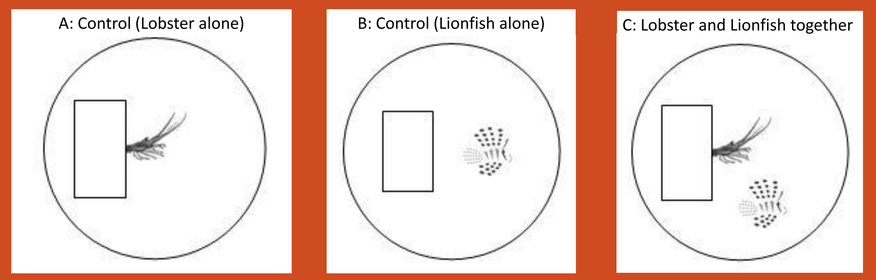

Fig 8. Schematic of experimental design to assess if lionfish displace lobster and the interactions take place between the species. Treatments: A. lobster only (control), B. lionfish only (control), C. lobster and lionfish.

Fig 9. Lobster in tank with habitat.

Fig 10. Infrared cameras used to capture night time activity .

Fig 11. Lobster and lionfish treatment.

Results

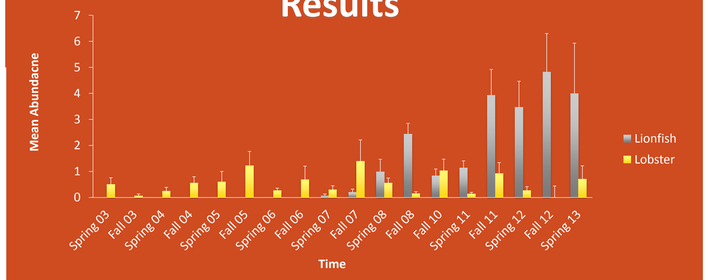

Fig 12. The overall abundance of both lionfish and lobster is displayed over a period of 18 Island School semesters.

Lionfish abundance has had a general increase since their appearance in 2007, while lobster abundance remains fairly constant.

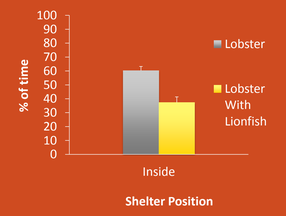

Fig 13: The percentage of time lobster spend inside its shelter during the control compared to when a lionfish is present.

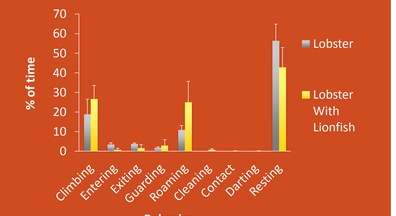

Fig 14: The percentage of time lobsters engaged in specific behaviors with and without a lionfish present.

With a lionfish present, lobster would spend 22.87% more time outside the habitat compared to the control treatments (Fig. 13). Additionally, lobster would spend 14.14% more time roaming with the lionfish in the tank compared to the control treatment (Fig. 14).

Discussion

In summary, lionfish displace lobster from artificial habitats. The lab work results indicated a significant change in both the amount of time lobster spent inside the habitat and lobster behavior with the presence of a lionfish in the tank. Overall, lobster spent significantly more time outside of the shelters and more time roaming with lionfish in the tank, indicating the lobster's displacement from its habitat.

Although lionfish abundance has been increasing over the past 6 years, lobster abundance has remained at a relatively constant level. This increase in lionfish abundance makes the displacement of lobster more likely to increase with time. Lobster fishermen have already found lionfish in their bycatch and a decreased number of lobster (Henderson and Cotê, 2011). Therefore the displacement has large socioeconomic implications as the lobster fishery is the largest fishery in The Bahamas. A solution to this issue would to be to start eating lionfish, creating market and alternative income for the lobster fishery. For future studies, it should be identified to what extent of an effect lionfish play on the lobster abundance in natural habitats and to examine the role the native fish species on lobster habitat use.

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Citations

Henderson, E.B., Cotê, I.M., 2011. Potential Effects of the Indo-Pacific Lionfish Invasion on The Bahamian Lobster Fishery. Proceedings of the 64th Gulf and Caribbean Fisheries Institute 1: 55-56.

Morris, J.A., Akins, J.L., Barse, A., Cerino, D., Freshwater, D.W., Green, S.J., Muñoz, R.C., Paris, C., and Whitfield, P.E. 2008. Biology and Ecology of the Invasive Lionfishes, *Pterois miles* and *Pterois volitans.* Gulf and Caribbean Fisheries Institute 61: 1-6.