Effect of lionfish densities on native coral-reef fishes from Lee Stocking Island, Bahamas during 2009-2012 (Biodiversity Loss Effects Lionfish project)

Website: https://www.bco-dmo.org/dataset/655301
Data Type: experimental
Version: 1
Version Date: 2016-08-22

Project
» Mechanisms and Consequences of Fish Biodiversity Loss on Atlantic Coral Reefs Caused by Invasive Pacific Lionfish (BiodiversityLossEffects_lionfish)

Contributors	Affiliation	Role
Hixon, Mark	University of Hawai'i (UH)	Principal Investigator
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Abstract
Effect of lionfish densities on native coral-reef fishes from Lee Stocking Island, Bahamas during 2009-2012 (Biodiversity Loss Effects Lionfish project)

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Coverage

Temporal Extent: 2011-06-26 - 2011-08-21

Dataset Description

This was a field experiment conducted on artificial patch reefs to test for the effect of lionfish density on native fish abundance, diversity, and community structure. 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 (average = 1, 2, 4, 7, 10, or 12 lionfish). Complete censuses of the native fish population on each reef were conducted weekly for 6-weeks during the summer recruitment season.

Related datasets:

- Effect of lionfish in main seagrass habitats - DOI: 10.1575/1912/bco-dmo.655342.1
- Effect of lionfish in seagrass satellite coral head habitats - DOI: 10.1575/1912/bco-dmo.655380.1
- Effect of lionfish in seagrass open area habitats - DOI: 10.1575/1912/bco-dmo.655420.1
- Effect of lionfish in standardized habitat units in seagrass - DOI: 10.1575/1912/bco-dmo.655455.1

Species key for all individuals identified in this dataset - DOI: 10.1575/1912/bco-dmo.655195.2

Methods & Sampling

This was a field experiment conducted on artificial patch reefs to test for effects of invasive red lionfish density on native coral-reef fishes. Four reefs were used as 0-lionfish control reefs and there was one reef per remaining lionfish treatment (2, 4, 6, 8, 10, and 12 lionfish/m^2). Using SCUBA and handnets, we collected lionfish ranging in initial size from 40 to 71mm total length [TL] from nearby reefs. Each lionfish was given a unique elastomer tag (Northwest Marine Technology Inc., Shaw Island, WA, USA) to differentiate between lionfish at the start of the experiment and any new immigrants over the course of the study and to monitor demographic rates as part of another study (see related files and references). Treatments were started on all reefs within a 2-week period. To maintain treatments, we monitored lionfish density during weekly visits and removed any new lionfish recruits (total of 15 throughout experiment) and immigrants (total of 5 throughout experiment). In addition, we removed resident native piscivores and standardized the number of Nassau grouper (*Epinephelus striatus*) and territorial damselfishes (*Stegastes* spp.) weekly to mitigate any confounding effects of these strong interactors on fish recruitment. Of the lionfish initially placed on the reefs, only 6 out of 40 disappeared. To account for the small changes in lionfish density throughout the experiment, we averaged the weekly lionfish densities on each reef over the course of the experiment (1, 2, 4, 7, 10, and 12 lionfish/m^2).

Following the establishment of lionfish density treatments, a pair of divers using SCUBA censused the entire fish community on each reef weekly for 7 weeks, recording the species, abundance, and body size (TL estimated to the nearest centimeter) of all fish present both on the reefs and within a 1-m radius around the reefs. Divers slowly approached the reefs and first counted all planktivorous and active species hovering above the reefs from a distance of approximately 3 m. From a distance of 1 m, the divers slowly circled the reefs and counted all other species, using dive lights to count cryptic species in holes.

Data Processing Description

All data were entered by one person, and then subsequently checked by another person to ensure accuracy.

DMO Notes:

-reformatted column names to comply with BCO-DMO standards
-replaced all spaces with "_"
-replaced all blank cells with "nd"

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Data Files

File	
nativeFishes_reefCensus.csv	(Comma Separated Values (.csv), 157.58 KB) MD5:c898905132971296586bf80faeb18be6
Primary data file for dataset ID 655301	

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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
General

Benkwitt, C. E. (2014). Non-linear effects of invasive lionfish density on native coral-reef fish communities. Biological Invasions, 17(5), 1383–1395. doi:10.1007/s10530-014-0801-3
General

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Parameters

Parameter	Description	Units
year	Year of survey; YYYY	unitless
month	Month of survey; mm	unitless
day	Day of survey; dd	unitless
time_start	Time that census began; HH:MM	unitless
time_end	Time that census ended; HH:MM	unitless
visit_number	Visit number; typically one visit per reef per week	unitless
lionfish_density_initial	Initial number of lionfish that were transplanted to each reef; each reef measured 1 square meters so lionfish density = number of lionfish on the reef	count per meter squared
lionfish_density_mean	Average lionfish density (rounded to the nearest fish) on each reef throughout the experiment	count per meter squared
reef_type	ART = Artificial; all observations conducted on an artificial reef	unitless
reef_number	Reef id number	unitless
species	First 2 letters of genus and first 2 letters of species; see species key dataset for full species names.	unitless
length_max_1	Number of individuals that were between 0-1 cm total length	count
length_max_2	Number of individuals that were between 1.1-2 cm total length	count
length_max_3	Number of individuals that were between 2.1-3 cm total length	count
length_max_4	Number of individuals that were between 3.1-4 cm total length	count
length_max_5	Number of individuals that were between 4.1-5 cm total length	count
length_max_10	Number of individuals that were between 5.1-10 cm total length	count

length_max_15	Number of individuals that were between 10.1-15 cm total length	count
length_max_20	Number of individuals that were between 15.1-20 cm total length	count
length_max_25	Number of individuals that were between 20.1-25 cm total length	count
length_max_30	Number of individuals that were between 25.1-30 cm total length	count
length_max_35	Number of individuals that were between 30.1-35 cm total length	count
length_max_40	Number of individuals that were between 35.1-40 cm total length	count
length_max_45	Number of individuals that were between 40.1-45 cm total length	count
length_max_50	Number of individuals that were between 45.1-50 cm total length	count
length_max_100	Number of individuals that were between 50.1-100 cm total length	count
length_max_150	Number of individuals that were between 100.1-150 cm total length	count
invert_count	Abundance of invertebrates surveyed; sizes were not estimated. See species key dataset for full species names.	count
notes	Notes on observations	unitless

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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

Mechanisms and Consequences of Fish Biodiversity Loss on Atlantic Coral Reefs Caused by Invasive Pacific Lionfish (BiodiversityLossEffects_lionfish)

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

Coverage: Three Bahamian sites: 24.8318, -076.3299; 23.8562, -076.2250; 23.7727, -076.1071; Caribbean Netherlands: 12.1599, -068.2820

The Pacific red lionfish (Pterois volitans), a popular aquarium fish, was introduced to the Atlantic Ocean in the vicinity of Florida in the late 20th century. Voraciously consuming small native coral-reef fishes, including the juveniles of fisheries and ecologically important species, the invader has undergone a population explosion that now ranges from the U.S. southeastern seaboard to the Gulf of Mexico and across the greater Caribbean region. The PI's past research determined that invasive lionfish (1) have escaped their natural enemies in the Pacific (lionfish are much less abundant in their native range); (2) are not yet controlled by Atlantic predators, competitors, or parasites; (3) have strong negative effects on populations of native Atlantic fishes; and (4) locally reduce the diversity (number of species) of native fishes. The lionfish invasion has been recognized as one of the major conservation threats worldwide.

The Bahamas support the highest abundances of invasive lionfish globally. This system thus provides an unprecedented opportunity to understand the direct and indirect effects of a major invader on a diverse community, as well as the underlying causative mechanisms. The PI will focus on five related questions: (1) How does long-term predation by lionfish alter the structure of native reef-fish communities? (2) How does lionfish predation destabilize native prey population dynamics, possibly causing local extinctions? (3) Is there a lionfish-herbivore-seaweed trophic cascade on invaded reefs? (4) How do lionfish modify cleaning mutualisms on invaded reefs? (5) Are lionfish reaching densities where natural population limits are evident?

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233027

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