Results of fish surveys on experimental reefs at Lee Stocking Island, Bahamas from 2009-2012 (Lionfish Invasion project)

Website: https://www.bco-dmo.org/dataset/3898
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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
Albins, Mark A.	Oregon State University (OSU)	Scientist
Ingeman, Kurt	Oregon State University (OSU)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Results of fish surveys on reefs in the vicintiy of Lee Stocking Island, Bahamas conducted from 2009 to 2012.

Part of sub-project titled "Large-scale, Long-term, Lionfish Experiment (LLLE)".

Note: **Data are embargoed** until 2017, per request of the lead PI. Contact PI for more information.

Methods & Sampling

This long-term, large-scale field experiment was designed to document the community-wide effects of invasive lionfish in the vicinity of Lee Stocking Island, Bahamas. Baseline surveys of the fish community were conducted at each of ten large (1400 to 4000 m2) reefs by counting and sizing all fishes within two permanent square plots (100 m2) and four permanent strip plots (50 m2) at each reef. Square plots were centered on the area of each reef with the greatest three-dimensional structure, whereas strip transects were placed to provide a representative sample of the entire reef (biased towards hard substrate). The reefs were paired based on habitat characteristics (depth, current, predominant substrate type, etc.), and one reef in each pair was designated as either low-lionfish-density (LLD) or high-lionfish-density (HLD). Lionfish were then removed from LLD reefs and added to HLD reefs. We attempted to remove all lionfish from LLD reefs, and to augment the density of lionfish on HLD reefs to the level observed on the highest-density reefs before the experiment. Surveys of each fish community were then repeated approximately quarterly. During each survey, any new lionfish appearing on LLD reefs were removed and distributed evenly across the HLD reefs (again, ensuring that densities at HLD reefs did not exceed natural invasive densities prior to the experiment). See details in the following related publications.

Related Publications:

Albins, M.A. (2012) Effects of the Invasive Pacific Red Lionfish Pterois volitans on Native Atlantic Coral-reef Fish Communities (Chapter 6). PhD Dissertation. Oregon State University, Corvallis, Oregon.

Albins, M.A. (in preparation) Invasive Pacific lionfish Pterois volitans reduce abundance and species richness of native Bahamian coral-reef fishes: results from a large-scale, long-term experiment. Intended for Ecological Applications.

Data Processing Description

BCO-DMO Processing Notes:
-Modified original parameter names to conform with BCO-DMO naming conventions.
-Added species names from the master species list (named 'NSF-OCE-0851162-Hixon-Albins_LLLE_SpeciesList_master.csv').
-Added all columns from the reef characteristics file (named 'NSF-OCE-0851162-Hixon-Albins_LLLE_ReefChar.csv).
-Time values of '9000' changed to '0900' (assumed to be typo).
-Added ISO_DateTime_start and ISO_DateTime_end (UTC) based on original date, time_start_local, time_end_local, and timezone of UTC-5.
-Added lenbin_min and lenbin_max to explicitly state the bin ranges.

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Parameters

Parameter	Description	Units
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.	dimensionless
reef_id	Reef Identification code.	dimensionless
site	Full name of experimental reefs. Column originally named 'ReefName'.	text
treatment	Experimental Treatment. LOW = low lionfish density; HIGH = high lionfish density.	dimensionless
treatment_code	Alternate code defining reef treatment. LLD = low lionfish density; HLD = high lionfish density. Numbers used to match up paired reefs.	dimensionless
lat	Latitude of experimental reefs.	decimal degrees
lon	Longitude of experimental reefs.	decimal degrees
area_substrate	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
nearest_reef	Approximate distance to nearest natural reef. Column originally named 'Nearest'.	meters
nearest_channel	Approximate distance to nearest tidal channel. Column originally named 'TidalChan'.	meters
nearest_edge_of_sound	Approximate distance to nearest edge of Exuma Sound. Column originally named 'ExSound'.	meters
substrate_type	Short description of predominant substrate type.	text
full_census	Were fish of all sizes enumerated during the survey? Y = yes; N = no; note: this value is Y for all rows.	Y or N

survey	Column originally named 'TimeStep'.BL = first round of pre-treatment surveys (Spring 2009).1 = first round of post-treatment surveys (Summer 2009).2 = second round (Fall 2009).3 = third round (Winter 2010) note: no surveys carried out on plot 1 or strips C or D at CNY; or at plot 2 strip c or D at TRT due to poor weather and visibility conditions.4 = fourth round (Spring 2010).5 = fifth round (Summer 2010).6 = sixth round (Fall 2011).7 = seventh round (Spring 2011).8 = no eighth round of surveys conducted due to Hurricane Irene.9 = ninth round (Fall 2011) note: no surveys carried out on plot 2 strips A, C, or D at NWC; or at plot 1 or 2 strips A, B, C, or D at SEC due to poor weather and visibility conditions.10 = tenth round (Spring 2012).11 = eleventh round (Summer 2012).	dimensionless
year	4-digit year of survey. Local time for the Bahamas (UTC-5).	year
month	2-digit month of survey. Local time for the Bahamas (UTC-5).	month
day	2-digit day-of-month of survey. Local time for the Bahamas (UTC-5).	day-of-month
sample_type	PLOT = 10m x 10m (100m^2) plot; STRIP = 2m x 25m (50m^2) strip transect.	text
subsample	Identifies the individual subsample (can take values of 1 or 2 for plots and values of A, B, C, or D for strip transects).	dimensionless
time_start_local	Time of day of the start of the survey (24-hr clock). Local time for the Bahamas (UTC-5).	HHMM
time_end_local	Time of day at the end of the survey (24-hr clock). Local time for the Bahamas (UTC-5).	HHMM
ISO_DateTime_start	Date/time (UTC) at start of survey formatted to ISO8601 standard. Converted from original date, time, and time zone.	YYYY-mm-ddTHH:MM:SS.ss
ISO_DateTime_end	Date/time (UTC) at end of survey formatted to ISO8601 standard. Converted from original date, time, and time zone.	YYYY-mm-ddTHH:MM:SS.ss
species_code	4-letter genus species code (typically first two letters are the first two of the genus and last two letters are the first two of the species).	dimensionless
species	Scientific name of species (Genus species).	text
stage	Originally named 'Phase'. N = juvenile or intermediate or fish without distinct post-settlement life stages; T = terminal phase.	dimensionless
count_non_fish	0 if species is a fish; otherwise count of specific invertebrate on particular subsample.	integer
notes	NONE if no notes associated with observation; otherwise may refer to data entry related or QA/QC related notes or notes about the particular observation (including poor visibility during survey or status of lionfish on LOW treatment reef etc.)	text
bin	Original name of length bin.	dimensionless
lenbin_min	Minimum of length bin range.	centimeters
lenbin_mx	Maximum of length bin range.	centimeters
count	The integer represents the count of a particular species on a particular subsample falling into the size bin.	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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