Results of field experiment testing for density dependence in lionfish growth, immigration, recruitement, and loss; conducted at Lee Stocking Island, Bahamas in 2011 (Lionfish Invasion project)

Website: https://www.bco-dmo.org/dataset/3970
Data Type: Other Field Results
Version: 1
Version Date: 2013-06-20

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
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Coverage

Spatial Extent: **Lat**:23.75047 **Lon**:-76.14035
Temporal Extent: 2011-06-25 - 2011-08-21

Dataset Description

A field experiment was conducted on artificial patch reefs to test for presence of density dependence in invasive red lionfish (*Pterois volitans*) recruitment, immigration, loss, and growth (in mass and length). **See also**: list of lionfish recruits and immigrants (PDF) that appeared on the study reefs during the experiment.

Related Publications:

Benkwitt, C.E. 2013. Density-dependent growth in invasive lionfish (*Pterois volitans*). Plos ONE 8(6): e66995. doi: 10.1371/journal.pone.0066995

Methods & Sampling

The experiment was conducted near Lee Stocking Island, Bahamas from June to August 2011. The experiment 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, 7, 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. Each week,

the number of lionfish on each reef was recorded, and new lionfish recruits and immigrants were removed. Every two weeks, lionfish growth in length was re-measured. At the end of the experiment (6 weeks), lionfish growth in mass was re-measured.

Data Processing Description

BCO-DMO Processing Notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Replaced blanks with 'nd' ('no data').
- Added lat and lon of the site from the metadata provided.
- 10-Jan-2018: removed embargo on dataset.

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Data Files

File
lionfish_density_dep.csv (Comma Separated Values (.csv), 22.35 KB) MD5:3fb72c67de0db3ba7fb1dbd3eae06094 Primary data file for dataset ID 3970

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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
lionfish_density	Density of lionfish on that reef (number of lionfish per meter squared).	number per m^2
location	Individual reef identification. All begin with "A" (for artificial reef) followed by a 2-digit number.	text
fish_id	Code unique to each individual lionfish. All begin with "L" and are followed by 4 digits.	code
tag	Unique elastomer tag given to each fish. R or L for right or left side of body. R = red; Y = yellow; B = blue; G = green; O = orange. UC = upper caudal; LC = lower caudal; UM = upper middle.	code
date	Date of measurement/information.	mm/dd/yyyy
present	Whether or not the fish was present on reef. Initial measure = first measure in lab; Present = present on reef; Absent = missing from reef.	text
len_tot	Total length of lionfish in centimeters.	cm
days_since_last_meas	Number of days since last measurement of lionfish.	integer
growth	Change in length between last measure and current measure.	cm
growth_rate	Growth rate (in length) in centimeters per day.	cm/day
mass	Mass of lionfish in grams.	g
change_in_mass	Change in mass between last measure and current measure. (Final mass - initial mass).	g

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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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