Dietary preference of the invasive lionfish (*Pterois volitans and Pterois miles*) in South Eleuthera

William F. Cannistraro, Maxwell C. Carty, William J. Cembalest, Sarah E. Davis, Colin F. Horgan, and Madison M. Howe

Advisors: Jocelyn A. Curtis-Quick and Vienna R. Saccomanno

Introduction

Lionfish (*Pterois volitans and Pterois miles*) were first seen in non-native waters in 1985. They are the first invasive fish species to the Caribbean and Atlantic coast of the United States. The first sightings were the result of releases of six lionfish from Floridian aquariums (Morris and Akins, 2012). In 2004 lionfish were first sighted in Bahamian waters, and within three decades they have extended their range from as far north as New York, and as far south as Brazil. Factors that contribute to their success include that they are generalist feeders, only limited by their mouth size, parasite resistant, prolific breeders, habitat generalists, possess venomous spines, and have few natural predators. Their presence in reef ecosystems is detrimental to the abundance and biomass of native fish. They remove species such as parrotfish and other grazers that are ecologically vital to preserving reef ecosystems. Research of lionfish gut contents has shown that lionfish select prey based on body shape and behavior (Green and Côté, in press). Lionfish stomach content analysis by the Cape Eleuthera Institute has identified most commonly consume prey off lionfish collected from the surrounding waters of Cape Eleuthera (see Fig. 6). However, lionfish prey selection and the degree that traits and behavior play is yet to be fully understood.

Methods

Prey Fish Collection

Prey species were collected using cast nets as well as handheld nets while free diving and SCUBA diving.

Figure 1. Cast-netting for prey fish.

Figure 2. SCUBA diving fish collection.

Figure 3. Free-diving fish collection.

Preference Trials

Lionfish were given a choice between two prey species to assess their preference by observing lionfish behavior as well as prey fish behavior. These trials ran for 20 minutes and were conducted in a rectangular tank divided into three sections; sections A and C contained prey fish, and section B contained the lionfish. Prey fish were enclosed in clear tubes to allow for visual and olfactory cues to influence lionfish prey preference. Grunts were used preferred prey fish as they came up most frequently in the Cape Eleuthera Institute's lionfish stomach content analyses (Fig.6).

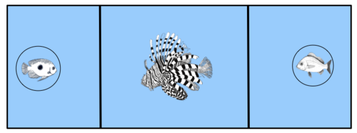

Figure 4. Experimental tank setup for preference trial.

Abundance Trials

Lionfish were given different abundance ratios to determine whether prey preference changed when the availability of prey fish changed. These trials were conducted in a large circular tank to assess the quantity of fish consumed over a 20-hour period. These trials were based on results from initial preference trials, and lionfish were given an equal prey ratio of 5:5 as well as a low to high prey ratio of 2:10. Since lionfish are crepuscular feeders, these trials were conducted overnight giving the lionfish its primary feeding times of dusk and dawn.

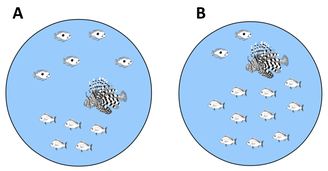

Figure 5a/b. Experimental setup for prey availability trials. 5a. Equal prey ratio. 5b. Low to high preferred prey ratio.

Purpose

The purpose of this study is to assess the prey preferences of lionfish as well as to determine whether that preference changes with availability of prey.

Results

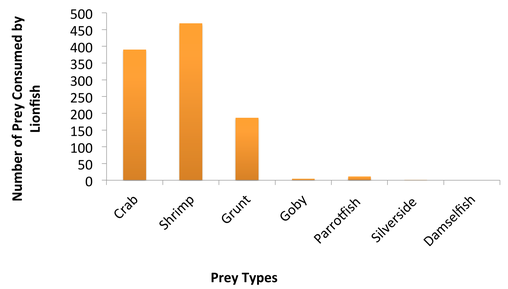

Figure 6. The most and least abundant prey items in the stomachs of lionfish (*Pterois volitans* and *Pterois miles*) from the surrounding waters of Cape Eleuthera, The Bahamas.

Stomach content analyses of 1,694 lionfish from the waters surrounding South Eleuthera identified 39 prey species and families. The most frequently consumed items included shrimp and crab. In terms of fish, the most often consumed were from the Grunt family. Some of the rare prey items included fish from the goby, parrotfish, silverside and damselfish families (see Fig. 6).

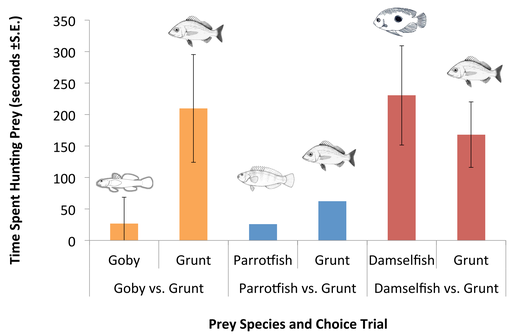

Figure 7. Lionfish's average time spent hunting prey per species based on three choice trials: goby vs. grunt, parrotfish vs. grunt and damselfish vs. grunt (mean ±SE).

In the lionfish prey preference trials on average, the lionfish spent more time exhibiting hunting behavior with the preferred grunt over goby and parrotfish. However, it was unclear whether there was a preference between damselfish and grunt due to the large variation in the data (see Fig. 7).

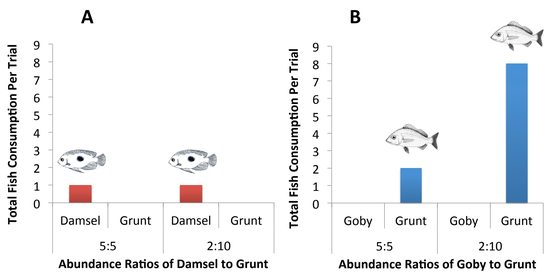

Figure 8a and 8b. Total fish consumed per trial of non-preferred to preferred -damsel to grunt and goby to grunt in which abundance ratios were either equal (5:5) or low, non-preferred to high preferred (2:10).

In the prey abundance trials, it was observed that the lionfish preferred damselfish over grunt regardless of availability (see Fig. 8a).

In the prey abundance trials, it was observed that the lionfish preferred goby over grunt regardless of availability (see Fig. 8b).

Discussion

This study assesses which morphological and behavioral factors make native reef fish more vulnerable to invasive lionfish predation. It was hypothesized that when given a choice between two prey fish that the lionfish would prefer fish found most frequently in stomach content data collected by the Cape Eleuthera Institute (see Fig. 6). Further, when given differing abundances of prey fish, the lionfish would choose its more preferred prey, even if the prey was less abundant. The results from choice trials showed that lionfish had a general preference for the grunt species; potential preference for damselfish was also observed. Grunt preference in the choice trials is supported by the stomach content data of the Cape Eleuthera Institute. It was surprising to observe lionfish attraction to damselfish, as damselfish were rare in the lionfish stomach content data.

When prey availability was changed it was observed that grunt were consumed at a greater rate than goby. When damselfish were a prey option in the abundance trials, damselfish were consumed over than grunt. Damselfish are a territorial species, so their higher hunting and consumption numbers could be a result of insufficient acclimation time to the tank resulting in less alertness and aggression. The grunts in the experiment were schooling. Thus, behavior from both the grunt and the damselfish seem to be drivers of lionfish prey choice. Due to the round shape of damselfish, these outcomes contrast with existing knowledge of lionfish preference for short and skinny prey (Green and Côté, in press).

Key Findings:

- Grunt's schooling behavior could have deterred lionfish predation.
- Damselfish's non schooling and lack of an established territory could have could have resulted in less aggression and alert behavior resulting in increased vulnerability to lionfish predation.
- In conclusion, lionfish predation was influenced by prey behavior more than prey morphology.

By understanding lionfish prey preference, it is possible to predict the changes to the reef fish assemblages and the potential knock on effects for the reef system. With this knowledge more informed management and protection strategies could be put in place. The dynamics of lionfish prey preference are not well understood and further research is required.

Figure 9. Lionfish stomach content analysis.

Figure 10. Lionfish corralling damselfish prey.

Acknowledgements

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Citations

Green, S.J., & Côté. I.M. (In Press). Trait-based diet selection: Prey behavior and morphology predict vulnerability to predation in reef fish communities. *Journal of Animal Ecology* doi: 10.1111/1365-2656.12250.

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