

# Results of lab experiment examining competition for refuge space between invasive lionfish and Nassau grouper; conducted at Lee Stocking Island, Bahamas from 2009-2012 (Lionfish Invasion project)

**Website:** <https://www.bco-dmo.org/dataset/3957>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2013-06-03

## Project

» [Ecological Release and Resistance at Sea: Invasion of Atlantic Coral Reefs by Pacific Lionfish](#) (Lionfish Invasion)

Contributors	Affiliation	Role
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## Abstract

Results of lab experiment examining competition for refuge space between invasive lionfish and Nassau grouper; conducted at Lee Stocking Island, Bahamas from 2009-2012.

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## Coverage

**Spatial Extent:** Lat:23.774192 Lon:-76.1075

**Temporal Extent:** 2010-07-14 - 2010-08-25

## Dataset Description

The investigators examined the interactions between invasive lionfish and native Nassau grouper using both a manipulative field study and a controlled lab experiment. This dataset results from the lab experiment testing for evidence of competition between lionfish and Nassau grouper for refuge space/shelter.

Related Datasets from sub-project "Interactions between native Nassau grouper and invasive lionfish":  
artificial and transplant reef census  
lionfish growth

## Related Publications:

Pusack, TJ. Submitted. Evidence of biotic resistance: native Nassau grouper (*Epinephelus striatus*) mitigate predator effects of invasive Pacific red lionfish (*Pterois volitans*) on Atlantic coral reefs. Ecological Applications.

Raymond WW, MA Albins, and TJ Pusack. In Review. Shelter competition between invasive Pacific red lionfish *Pterois volitans* and native Nassau grouper (*Epinephelus striatus*). Journal of Experimental Marine Biology and

Ecology.

## Methods & Sampling

In the controlled lab experiment, the investigators tested for evidence of competition for refuge space between lionfish and Nassau grouper at various size ratios. They used size ratios of 1:1, 1:4, 3:1 (lionfish:Nassau grouper TL). Mesh cages were placed in in-ground tanks with flow-through sea water. Specimens were first observed in isolation and then together. There was one refuge space (half of a cinder block) in each area either during the isolation period or when the fish were all together. To test for competition, the investigators established whether or not each specimen was closer to or further away from the shelter during the isolation period using a random positioning probability. This procedure was repeated when the two species were together to look for changes in behavior.

The investigators also tested for whether or not the larger specimen (predation species) would consume various species, either the opposite experimental specimen or a common prey fish (*Halichoeres bivittatus*, common name Slippery dick wrasse). The following predation events were observed throughout the experiment:

Predator species	Prey species	Number of predation events
<i>Epinephelus striatus</i>	<i>Pterois volitans</i>	0
<i>Epinephelus striatus</i>	<i>Halichoeres bivittatus</i>	7
<i>Pterois volitans</i>	<i>Epinephelus striatus</i>	0
<i>Pterois volitans</i>	<i>Halichoeres bivittatus</i>	6
<i>Pterois volitans</i>	<i>Haemulon</i> sp.	4

## Data Processing Description

BCO-DMO Processing Notes:

- Modified parameter names to conform with BCO-DMO naming conventions.
- Added lat and lon from the metadata provided.
- Replaced blanks and 'NA' with 'nd' ('no data').
- Added comments in the notes columns to indicate when observations stopped because one or more of the fish escaped.
- 09-Jan-2018: removed embargo on dataset.

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## Data Files

File
<b>grouper_lionfish_refuge_comp.csv</b> (Comma Separated Values (.csv), 39.05 KB) MD5:b3ca30cd8d6a9c8af8133078014ae82b
Primary data file for dataset ID 3957

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## Parameters

Parameter	Description	Units
site	Name of the site.	text
lat_site	Latitude of the site.	decimal degrees
lon_site	Longitude of the site.	decimal degrees
replicate	Indicates the (unique) replicate for each size ratio.	integer
location	Denotes which in-ground tank (IGTA) was used: IGTA-SW is the in-ground tank on the southwest corner. IGTA-NW is the in-ground tank on the northwest corner. IGTA-NE is the in-ground tank on the northeast corner.	code
target_size_ratio	Indicates the target size raio of lionfish total length to grouper total length.	dimensionless
actual_size_ratio	The actual calculated size ratio by dividing the lionfish total length (len_lionfish) by grouper total length (len_grouper).	dimensionless
len_lionfish	Total length in centimeters of the lionfish.	cm
len_grouper	Total length in centimeters of the Nassau grouper.	cm
date	Date that each observation was done in mm/dd/YYYY format.	unitless
time	Time of day of the observations; 24-hour clock.	HHMM
lionfish_to_refuge_dist_scaled	The distance between the lionfish and the refuge (cinder block) while in isolation. This distance was recorded on a sheet of paper with a scaled schematic of the actual cage dimensions.	cm
lionfish_to_refuge_dist_actual	Estimated distance of lionfish to the cinder block (refuge) based on what was recorded on the sheet.	cm
grouper_to_refuge_dist_scaled	The distance between the Nassau grouper and the refuge (cinder block) while in isolation. This distance was recorded on a sheet of paper with a scaled schematic of the actual cage dimensions.	cm
grouper_to_refuge_dist_actual	Estimated distance of Nassau grouper to the cinder block (refuge) based on what was recorded on the sheet.	cm

lionfish_to_grouper_dist_scaled	The distance between the lionfish and Nassau grouper when together; recorded on a sheet of paper with a scaled schematic of the actual cage dimensions.	cm
lionfish_to_grouper_dist_actual	Estimated distance between the lionfish and Nassau grouper based on sheet recordings.	cm
notes_lionfish	Notes about the behavior, position, or movement of lionfish.	text
notes_grouper	Notes about the behavior, position, or movement of Nassau grouper.	text

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## Deployments

### PIMS\_Hixon

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/59038">https://www.bco-dmo.org/deployment/59038</a>
<b>Platform</b>	Tropical Marine Lab at Lee Stocking Island
<b>Start Date</b>	2009-05-30
<b>End Date</b>	2012-08-18
<b>Description</b>	Various lab experiments were conducted between 2009 and 2012 at the facilities at the Perry Institute for Marine Science Tropical Marine Lab (at Lee Stocking Island, Bahamas) for the project "Ecological Release and Resistance at Sea: Invasion of Atlantic Coral Reefs by Pacific Lionfish".

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## Project Information

### Ecological Release and Resistance at Sea: Invasion of Atlantic Coral Reefs by Pacific Lionfish (Lionfish Invasion)

**Website:** <http://hixon.science.oregonstate.edu/content/highlight-lionfish-invasion>

**Coverage:** Bahamas; Cayman Islands; Mariana Islands; Philippines

Invasive species are increasingly introduced by human activities to new regions of the world where those species have never existed previously. In the absence of natural enemies (predators, competitors, and diseases) from their homeland, invasives may have strong negative effects on invaded ecosystems, especially systems with fewer species ("ecological release"), and may even drive native species extinct. However, if native natural enemies can somehow control the invaders ("ecological resistance"), then ecological disruption can be prevented or at least moderated. Most of the many invasive species in the sea have been seaweeds and invertebrates, and the few documented invasive marine fishes have not caused major problems. However, this situation has recently changed in a stunning and ominous way. In the early 1990s, lionfish (*Pterois volitans*) from the Pacific Ocean were accidentally or intentionally released from aquaria to the ocean in the vicinity of Florida. Camouflaged by shape and color, protected by venomous spines, consuming native coral-reef fishes voraciously, and reproducing rapidly, lionfish have subsequently undergone a population explosion. They now range from the mid-Atlantic coast of the US to the Caribbean, including the Bahamas. Native Atlantic fishes

have never before encountered this spiny, stealthy, efficient predator and seldom take evasive action. In fact, the investigator has documented that a single lionfish is capable of reducing the abundance of small fish on a small coral patch reef by nearly 80% in just 5 weeks. There is great concern that invasive lionfish may severely reduce the abundance of native coral-reef fishes important as food for humans (e.g., grouper and snapper in their juvenile stages) as well as species that normally maintain the integrity of coral reefs (e.g., grazing parrotfishes that can prevent seaweeds from smothering corals). There are far more species of coral-reef fish in the Pacific than the Atlantic, so this invasion may represent a case of extreme ecological release with minor ecological resistance. Dr. Hixon and colleagues will study the mechanisms of ecological release in lionfish, as well as examine potential sources of ecological resistance in the heavily invaded Bahamas. Because very little is known about the ecology and behavior of lionfish in their native Pacific range, he will also conduct comparative studies in both oceans, which may provide clues regarding the extreme success of this invasion. In the Bahamas, the investigator will document the direct and indirect effects on native species of the ecological release of lionfish, both as a predator and as a competitor. These studies will be conducted at various scales of time and space, from short-term experiments on small patch reefs, to long-term experiments and observations on large reefs. Whereas direct effects involve mostly changes in the abundance of native species, indirect effects can be highly variable. For example, lionfish may actually indirectly benefit some native species by either consuming or outcompeting the competitors of those natives. The project will explore possible ecological resistance to the invasion by determining whether any native Bahamian species are effective natural enemies of lionfish, including predators, parasites, and competitors of both juvenile and adult lionfish. Comparative studies of natural enemies, as well as lionfish ecology and behavior, in both the Atlantic and the Pacific may provide clues regarding the explosive spread of lionfish in the Atlantic.

Regarding broader impacts, this basic research will provide information valuable to coral-reef and fisheries managers fighting the lionfish invasion in the US, the Bahamas, and the greater Caribbean, especially if sources of native ecological resistance are identified. The study will fund the PhD research of U.S. graduate students, as well as involve assistance and participation by a broad variety of undergraduates and reef/fisheries managers, including women, minorities, native Bahamians, and native Pacific islanders. Participation in this project will promote education in marine ecology and conservation biology directly via Dr. Hixon's and graduate students' teaching and outreach activities, and indirectly via the experiences of undergraduate field assistants and various associates.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0851162</a>

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