The Lion, The Fish, and The Mangrove: Quantifying the Interactions Between Schoolmaster Snapper and Invasive Lionfish in a Mangrove Ecosystem

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Introduction:

The Red Lionfish (*Pterois volitans*) an Indo-Pacific native, was unintentionally released into the Atlantic via the aquarium trade in 1985. After its introduction, the populations quickly increased, with the first sighting in the Bahamas occurring in 2004 (Scholfield 2009). Surviving anywhere from 1-1000 ft., and at salinity levels as low as 7ppt, there are few habitats that lionfish can't survive (Jud, 2015). Recently, studies have shown that lionfish have begun to invade mangroves, and could outcompete native species for resources (Dark, 2013). Mangroves are an important ecosystem as they act as nurseries and provide protection for many juvenile fish.

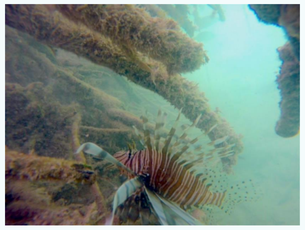

Figure 1: Lionfish amongst mangrove roots in Rollins Creek

Past studies have shown that red lionfish cause the dispersal of native fish on coral reef structures, specifically Nassau grouper, indicating the territorial threat of lionfish (Raymond, 2014). If a similar impact occurs in the mangroves, this could cause the dispersal of fish from the safety of the roots, leaving them at a higher risk of predation from birds and other larger marine predators.
For our project, lionfish and snapper were be studied together in an experimental mangrove system because both species occupy a similar niche within this ecosystem.

Questions & Objectives:

•Do lionfish cause the dispersal of schoolmaster snappers in a mangrove ecosystem?

•Observe how lionfish cause snapper dispersal in an artificial mangrove system
•Investigate the invasion of lionfish in mangroves
•Understand the impacts of lionfish in a mangrove ecosystem on native species

Methods:

Study Area and Collection

•Schoolmaster snapper (*Lutjanus apodus*) and red lionfish (*Pterois volitans*) were used.
•The schoolmaster snapper were caught in Page Creek using a seine net and metal traps.
•The lionfish were caught on various patch reefs in South Eleuthera using plastic nets while on SCUBA.
•Individuals were returned to the laboratory facilities for pre-acclimatization before trials began.

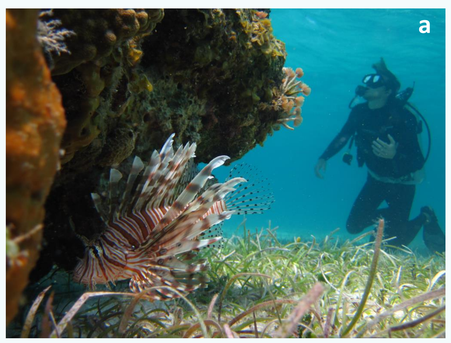

Figure 2: a. Lionfish were caught while on SCUBA using hand nets. **b.** Schoolmaster snapper were caught with seine nets.

Methods Continued:

Experimental Design

•A raceway tank (242 x 58 x 30 cm) was divided into a 30-square quadrat.
•Located on one side of the tank was a red mangrove root, which served as the shelter.
•A GoPro was suspended above the tank to record the trial.
•For the initial acclimatization stage, a divider was used to separate the snapper and lionfish for five hours.

Experimental Stages

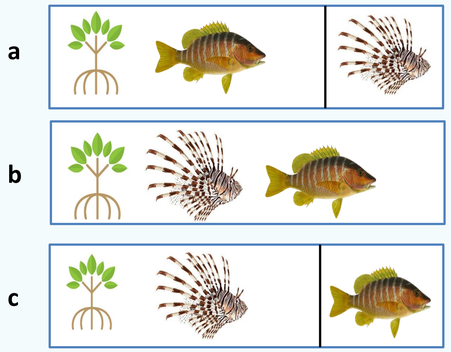

Figure 3: a. The snapper was filmed for an hour and a half to observe natural behaviors. **b.** The barrier was removed and both fish were filmed together for an hour and a half. **c.** The barrier was returned and the lionfish was filmed alone in the mangrove for an hour and a half.

Data Collection

•Video analysis was used to avoid human interference.
•Videos were analyzed by stopping every two minutes (Fig. 4)
•For each trial the positioning of both individuals and whether it was inside or outside the mangrove was noted (Table. 1)
•From these values, percentage occurrence of each individual in the mangrove was calculated for both solo and interaction trials.

Solo	Interaction		Solo
Snapper	Snapper	Lionfish	Lionfish
In	Out	In	Out
In	In	Out	Out
In	Out	In	In

Table 1: An example of data collected from video trials, used for calculating percent occurrence.

Figure 4: Data was collected using video analysis.

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Results:

After collecting data onto a table (Table. 1) and recording whether the snapper or the lionfish was either "IN" or "OUT" of the mangrove, the percent occurrence in the mangrove for the solo and interaction trials was calculated. A Wilcox signed-rank test was conducted with these percent occurrences. Between the snapper solo and interaction trial, a significant difference in the percent occurrence in the mangrove was found (W = 34.5, p = 0.01027). The lionfish showed no significant difference in percent occurrence in the mangrove between the solo and interaction (W = 18, p = 1).

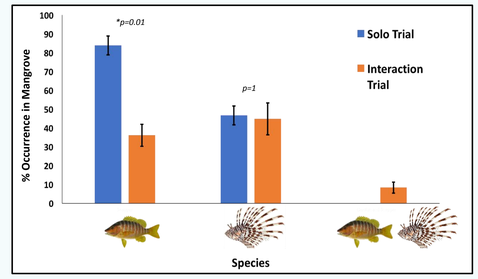

Figure 5: The percent occurrence in the mangrove for the lionfish and the snapper for the solo and interaction trial. The p values produced by the Wilcox signed-rank test are listed above each fish respectively. The error bars indicate standard deviation for all trials (n=7).

Discussion:

From the results we can draw two conclusions. Firstly, the snapper's use of the mangrove changed in the interaction trial compared to the solo trial. Secondly, the amount of times the lionfish used the mangrove did not change between the solo and interaction trials. Therefore, we can conclude that snappers use the mangrove system less frequently when in the presence of lionfish. As a result of this, it could cause them to move into the flats, potentially leaving them at a higher risk of predation from birds and other larger marine predators.
Increased predation could result in the decline of juvenile snapper populations in the mangroves, resulting in decreased reef recruitment. This could cause an overall decrease in the populations. As snappers are a commercially valuable species, if these fish become less accessible due to population declines, it could have major implication on fishing industries.

Future Research

As we observed no predatory behaviors from the lionfish, we can assume their threat is territorial, and therefore, an investigation of the long-term behavioral impacts of lionfish on snapper could be beneficial. The snapper may become accustomed to the presence of the lionfish and eventually re-enter the mangrove. Another study could investigate the effects of lionfish on different mangrove species, as they may use the mangrove differently and have different reactions to the lionfish.

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