Damselfish energetics from multiple shallow reef sites in the Caribbean between June 2016-2019

Website: https://www.bco-dmo.org/dataset/887892
Data Type: Other Field Results
Version: 1
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Project
» Beyond Cleaning and Symbiosis: Ecology of 'Ticks of the Sea' on Coral Reefs (Gnathiid isopod ecology)

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Abstract
Food webs are a complex array of trophic interactions. With a heavy emphasis on "classic" predator-prey interactions, most studies of trophic dynamics completely omitted parasitic interactions. However, recent work has shown that parasites contribute significantly to many aspects of trophic structure. In the current study, I have estimated the biomass transfer by parasites and predators from members of the genus Stegastes from multiple sites in the Caribbean. These results show that most of the parasite-driven biomass transfer comes from ectoparasitic gnathiid isopods. Moreover, I have found that predation rates are high for juveniles and decrease as they become adults, while the opposite is true for parasitism. Despite this, more biomass is being transferred from adults than younger stages via both predation and parasitism. I also show that in coral reef ecosystems, parasitism can transfer more biomass than predation for adult Stegastes. These results highlight the contribution of parasites to energy flow in coral reef environments and suggest that they must be considered in future food web studies.

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Coverage

Location: Shallow Caribbean Reef habitats
Spatial Extent: **N**:18.4703942 **E**:-64.5725066 **S**:17.939 **W**:-67.0571313
Temporal Extent: 2016-06 - 2019-06

Methods & Sampling

This dataset represents Damselfish energetics from multiple shallow reef sites between June 2016-2019 from shallow Caribbean reef habitats. Regional location of the sampling sites: STJ = St. John, USVI, STT = St. Thomas, USVI, CUA = Culebra, PR, PRO = La Parguera, PR, GNA = Guana Island, BVI.

Damselfish (10-15 per set) were caught with a modified cast net, secured in individual mesh cages, and placed on the reef for ten 45-minute "sets" which were distributed over a 24-hour period. I chose 45 minutes because it was a sufficient length of time for gnathiids to locate and attach, while also being unlikely that any would complete feeding and drop off prior to retrieval. At each site, the most common species of Stegastes was selected for caged sets. The dusk and dawn time periods, which are known peak times for gnathiid activity, include two sets that have a small overlap in time to capture the full magnitude of the sharp peaks in activity. The entire ten-set distribution was completed at each of the five sites for adult damselfish.

To compare infestation among various post-settlement life-history stages I simultaneously set caged fish representing juvenile, intermediate, and adult stages during peak gnathiid activity times. Special care was taken to place individuals of each stage in locations where they could likely be found at that time. I also performed sets to compare gnathiid infestation among adults of different Stegastes species. As with the life history comparison sets, care was taken to place individuals of each species in the habitats with which they naturally associate. Life history and species comparison sets were completed for a subset of sampling sites.

Adult damselfish were caught and tagged near the surface with T-bar small anchor tags (Hühn et al., 2014). Tagged fish were placed back in their respective territory and after a period of 7 days were checked weekly. The 7-day lag time allowed for any deleterious effects of the tagging procedure to manifest themselves and be excluded from comparisons. Any fish missing from their territory or the surrounding area was assumed to have been consumed (Booth and Hixon, 1999; Carr et al., 2002). Additionally, juvenile Stegastes were caught and tagged with elastomer tags and monitored for a period of 14 days. The shorter time period used versus adult fish was based on the expectation of higher mortality of juvenile fish.

Site locations by Region:

St. Thomas

- Brewer's Bay: 18.3483789, -64.966713

St. John

- Lameshur Bay: 18.319258, -64.7189772
- Salt Pond: 18.3091129, -64.7160396

Guana Island

- White Bay: 18.4703942, -64.5725066

Culebra

- Tamarindo: 18.3154237, -65.3121248
- Punta Soldado: 18.281264, -65.2858685

La Parguera

- Cayo Enrique: 17.9623981, -67.0443352
- Medialuna: 17.939, -67.052
- El Mario: 17.9578661, -67.0571313

Data Processing Description

Length-weight estimates were generated from bayesian estimates (retrieved from Fishbase.se)

BCO-DMO Curation Notes

- Imported "DamselEnergetics.csv" into the BCO-DMO system
- Added columns for "Latitude" and "Longitude" based on provided location data
- Rounded "Latitude" and "Longitude" to 3 decimal places (or to the thousandth place)
- Exported file as "887892_v1_damselfish_energetics"

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Data Files

File
887892_v1_damselfish_energetics.csv (Comma Separated Values (.csv), 108.08 KB) MD5:baec1e41b626776c17ba31ea074b57f3 Primary data file for dataset ID 887892, version 1

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Related Publications

Booth, D. J., & Hixon, M. A. (1999). Food ration and condition affect early survival of the coral reef damselfish, Stegastes partitus. Oecologia, 121(3), 364–368. https://doi.org/10.1007/s004420050940
Methods

Carr, M. H., Anderson, T. W., & Hixon, M. A. (2002). Biodiversity, population regulation, and the stability of coral-reef fish communities. Proceedings of the National Academy of Sciences, 99(17), 11241–11245. https://doi.org/10.1073/pnas.162653499
Methods

Hühn, D., Klefoth, T., Pagel, T., Zajicek, P., & Arlinghaus, R. (2014). Impacts of External and Surgery-Based Tagging Techniques on Small Northern Pike Under Field Conditions. North American Journal of Fisheries Management, 34(2), 322–334. https://doi.org/10.1080/02755947.2014.880762
Methods

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Parameters

Parameter	Description	Units
id	Numbered identifier for individuals in study	unitless
site	Sample site within islands	unitless
island	Name of island where sampling took place	unitless
latitude	Latitude of sampling site (North is Positive)	decimal degrees
longitude	Longitude of sampling site (West is negative)	decimal degrees
stage	Life history stage of fish in study (ad=adult, int=intermediate, juv=juvenile)	unitless
species	Fish species (sa=Stegastes adustus, sd=Stegeastes diencaeus, sl=Stegastes leucostictus, sp=Stegastes planifrons)	unitless

seg	Part of study the sample belongs to (lhc=life history comparison; parasites=24 hour parasite infestations; sc=species comparison; pred=fish predation)	unitless
block	Time block for 24 hour parasite infestation (block corresponds to the time they were set)	unitless
starttime	Time that fish cages were placed on the reef	unitless
endtime	Time that fish cages were retrieved from the reef	unitless
p1	Count of the first stage gnathiids	unitless
p2	Count of the second stage gnathiids	unitless
p3	Count of the third stage gnathiids	unitless
ptotal	Total count of gnathiids	unitless
length	Total length of gnathiids	centimeters (cm)
massgramsmeas	Mass of subset of individuals that were weighed	grams (g)
surv	Survival (for predation monitoring)	unitless
comments	Comments or notes on fish	unitless
biomasscalc	Calculated biomass from length:weight regression	grams (g)
p1bio	Biomass removed from first stage gnathiids	grams (g)
p2bio	Biomass removed from second stage gnathiids	grams (g)
p3bio	Biomass removed from third stage gnathiids	grams (g)
ptotbio	Total biomass removed from fish by gnathiids	grams (g)
propbio	Proportion of individual's biomass transferred	grams (g)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Fish Cage
Dataset-specific Description	Plastic hardware cloth and zip ties were used to make cages for fish sets.
Generic Instrument Description	Used to catch fish.

Dataset-specific Instrument Name	
Generic Instrument Name	Hand Net
Dataset-specific Description	Assorted nets were used to collect fish.
Generic Instrument Description	A hand net (also called a scoop net or dip net) is a net or mesh basket held open by a hoop. They are used for scooping fish near the surface of the water.

Dataset-specific Instrument Name	Subcutaneous elastomer tags
Generic Instrument Name	tracking tag
Dataset-specific Description	Subcutaneous elastomer tags were used to tag non-adult fish (https://www.nmt.us/visible-implant-elastomer/)
Generic Instrument Description	Devices attached to living organisms with the purpose of determining the location of those organisms as a function of time after tagging and release.

Dataset-specific Instrument Name	Floy T-bar anchor tags
Generic Instrument Name	tracking tag
Dataset-specific Description	Floy T-bar anchor tags were used for tagging fish (chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.floytag.com/uploads/floycatalog.pdf)
Generic Instrument Description	Devices attached to living organisms with the purpose of determining the location of those organisms as a function of time after tagging and release.

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Project Information

Beyond Cleaning and Symbiosis: Ecology of 'Ticks of the Sea' on Coral Reefs (Gnathiid isopod ecology)

Coverage: Eastern Caribbean, Philippines, Australia

NSF Award Abstract:
Most research on the complex biological interactions that inhabit coral reefs has focused on larger organisms that are easily observed by divers. However, marine scientists are increasingly aware of the importance of the tiny organisms that make up the "smaller majority." This includes parasites, organisms that feed on other organisms without killing them, which may make up as many as 80% of the species on coral reefs. Among the most important parasitic organisms on coral reefs are gnathiid isopods, so-called 'ticks of the sea', that share many similarities with blood-feeding ticks and other arthropods on land. Like ticks and mosquitoes, gnathiids transmit malaria-like blood parasites. In high numbers, they can remove enough blood to kill adult fish, but even a single gnathiid can kill a juvenile fish. Thus, gnathiids may have a significant effect on coral reef communities through their effects on coral reef fishes. This project will use an integrative interdisciplinary approach involving field and laboratory observations and experiments, and molecular tools. In addition to contributing to our understanding of life in our oceans, this research will provide continued support for U.S. Doctoral and Masters students and will create valuable research opportunities for undergraduates from multiple institutions. The project will further build on the investigators existing relationships with resource managers, local divers, fishers, and boat operators, as well as K-12 schools and environmental education programs, and will contribute to local economies. A major goal of our outreach efforts will include an exhibit featuring our research at Coral World Ocean Park on St. Thomas, participation in Virgin Islands radio programs, and hosting high school students from South Carolina Governor's School.

The overall goal this investigation is to understand the ecology of fish-parasite interactions on coral reef and associated ecosystems. This project focuses on fish-parasitic gnathiid isopods, the most common ectoparasites of coral reef fishes that are best known for their role in cleaning symbiosis, as the major food item of cleaner fishes. However, their abundance, host range, role as micropredator, disease vector, and potential prey item for other species, as well as their strong association with the benthos suggests the potential for much stronger community impacts. The goals for this project are to: 1) characterize the factors influencing local gnathiid isopod density by examining the role of fish-hosts, benthic cover, gnathiid predators including cleaners, and gnathiid conspecific attraction; 2) determine and quantify variation in host exploitation and the effects of gnathiid density on larval fish-host recruitment. To accomplish the first objective, the investigators will trap gnathiids from the substrate at sites in the Caribbean, Australia, and the Philippines. Variables associated with benthic habitat as well as local fish communities will be quantified and compared with local gnathiid abundance. Laboratory experiments will be conducted to determine the effects of different host species on gnathiid growth and reproduction and to determine the role of conspecific attraction in the formation of aggregations. Predators of gnathiids will be identified through examination of gut contents and through laboratory feeding studies. To accomplish the second objective, patterns of host-exploitation will be determined by DNA barcoding of blood meals from wild-caught gnathiids and results compared with the availability of different host species. To determine the effects of gnathiids on early life history stages of coral reef fishes, gnathiid abundance will be manipulated on small artificial patch reefs onto which newly-settled reef fishes will be transplanted.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536794

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