[DRAFT] The biomass of turf samples in damselfish territory before and after treatment with fertilizer in Mo'orea, French Polynesia from June to July 2025

Website: https://www.bco-dmo.org/dataset/950508
Version: 1
Version Date: 2025-02-04

Project
» Positive Effects of Coral Biodiversity on Coral Performance: Patterns, Processes, and Dynamics (Coral Biodiversity)

Contributors	Affiliation	Role
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Abstract
[drafted by Dana] A study to examine the effects of fertilizer addition on damselfish behavior was conducted in June and July 2025 in Mo'orea, French Polynesia. As part of a before-after control impact (BACI) experiment, algal turf samples from damselfish territories were sampled both before and after the experiment and analyzed for biomass and elemental composition.

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Coverage

Location: Moorea, French Polynesia (17°28'41.9"S 149°50'21.3"W), depth < 3m
Spatial Extent: **Lat**:-17.478306 **Lon**:-149.83925
Temporal Extent: 2025-06-13 - 2025-07-14

Dataset Description

This dataset is part of a larger study of the coral reef ecosystem in Mo'orea, French Polynesia that examines mechanisms governing interactions between damselfish, corals, and turf algae. The different analyses from the broader study are listed here, with links to these associated data in the 'Related Datasets' section below.

Analyses undertaken include:

- Fertilizer impacts on damselfish behavior (*Damselfish behavior video dataset 949539)*
- Fertilizer impacts on biomass plus isotopic composition of algal turfs ***(this dataset of damselfish turf biomass)***
- Fertilizer impacts on coral predation and herbivory (*Corallivory dataset 9xxxxxx, Herbivory dataset 9xxxxx)*
- Impacts of fertilizer and caging on coral and algal growth (*Coral growth dataset 9xxxxx, Algal overgrowth dataset 9xxxxxx)*

- Coral-turf allelopathy (*Turf extracts PAM dataset 949219, Coral-algal contact dataset 9xxxxxx)*
- Species composition of turf gardens (*Turf cover composition dataset + supplemental for Coral Reefs paper)*

Methods & Sampling

More needed here?

Changes in traits of damselfish turfs were assessed by collecting six samples of turf that were about two centimeters square (~2 cm2) using a hammer and chisel from each damselfish territory both pre- and 14 days post-treatment. During each collection, three samples from each territory were used to assess biomass, and three were used to assess carbon to nitrogen ratio (C:N) of the turfs within each territory, resulting in 180 turf samples for each assessment of each treatment and timepoint. Exact dimensions of each turf sample were measured to the nearest millimeter. Turf filaments were removed from each sample via forceps in the lab and dried at 60°C until they reached a constant dry weight. Samples for biomass analysis were then ashed at 450°C in a muffle furnace until they reached a constant weight. Ash-free-dry mass was used to assess algal mass to avoid counting small bits of carbonate that were difficult to remove from all filaments. This was calculated as the difference between the mass of the sample before and after ashing and then standardized per unit area sampled (grams per square centimeter; g cm-2). Treatment effects on biomass were then assessed using gamma regression with a log link, with BACI fixed effects and random effects ***specified as above. ???*** Model assumptions were again assessed using the Dharma package (Hartig 2022).

To minimize cost associated with analyzing turf elemental composition, we combined triplicates from each territory by subsampling 1 mg of dried turf from each of the “Day 14” samples, reducing the number of samples to 30 (n=15 per treatment). These samples were acid fumed to remove carbonate and analyzed with a continuous-flow isotope-ratio mass spectrometry (CF-IRMS) using a Micromass Optima interfaced to a CE Elantech NA2500 elemental analyzer. Algal tissue Carbon:Nitrogen (C:N) ratios were then compared between treatments using a linear mixed effects model with a random effect to account for spatial blocking. Model assumptions were assessed using the DHARMa package (Hartig 2022).

Data Processing Description

Treatment effects on biomass were then assessed using gamma regression with a log link, with BACI fixed effects and random effects ***specified as above. ???*** Model assumptions were again assessed using the DHARMa package (Hartig, 2022).

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Related Publications

Hartig, F. (2016). DHARMa: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models [Dataset]. In CRAN: Contributed Packages. The R Foundation. https://doi.org/10.32614/cran.package.dharma *Software*

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Related Datasets

IsSupplementTo

Altman-Kurosaki, N. T., Hay, M. E. (2025) **DRAFT Fertilizer impacts on damselfish behavior in Mo'orea.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-23 http://lod.bco-dmo.org/id/dataset/949539 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Date	Date of sample collection	unitless
Sample_num	Sample number of the turf sample	unitless
Territory	Territory number	unitless
Pair	Spatial pair for a given set of damselfish territories (A through O); used for spatial blocking	unitless
Pre_post_trt	Indicates whether biomass sample was collected before (pre-) or after (post-) treatment with fertilizer	unitless
Fertilized	Indicates if territory had fertilizer applied to it (Y) or was a control (N)	unitless
Replicate	Indicates measurements for a given turf triplicate used in biomass measurements	unitless
Length	Length of turf sample	centimeters (cm)
Width	Width of turf sample	centimeters (cm)
Area	Calculated area of turf sample (from length x width)	square centimeters (cm^2)
Dry_weight_lab	Dry weight of turf sample measured in the lab in Atlanta	grams (g)
AFDW	Ash free dry weight; the weight of the sample after being ashed in the muffle furnace	grams (g)
Biomass	Dry weight minus ash free dry weight	grams (g)

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Instruments

Dataset-specific Instrument Name	CF-IRMS interface
Generic Instrument Name	Continuous Flow Interface for Mass Spectrometers
Dataset-specific Description	Algal turf samples were analyzed with a continuous-flow isotope-ratio mass spectrometry interfaced to an elemental analyzer.
Generic Instrument Description	A Continuous Flow Interface connects solid and liquid sample preparation devices to instruments that measure isotopic composition. It allows the introduction of the sample and also reference and carrier gases. Examples: Finnigan MATConFlo II, ThermoScientific ConFlo IV, and Picarro Caddy. Note: This is NOT an analyzer

Dataset-specific Instrument Name	CE Elantech NA2500 elemental analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Algal turf samples were analyzed with a continuous-flow isotope-ratio mass spectrometry interfaced to a CE Elantech NA2500 elemental analyzer.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Micromass Optima interfaced to an elemental analyzer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Algal turf samples were analyzed with a continuous-flow isotope-ratio mass spectrometry (CF-IRMS) using a Micromass Optima interfaced to an elemental analyzer.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	hammer and chisel
Generic Instrument Name	Manual Biota Sampler
Dataset-specific Description	Algal turfs were collected using a hammer and chisel to obtain six samples that were two centimeters square.
Generic Instrument Description	"Manual Biota Sampler" indicates that a sample was collected in situ by a person, possibly using a hand-held collection device such as a jar, a net, or their hands. This term could also refer to a simple tool like a hammer, saw, or other hand-held tool.

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Project Information

Positive Effects of Coral Biodiversity on Coral Performance: Patterns, Processes, and Dynamics (Coral Biodiversity)

Coverage: Moorea, French Polynesia, South Pacific Ocean (17º32'S 149º50'W)

NSF Award Abstract:
Coral reefs are extremely diverse, supply critical ecosystem services, and are collapsing at an alarming rate, with 80% coral loss in the Caribbean and >50% in the Pacific in recent decades. Previous studies emphasized negative interactions (competition, predation) as structuring reef systems, but positive interactions in such species-rich systems could be of equal importance in maintaining ecosystem function. If foundation species like corals depend on positive interactions, then their fitness may decline with the loss of surrounding species, creating a biodiversity meltdown where loss of one coral causes losses of others. This project conducts manipulative field experiments to understand the role of coral biodiversity in facilitating coral growth, survival, resilience, and retention of these foundation species and the critical ecosystem services they provide in shallow tropical seas. This project is committed to: 1) Educating and exciting influential business and civic leaders about conservation and restoration of coastal marine systems before these systems lose ecological function and value. This will involve influential Rotary clubs within North Georgia/Atlanta (the major economic engine of the southeastern US) as an initial focus. 2) Using the Research News and Institute Communications Office at Georgia Tech and well-developed contacts with science writers to produce popular press pieces on important ocean ecology discoveries emerging from these studies. (3) Organizing a public workshop of internationally prominent scientists focused on Maintaining Marine Biodiversity as a Strategy to Sustain Ecosystem Services and Coastal Cultures and Economies. A previous effort like this, organized by the investigators, attracted about 200 attendees and was webcast to numerous high schools in Georgia and to foreign investigators in less developed countries that could not attend. Speakers also conducted in-person video interviews with local high school classes. Due to that success, this model will be repeated. 4) Working with an association of educators and cultural leaders in French Polynesia to produce electronic format presentations on our work and on reef conservation that are appropriate for use by both teachers and leaders within Polynesian culture.

Ecologists have excelled at demonstrating the importance of direct (often negative) interactions among species pairs. However, when these interactions occur in a complex context among thousands of other species in the field, the sum of the many, poorly-known, indirect interactions can counterbalance, or even reverse, the better-known direct interactions, generating diffuse mutualisms instead of agonistic outcomes. In a proof-of-concept initial experiment, coral growth and survivorship were greater in coral polycultures than monocultures, especially during early stages of community development. Processes generating this outcome are unclear but understanding these is of critical importance as diversity and function of reefs decline and as humans need to predict and adapt to changing environments. This interdisciplinary investigation merges expertise in experimental field ecology, chemical ecology, and the ecology of microbiomes to investigate the functional role of biodiversity in coral reef ecosystems. Experiments use a novel coral transplantation method and field manipulations to assess: 1) whether greater coral species diversity enhances coral community performance, as well as growth and survivorship of individual corals, 2) whether greater genotypic diversity enhances coral performance within a species, 3) whether greater diversity of seaweed competitors further suppresses corals and enhances seaweed performance, and 4) the processes driving the patterns documented above, including the roles of disease, intraspecific versus interspecific competition, predators, mutualists, and differential access to, or use of, resources. The research investigates the relationship between biodiversity and ecosystem function across dimensions of coral taxonomic diversity, from species to genotypes, and creates a series of experiments elucidating general principles underlying ecosystem dynamics. Filling these knowledge gaps advances our fundamental understanding of how biodiversity influences ecosystem function at multiple scales and provides insight into the processes promoting coral coexistence in these species-rich ecosystems. Findings will have practical implications for coral management and restoration and may improve predictions regarding coral reef resilience and recovery in the face of changing climate.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947522

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