Sponge abundance data from field surveys conducted in May 2023 and June 2024 in the Florida Keys, FL

Website: https://www.bco-dmo.org/dataset/969399
Data Type: Other Field Results
Version: 1
Version Date: 2025-07-21

Project
» RAPID: Consequences of Rapid Environmental Change on Pelagic-to-Benthic Coupling by Sponges on the Continental USAs only Barrier Reef Ecosystem (Temp & DO Effects on Sponges)

Contributors	Affiliation	Role
Butler, Mark	Florida International University (FIU)	Principal Investigator
Kerigan, John	Florida International University (FIU)	Student
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains sponge abundance data from field surveys conducted in May 2023 and June 2024 in the Florida Keys as described in the following study description. See the "Related Datasets" section for more datasets from this study. Study description: Climate change is quickly altering marine environments by increasing sea surface temperatures and decreasing dissolved oxygen (DO) levels. Although these effects have been well-studied on the declining corals, the impact of temperature and dissolved oxygen extremes on the functional roles of sponges remains primarily unexamined. This study, conducted in the Lower Florida Keys, FL (USA) had two objectives: (1) compare sponge abundance and size distributions on hardbottom before and after the summer 2023 heatwave, and (2) investigate the filtration capacity of eight common sponge species from the Florida Keys with different morphologies (tubular vs. spherical) and microbial associations (HMA vs LMA) in mesocosms that simulated elevated temperature and hypoxic conditions for ~45 minutes. Field surveys by divers at the same 24 sites in May 2023 and June 2024 revealed that the abundance and size of spheroid sponges (e.g., Speciospongia vesparium, Hippospongia lachne) declined after the heatwave, but no noticeable effects were detected among the other species surveyed. The mesocosm experiments revealed tubular and LMA sponges consistently exhibited higher filtration efficiency of high nucleic acid (HNA) bacteria than spherical and HMA sponges under most treatment conditions. Elevated temperatures (2.5 to 5°C above ambient) significantly reduced HNA bacteria filtration capacity in spherical and HMA sponges (-43.6% ± 5.1 to -21.5% ± 4.4), whereas LMA tubular sponges were unfazed (-52.3% ± 11.6% to -62.6% ± 8.8%). The findings imply that future reef communities may shift toward more sponge dominance, particularly by heat and hypoxia-resistant, fast-growing LMA species, potentially altering ecosystem functions like water quality regulation, nutrient cycling, and habitat structure.

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Coverage

Location: Florida Keys, Florida USA
Spatial Extent: **N**:24.74377 **E**:-81.25772 **S**:24.63917 **W**:-81.49574
Temporal Extent: 2023-06 - 2024-04

Dataset Description

See "Related Datasets" for other data from this study

Methods & Sampling

Study objectives:

Objective 1: Assess changes in sponge community structure resulting from the current heatwave across an inshore-to-offshore gradient and an Upper Keys-to-Lower Keys gradient for which we have pre-event data, and to do so in the context of GOLT predictions.

Field Sampling:
Divers revisited in June 2024 approximately 25 inshore sites in the Florida Keys first surveyed in May 2023 to estimate the size-specific abundance of sponges using the same, well-established survey methods as used previously. On each site, we combined belt transect sampling (n = four 2m x 25m belt transects) and quadrat sampling (n = ten 1m x 1m quadrats) to estimate the density and size structure of the 26 most common sponge species. Within each belt transect, divers identified, counted, and measured (diameter and height to estimate volume) all sponges >20 cm in diameter or height.

Objective 2: Test whether elevated seawater temperatures and low DO affect the filtering of microbes, consumption of DOM, or fixation of nitrogen by sponges that differ in phylogeny, morphology, microbiome, or habitat of origin.

Methods: We measured in experimental mesocosms changes in seawater concentrations of various planktonic components and water chemistry caused by sponge filtration under different temperature and DO regimes and among sponges representing different habitats, morphological types, and microbiomes. See "Related Datasets" for data from the mesocosm experiments.

BCO-DMO Processing Description

* Sheet 1 of submitted file "field survey sponge abundance data for archive.xlsx" was imported into the BCO-DMO data system for this dataset. Table will appear as Data File: 969399_v1_sponge-field-abundance.csv (along with other download format options).

* A second form of this data table (long format) was added as a supplemental file by unpivoting the abundance columns to transform the table from separate columns per species code (wide format) into a table columns "Species_Code" and "Abundance." See the Data Files section for more context from the file descriptions.

Missing Data Identifiers:
* In the BCO-DMO data system missing data identifiers are displayed according to the format of data you access. For example, in csv files it will be blank (null) values. In Matlab .mat files it will be NaN values. When viewing data online at BCO-DMO, the missing value will be shown as blank (null) values.

* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]

* Supplemental file species_list.csv formatted from an embedded table provided by data submitter in the "field survey metadata for archive.xlsx".

* Species names provided were matched to names at the World Register of Marine Species (WoRMS) by using the WoRMS taxa match tool used to find misspellings. (taxa match was run 2025-07-17). Taxon identifiers (AphiaID and LSID) added to supplemental file species_list.csv.

* Site list extracted and formatted from information provided within file "field survey metadata for archive.xlsx"

* Lat and Lon columns added to the sponge size table (joined in using the site name)

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Related Datasets

IsRelatedTo

Butler, M., Kerigan, J. (2025) **Sponge mesocosm data testing effects of temperature and dissolved oxygen on sponge filtration from experiments conducted in November of 2024 at Newfound Harbor Marine Institute, FL.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-07-17 http://lod.bco-dmo.org/id/dataset/969125 [view at BCO-DMO]
Relationship Description: Data collected as part of the same study.

Butler, M., Kerigan, J. (2025) **Sponge size data from field surveys conducted in May 2023 and June 2024 in the Florida Keys, FL.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-07-21 http://lod.bco-dmo.org/id/dataset/969406 [view at BCO-DMO]
Relationship Description: Data from the same field sponge field survey in May 2023 and June 2024 in the Florida Keys, FL

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Parameters

Parameter	Description	Units
Date	The date the data was collected	unitless
Site	Site name	unitless
Lat	Site latitude	decimal degrees
Lon	Site longitude	degrees decimal minutes
SPHVES	Abundance data for species code: SPHVES. See supplemental file 'species_list.csv' for more information about this category.	unitless
IRCCAM	Abundance data for species code: IRCCAM. See supplemental file 'species_list.csv' for more information about this category.	unitless
IRCSPE	Abundance data for species code: IRCSPE. See supplemental file 'species_list.csv' for more information about this category.	unitless
IRCSTR	Abundance data for species code: IRCSTR. See supplemental file 'species_list.csv' for more information about this category.	unitless
SPOCHE	Abundance data for species code: SPOCHE. See supplemental file 'species_list.csv' for more information about this category.	unitless
SPOBAR	Abundance data for species code: SPOBAR. See supplemental file 'species_list.csv' for more information about this category.	unitless

HIPLAC	Abundance data for species code: HIPLAC. See supplemental file 'species_list.csv' for more information about this category.	unitless
HALVIR	Abundance data for species code: HALVIR. See supplemental file 'species_list.csv' for more information about this category.	unitless
TEDIGN	Abundance data for species code: TEDIGN. See supplemental file 'species_list.csv' for more information about this category.	unitless
SPOGRA	Abundance data for species code: SPOGRA. See supplemental file 'species_list.csv' for more information about this category.	unitless
AAPSPE	Abundance data for species code: AAPSPE. See supplemental file 'species_list.csv' for more information about this category.	unitless
NIPERE	Abundance data for species code: NIPERE. See supplemental file 'species_list.csv' for more information about this category.	unitless
GEOGIB	Abundance data for species code: GEOGIB. See supplemental file 'species_list.csv' for more information about this category.	unitless
APLFUL	Abundance data for species code: APLFUL. See supplemental file 'species_list.csv' for more information about this category.	unitless
ANTVAR	Abundance data for species code: ANTVAR. See supplemental file 'species_list.csv' for more information about this category.	unitless
SPOCOM	Abundance data for species code: SPOCOM. See supplemental file 'species_list.csv' for more information about this category.	unitless
TETCRY	Abundance data for species code: TETCRY. See supplemental file 'species_list.csv' for more information about this category.	unitless
UNKSPO	Abundance data for species code: UNKSPO. See supplemental file 'species_list.csv' for more information about this category.	unitless
PTEANC	Abundance data for species code: PTEANC. See supplemental file 'species_list.csv' for more information about this category.	unitless
PSEAME	Abundance data for species code: PSEAME. See supplemental file 'species_list.csv' for more information about this category.	unitless
SOLBOU	Abundance data for species code: SOLBOU. See supplemental file 'species_list.csv' for more information about this category.	unitless

SOLHYA	Abundance data for species code: SOLHYA. See supplemental file 'species_list.csv' for more information about this category.	unitless
MILALC	Abundance data for species code: MILALC. See supplemental file 'species_list.csv' for more information about this category.	unitless

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Project Information

RAPID: Consequences of Rapid Environmental Change on Pelagic-to-Benthic Coupling by Sponges on the Continental USAs only Barrier Reef Ecosystem (Temp & DO Effects on Sponges)

Coverage: Florida Keys, Monroe County, Florida, USA

NSF Award Abstract:

It's been hot, record hot in the Western Atlantic. In the shallow seas surrounding the Florida Keys, a region that harbors the world’s third longest coral barrier reef and the only one in the continental USA, water temperatures peaked in late July 2023 at 101F. Even at 30ft deep on the coral reef temperatures reached an unprecedented 90F, unleashing a wave of fish kills, corals bleaching, and dying octocorals and sponges. Marine scientists are concerned about the effects of this unprecedented climatic event on coral reefs in the Caribbean and Florida, and there has been a flood of media press as well. Yet, the focus has been almost exclusively on corals. Although corals provide the structural foundation for coral reefs, the functioning of coral reef ecosystems also depends on the health of other reef organisms. Of particular importance are sponges, which are key to capturing and recycling nutrients and carbon from the surrounding seas – a process referred to as “pelagic-to-benthic coupling”. This project (a) assesses the damage of the summer 2023 heatwave on shallow water and reef dwelling sponges in the Florida Keys, (b) tests the effects of high seawater temperatures and associated low oxygen levels on sponges, and (c) using those data, develops a model to help predict the effect of future heatwaves on sponges and the ecological services they provide to the ecosystem. The project includes training for undergraduate and graduate students at a minority-serving institution and public outreach and engagement with K-12 students through a partner NGO. Project results inform resource managers with the Florida Keys National Marine Sanctuary.

Seawater temperatures in the Caribbean rapidly rose to unprecedented levels in summer 2023, unleashing a cascade of disturbance to coral reef ecosystems. The event galvanized scientists, resource managers, and the media into action but nearly all of that attention focused on corals. Corals provide the structural foundation for coral reefs, but the functioning of coral reef ecosystems as nutrient sinks and recyclers in otherwise oligotrophic seas is highly dependent on another taxon: sponges. Sponges are key to pelagic-to-benthic coupling and nutrient recycling on coral reefs and coastal backreef habitats, yet almost nothing is known of the effect of extreme environmental stress on sponge survival and function on coral reef ecosystems. The team is (a) using field surveys and leveraging pre-event baseline data to assess changes in sponge community structure across an inshore to offshore gradient in the Florida Keys; (b) using mesocosm experiments to examine the effects of elevated seawater temperatures and low dissolved oxygen on filtering of microbes, consumption of dissolved organic material, and fixation of nitrogen by sponges that differ in phylogeny, morphology, microbiome, or habitat; and (c) integrating these data to model projected changes in coastal and coral reef pelagic-to-benthic coupling. The results of this project advance understanding of the functional role of sponges in coral reef ecosystems in a changing climate.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2347307

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