Results of experiment comparing herbivorous fish grazing at reefs with manipulated lionfish densities at Lee Stocking Island, Bahamas in 2011 (Lionfish Invasion project)

Website: https://www.bco-dmo.org/dataset/4014
Data Type: Other Field Results
Version: 1
Version Date: 2013-08-16

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 experiment comparing herbivorous fish grazing at reefs with manipulated lionfish densities at Lee Stocking Island, Bahamas in 2011.

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Coverage

Spatial Extent: **N**:23.8313 **E**:-76.02326 **S**:23.6725 **W**:-76.25342
Temporal Extent: 2011-07-22 - 2011-07-31

Dataset Description

A field experiment was conducted at Lee Stocking Islands, Bahamas from 07/22/2011 to 07/31/2011 to study the grazing activity of herbivorous fishes at reefs with manipulated lionfish (*Pterois volitans*) densities (low and high).

Methods & Sampling

The grazing rates of herbivorous fishes (bites/time) and the resulting algal loss rates (change in percent cover/time) were measured on paired-by-treatment, algal-covered substrata. At reefs with high lionfish densities, treatments consisted of the presence vs. absence of lionfish in local habitats where algal-covered substrata were distributed. Reefs with low lionfish densities included only the lionfish-absent treatment. Divers counted the number of bites on each replicate sample of algal-covered substratum for each herbivore observed during each of 16 replicate 20-min observation periods per reef. Herbivore behavior was sampled by 4 replicate 60-min automated video observations per reef. Each grazing herbivore was identified to the

species-level and its total body length was estimated visually. Changes in percent algal cover were measured from before-after photographs of each replicate substratum using ImageJ.

Data Processing Description

BCO-DMO Processing Notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Added lat and lon values, and other descriptive information, for each site from the metadata.
- Replaced abbreivated reef name with full reef name from metadata.
- Transposed/re-arranged family names into a column (rather than separate columns).
- 09-Jan-2018: removed embargo on dataset.

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Data Files

File
lionfish_effects_on_grazing.csv (Comma Separated Values (.csv), 161.12 KB) MD5:516a816aff0fe70359f0e0d09b94e1f5 Primary data file for dataset ID 4014

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Parameters

Parameter	Description	Units
date	Date when data were collected.	mm/dd/YYYY
site	Name of experimental reef site.	text
lat	Latitude of experimental reef site.	decimal degrees
lon	Longitude of experimental reef site.	decimal degrees
area	Approximate area of hard substrate at each reef location.	square meters
depth_min	Approximate minimum depth at reef location.	meters
depth_max	Approximate maximum depth at reef location.	meters
reef_pair_code	Reef pair code. Reefs with same code were paired based on similarities in reef area; type; depth and location. One reef in each pair was assigned to one of the two lionfish treatments.	code
nearest	Approximate distance to nearest natural reef.	meters
tidal_chan	Approximate distance to nearest tidal channel.	meters
ex_sound	Approximate distance to nearest edge of Exuma Sound.	meters
substrate_type	Short description of predominant substrate type.	text
site_treatment	Experimental treatment type. LOW = low lionfish density; HIGH = high lionfish density.	text
replicate	Replicate number of algal-covered substrate observed.	integer

treatment	Relative lionfish presence treatment (where grazing on replicate substrata were observed): CTRL = within low-lionfish density reef where lionfish are absent;LABS = within high-lionfish density reef where lionfish are absent;LPRS = within high-lionfish density reef where lionfish are present	text
ledge_pair	Ledges where replicate substrata were placed in order to observe grazing were paired by similar microhabitat within reefs (10 pairs per reef).	code
ledge_treatment	Lionfish presence-absence at time of observation.	text
filmed	Whether replicate was filmed with an underwater camera or observed by a SCUBA diver. Y = yes; N = no.	Y or N
obs_time	Amount of time replicate was observed.	minutes
algal_pcnt_init	Initial algal percent cover of each replicate substrate prior to observation.	percentage
algal_pcnt_final	Final algal percent cover of each replicate substrate following observation.	percentage
algal_loss	Total loss in algal percent cover of each replicate substrate (difference between initial and final percent cover).	percentage
fish_count_tot	Total number of fish (of all families) observed grazing on introduced substrate per replicate.	integer
bites_tot	Total number of bites (from all families) observed on introduced substrate.	integer
prey_tot	Total number of fish (from all families)	integer
prey_bites_tot	Total number of bites from fish (from all families)	integer
adult_tot	Total number of fish (from all families) >10 cm TL observed grazing on introduced substrate per replicate.	integer
adult_bites_tot	Total number of bites from fish (from all families) >10 cm TL observed on introduced substrate.	integer
graze_rate	Total number of bites per observation time.	integer
family	Family name.	text
family_common	Common name of family.	text
count	Total number of fish of the family observed on introduced substrate. (Equal to prey_num + adult_num)	integer
number_of_bites	Total number of bites observed on introduced substrate per family of fishes. (Equal to prey_bites + adult_bites)	integer
prey_num	Number of prey fish (	integer
prey_bites	Number of bites observed by prey fish (	integer
adult_num	Number of adult fish (>10 cm TL) of the family observed on introduced substrate.	integer
adult_bites	Number of bites observed by adult fish (>10 cm TL) of the family on introduced substrate.	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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