Fish species survey from the Bahamas from 2009-2012.

Website: https://www.bco-dmo.org/dataset/700226

Data Type: Other Field Results

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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 Hawaii	Principal Investigator
Albins, Mark A	Auburn University	Scientist
Kindinger, Tye L	Oregon State University (OSU)	Contact
Ake, Hannah	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Fish species survey from the Bahamas from 2009-2012.

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Dataset Description

Abundance through time on reefs during surveys of native herbivorous fishes in response to the presence of invasive lionfish.

For related datasets, please visit the project link listed at the top of the page.

Acquisition Description

Methods from Kindinger and Albins (2016) "Consumptive and non-consumptive effects of an invasive marine predator on native coral-reef herbivores" doi: [10.1007/s10530-016-1268-1](10.1007/s10530-016-1268-1)

Visual surveys of reef fishes were conducted by a pair of SCUBA divers throughout (seafloor to surface) two permanent square plots (10 9 10 m) and four permanent strip transects (2 9 25 m), for a total area of 400 m2 per reef (see Albins 2015 for detailed description). We positioned square plots to include areas of the reef with the highest apparent relief, and strip transects were placed randomly across the remaining hard substrate, with the intent of including all important high-relief habitat features. Divers conducted censuses of each sampling unit whereby each fish was identified to the species-level and total length (TL) was visually estimated to the nearest cm. Paired reefs (low- and high-lionfish-densities) were surveyed within 24 h by the same set of observers, and all reefs were surveyed by the author (M. Albins). Every 3–5 months thereafter, we resurveyed the fish community at all experimental reefs.

We quantified CEs of invasive lionfish on native herbivorous fish populations throughout the 2-year experiment by comparing the change in density and biomass of small and large herbivorous fishes between lionfish-density treatments. Small fish were B 10 cm TL, which encompasses the majority of prey fish sizes reported in invasive lionfish gut-content studies for the size range of lionfish (2–35 cm TL) observed on our experimental reefs (Morris and Akins 2009 ; Mun˜oz et al. 2011). Responses of fish [10 cm TL were consistent, regardless of whether individuals were binned into medium (11–20 cm TL) and large ([20 cm TL) size classes, so hereafter we refer to all fish[10 cm TL as large . To determine the relative response of different sub guilds of herbivorous fishes, we also calculated the change in small and large fish density and biomass by fish family: (1) parrotfishes (Labridae); (2) surgeonfishes (Acanthuridae); (3) angelfishes (Pomacanthidae); and (4) damselfishes

(Pomacentridae). We used published length-weight conversions to calculate fish biomass; parameters of closely related species were used when conversions were not available (Online Resource 1). We calculated changes in fish density and biomass at every survey interval by subtracting the baseline value (prior to initial lionfish manipulation) for each sub-sample (plots and transects) from the corresponding value of each subsequent survey.

To test for an effect of invasive lionfish through time on changes in density and/or biomass of each group of native fishes (described above), we fitted linear mixed effects models (LMMs) with lionfish density treatment and time as categorical fixed effects, and sub -sample nested within reef as random effects (Pinheiro and Bates 2000 ; Bolker et al. 2009 ; Zuur et al. 2009). Time was a categorical variable because we had no a priori reason to assume any linear relationships with response variables. Full models included weighted terms allowing variances to differ among reefs and AR1 covariance structures to account for temporal autocorrelation (Zuur et al. 2009). We fitted full and reduced models (with vs. without weighted terms and/or AR1 structures) using restricted maximum likelihood (REML) and compared full and reduced models using Akaike's Information Criterion (AIC) and likelihood ratio tests (LRTs, Online Resource 2). Visual examination of residuals of the best-fit models indicated that the assumptions of normality, homogeneity, and independence were all met.

To assess the significance of fixed effects, we refit each model using maximum likelihood estimation (ML) and applied LRTs (Zuur et al. 2009). Fixed effects that were not significant were sequentially dropped from models. The resulting best-fit models in terms of variance structure, temporal correlation, and fixed effects were refit using REML in order to estimate the fixed-effects parameters and associated effect sizes. If LRTs indicated the lionfish 9 time interaction was significant, we made simultaneous inferences about the marginal effects of the lionfish treatment at each survey period, and adjusted the associated p values to maintain an approximately 5 % family-wise error rate (Hothorn et al. 2008). Regardless of whether the lionfish 9 time interaction was significant, we estimated expected values and standard error of the means (SEMs) for all response variables from low- and high-lionfish-density treatments during each survey period. We also fit LMMs to compare the baseline levels of each response variable between lionfish-density treatments using a similar procedure to the one outlined above, but with density and biomass of each group of small and large fishes (described above) as the response (rather than the change in these variables). Additionally, we fit LMMs to assess whether small (B 10 cm) and large ([10 cm) native mesopredators (Online Resource 1) that are potentially ecologically-similar to invasive lionfish differed between the reefs assigned to each lionfish density treatment at the baseline survey (mesopredator density and biomass) and at each subsequent survey period (change in mesopredator density and biomass).

Processing Description

BCO-DMO Processing Notes:

- reformatted column names to comply with BCO-DMO standards
- reformatted dates
- nd used to fill blank cells

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Related Publications

Kindinger, T. L., & Albins, M. A. (2016). Consumptive and non-consumptive effects of an invasive marine predator on native coral-reef herbivores. Biological Invasions, 19(1), 131–146. doi:10.1007/s10530-016-1268-1

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Parameters

Parameter	Description	Units
year	Year of observation	unitless
time	Time step of observation (0 -7 where 0 = baseline)	unitless
site	Name of study site (reef)	unitless
site_treatment	Lionfish treatment of site (reef): Low-lionfish-density reef or High-lionfish-density reef	unitless
site_pair	Site pairs	unitless
sample_type	Sampling method used: PLOT = square 10 x 10 m plots; STRIP = 2 x 25 m line transects	unitless
subsample_ID	ID of sampling area per study site	unitless
family	Family of fish	unitless

species	Species of fish: species codes are first two letters of genus and species (see species key)	unitless
size_1	Number of individuals counted of each size (1 cm total body length)	count
size_2	Number of individuals counted of each size (2 cm total body length)	count
size_3	Number of individuals counted of each size (3 cm total body length)	count
size_4	Number of individuals counted of each size (4 cm total body length)	count
size_5	Number of individuals counted of each size (5 cm total body length)	count
size_6	Number of individuals counted of each size (6 cm total body length)	count
size_15	Number of individuals counted of each size (15 cm total body length)	count
size_20	Number of individuals counted of each size (20 cm total body length)	count
size_25	Number of individuals counted of each size (25 cm total body length)	count
size_30	Number of individuals counted of each size (30 cm total body length)	count
size_35	Number of individuals counted of each size (35 cm total body length)	count
size_40	Number of individuals counted of each size (40 cm total body length)	count
size_45	Number of individuals counted of each size (45 cm total body length)	count
size_50	Number of individuals counted of each size (50 cm total body length)	count
size_100	Number of individuals counted of each size (100 cm total body length)	count
size_150	Number of individuals counted of each size (150 cm total body length)	count
size_200	Number of individuals counted of each size (200 cm total body length)	count
size_250	Number of individuals counted of each size (250 cm total body length)	count

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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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