Results of field experiment testing for the effects of lionfish density on native fishes; conducted at Lee Stocking Island, Bahamas in 2011 (Lionfish Invasion project)

Website: https://www.bco-dmo.org/dataset/3971
Data Type: Other Field Results
Version: 21 June 2013
Version Date: 2013-06-21

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

Contributors	Affiliation	Role
Hixon, Mark	Oregon State University (OSU)	Lead Principal Investigator
Benkwitt, Cassandra E.	Oregon State University (OSU)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **Lat**:23.75047 **Lon**:-76.14035

Dataset Description

A field experiment was conducted on artificial patch reefs to test for the effect of lionfish (*Pterois volitans*) density on native fish abundance, diversity, and community structure. This dataset includes counts of native fish species observed on reefs where lionfish density was controlled.

Related Publications:

Benkwitt, C.E. In Prep. Non-linear effects of invasive lionfish density on native fish communities. Intended for Biological Invasions.

Methods & Sampling

The experiment was conducted near Lee Stocking Island, Bahamas from June to August 2011. The expermint used 10 reefs which were manipulated so that 4 reefs had 0 lionfish on them (controls), and 6 each had a unique density of lionfish (1, 2, 4, 8, 10, or 12). These numbers represent the weighted average weekly lionfish densities (number of lionfish per meter squared) on each reef throughout the whole experiment. Complete censuses of the native fish population on each reef were conducted weekly for 6-weeks during the summer recruitment season.

Data Processing Description

BCO-DMO Processing Notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Replaced blanks with 0 in the count columns; replaced blanks with 'nd' ('no data') in all other columns.
- Added lat and lon of the site from the metadata provided.
- Transposed size bins to rows in lowest level of data.
- 09-Jan-2018: removed embargo on dataset.

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Data Files

File
lionfish_density_eff_native_fish.csv (Comma Separated Values (.csv), 3.34 MB) MD5:a2d4f5fabe021d62a4b2b6d842595fa4 Primary data file for dataset ID 3971

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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
location	Individual reef identification. All begin with "A" (for artificial reef) followed by a 2-digit number.	text
lionfish_density	Density of lionfish on the reef (number per meter squared).	number per m^2
visit_num	Survey number on that reef.	integer
month	2-digit month of survey.	mm (01 to 12)
day	2-digit day of month of survey.	dd (01 to 31)
year	4-digit year of survey.	YYYY
time_start	Time of the start of the survey (24-hr clock).	HHMM

time_end	Time of the end of the survey (24-hr clock).	HHMM
person1	Initials of first observer.	text
person2	Initials of second observer.	text
species_code	4-letter code for native fish species. First two letters represent first two letters of genus; second two letters are first two letters of species.	code
non_fish_count	Count of individuals on reef for any non-fish species (i.e. invertebrates).	integer
notes	Notes.	text
lenbin_min	Minimum of length bin range (centimeters).	cm
lenbin_max	Maximum of length bin range (centimeters).	cm
count	Abundance of that species on the reef that are within that length range.	integer

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Deployments

LSI_Reef_Surveys_09-12

Website	https://www.bco-dmo.org/deployment/59019
Platform	Tropical Marine Lab at Lee Stocking Island
Start Date	2009-05-30
End Date	2012-08-18
Description	Locations of coral reef survey dives and sightings, or collections of the invasive red lionfish, Pterois volitans, near Lee Stocking Island, Bahamas for the projects "Ecological Release and Resistance at Sea: Invasion of Atlantic Coral Reefs by Pacific Lionfish" and "Mechanisms and Consequences of Fish Biodiversity Loss on Atlantic Coral Reefs Caused by Invasive Pacific Lionfish" (NSF OCE-0851162 & OCE-1233027). All dives were made from various small vessels (17' to 24' l.o.a., 40 to 275 HP outboard motors, 1 to 7 GRT). Vessel names include, Sampson, Orca, Potcake, Lusca, Lucaya, Zardoz, Parker, and Nuwanda.

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-0851162

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