

Carbon and nitrogen stable isotopes of marine inorganic and organic matter around O'ahu, Hawai'i, December 2017

Website: <https://www.bco-dmo.org/dataset/844810>

Data Type: Other Field Results

Version: 1

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Project

» [Phenotype and genotype of coral adaptation and acclimatization to global change](#) (Coral Adaptation)

Contributors	Affiliation	Role
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Abstract

A complete description of the collection and experimental methods is available in Price et al. (in review). In brief, sampling of inorganic and organic matter occurred between 6 and 16 December 2017 from six sites (Electric Beach, Hale'iwa, Hawai'i Institute of Marine Biology [HIMB], Magic Island, Sampan Channel, and Waimānalo) surrounding the island of O'ahu, Hawai'i, USA. Up to 8 L of seawater was collected in pre-acidified 2 L brown Nalgene bottles during the day (12:00 – 14:00) and night (18:00 – 20:00) and placed on ice in a cooler. Seawater samples were used to assess dissolved inorganic carbon, dissolved organic matter, and particulate organic matter and the specific methods used for each are described below. Zooplankton samples were also collected, but only during the nighttime sampling at four of the six sites (HIMB, Magic Island, Sampan, Waimānalo).

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Funding](#)

Coverage

Spatial Extent: N:21.5942 E:-157.683 S:21.2861 W:-158.132

Temporal Extent: 2017-12-06 - 2017-12-16

Methods & Sampling

Dissolved inorganic carbon (DIC) – 20 ml of seawater was filtered (0.45 µm pore size) and preserved in a glass crimp-top bottle with 200 µl of dried mercuric chloride for subsequent isotope analysis. The remaining seawater collected from each site was pre-filtered through 55 µm nylon mesh to remove large particulates and zooplankton. The $\delta^{13}\text{C}$ of DIC samples was analyzed at the Duke University Environmental Isotope Laboratory using a Thermo Finnigan Delta Plus XL continuous flow mass spectrometer via a ThermoFinnigan GasBench II and reported in permil relative to V-PDB. Repeated measurements of internal standards had a standard deviation of ± 0.2 per mil.

Dissolved organic carbon (DOC) – 40 ml of seawater was filtered through a quartz microfiber filter into a

polytetrafluoroethylene bottle and acidified using 10% HCl to reach a pH below 2 to preserve the sample. The d13C of DOC samples was analyzed using an OI Analytical 1030D Total Organic Carbon Analyzer in the Aquatic Biogeochemical Laboratory at North Carolina State University and reported in permil relative to V-PDB. Repeated measurements of external standards had a standard deviation of ± 0.4 per mil.

Particulate organic matter (POM) – Between 3 – 4 L of the seawater was filtered through a quartz microfiber filter until the filter became light brown in color and was immediately stored at -20 degrees C for subsequent isotopic analysis of particulate organic carbon (POC) and particulate organic nitrogen (PON). The POM filters were fumigated with 12 M hydrochloric acid to remove carbonates (Moyer et al. 2013). All samples were combusted using a PDZ Europa ANCA-GSL elemental analyzer interfaced to a PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK) at the University of California (UC) Davis Stable Isotope Facility. The d13C and d15N values are reported in permil relative to V-PDB and air, respectively. The standard deviation of replicate analyses for these POM samples was ± 0.31 per mil for d13C. The standard deviations of replicate analyses for d15N of POM was not able to be calculated due lack of additional sample material.

Zooplankton – Zooplankton were collected using a bucket with an illuminated dive torch affixed to the bottom, which was placed on the seafloor near the reef at 1 m depth for 5 min. The zooplankton were separated into 150 – 400 μm and 400 – 800 μm size fractions in the field, stored on ice, and then isolated onto a glass fiber filter and stored at -20 degrees C upon return to the lab the same day. The zooplankton samples were processed separately for d13C and d15N. For d13C, zooplankton samples were fumigated with 12 M hydrochloric acid to remove carbonates. The samples were processed for d15N without pretreatment to ensure that these isotope values were unaffected by acidification. All samples were combusted using a PDZ Europa ANCA-GSL elemental analyzer interfaced to a PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK) at the University of California (UC) Davis Stable Isotope Facility. The d13C and d15N values are reported in permil relative to V-PDB and air, respectively. The standard deviation of replicate analyses for these zooplankton samples was ± 0.55 per mil for d15N of zooplankton. The standard deviations of replicate analyses for d13C of zooplankton was not able to be calculated due lack of additional sample material.

Data Processing Description

BCO-DMO Processing Notes:

- data submitted in Excel file 'Source Isotope Data for BCO-DMO_Price et al.xlsx' sheet 'Data for BCO_DMO'
- added conventional header with dataset name, PI name, version, date
- renamed columns to conform with BCO-DMO naming conventions (removed units, spaces, special characters)
- re-formatted dates from d-Mon-yy to yyyy-mm-dd
- split Coordinates column into Lat and Lon
- changed special characters: ' to ' and ā to a, μ to u

[[table of contents](#) | [back to top](#)]

Data Files

File
cn_h2o_zoop.csv (Comma Separated Values (.csv), 7.36 KB) MD5:080534e47f108622fe0e9e74cabfb9a5
Primary data file for dataset ID 844810

[[table of contents](#) | [back to top](#)]

Related Publications

Moyer, R. P., Bauer, J. E., & Grottolli, A. G. (2012). Carbon isotope biogeochemistry of tropical small mountainous river, estuarine, and coastal systems of Puerto Rico. *Biogeochemistry*, 112(1-3), 589–612. doi:[10.1007/s10533-012-9751-y](https://doi.org/10.1007/s10533-012-9751-y)
Related Research

Price, J. T., McLachlan, R. H., Jury, C. P., Toonen, R. J., & Grotto, A. G. (2021). Isotopic approaches to estimating the contribution of heterotrophic sources to Hawaiian corals. *Limnology and Oceanography*, 66(6), 2393–2407. Portico. <https://doi.org/10.1002/lno.11760>
Results

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
Sample	sample identifier	unitless
Sample_Type	sample type: DIC; DOC; Zooplankton	unitless
Location	general location of sampling	unitless
Site	collection site	unitless
Lat	latitude; north is positive	decimal degrees
Lon	longitude; east is positive	decimal degrees
Collection_Date	collection date; local time	unitless
Analysis_Date	analysis date; local time	unitless
d13C	a measure of the ratio of stable isotopes of carbon 13C : 12C	per mil
Carbon	carbon concentration	micrograms/liter
d15N	a measure of the ratio of the stable isotopes of nitrogen 15N:14N	per mil
Nitrogen	nitrogen concentration	micrograms/liter

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	PDZ Europa ANCA-GSL elemental analyzer (Sercon Ltd., Cheshire, UK)
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	Used for Particulate Organic Matter (POM) analysis in zooplankton samples.
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

Dataset-specific Instrument Name	Thermo Finnigan Delta Plus XL continuous flow mass spectrometer and ThermoFinnigan GasBench II
Generic Instrument Name	Continuous Flow Interface for Mass Spectrometers
Dataset-specific Description	Used for Dissolved Inorganic Carbon (DIC) analysis.
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	PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used for Particulate Organic Matter (POM) analysis in zooplankton samples.
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	OI Analytical 1030D Total Organic Carbon Analyzer
Generic Instrument Name	Total Organic Carbon Analyzer
Dataset-specific Description	Used for Dissolved Organic Carbon (DOC) analysis.
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO ₂). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

[[table of contents](#) | [back to top](#)]

Project Information

Phenotype and genotype of coral adaptation and acclimatization to global change (Coral Adaptation)

Coverage: Oahu, HI and Hawaii Institute of Marine Biology

Project Summary:

Overview: This study proposes to evaluate the adaptation and acclimatization capacity of eight species of

Hawaiian corals to long-term exposure of elevated temperature and ocean acidification (OA) conditions using a two-part approach: 1) a survey of natural corals found across natural temperature and pCO₂ gradients and 2) a two-year long mesocosm study which will expose corals collected in part 1 to a range of temperature and pCO₂ conditions expected this century. In both approaches, the phenotypic (i.e., physiological and biogeochemical) responses of corals to future climate change will be measured in conjunction with the already funded genotypic (i.e., genomic and transcriptomic) responses of the same corals by Dr. Rob Toonen. This study will address variation at both the population and species level. It will also be the first study to examine the effects of elevated temperature and pCO₂ on corals in replicated mesocosms over a multiannual timeframe with a comprehensive suite of physiological, biogeochemical, and genomic tools.

Intellectual Merit: Coral reefs are among the most diverse ecosystems on the planet, housing an estimated 25% of marine species. Yet, they appear to be especially susceptible to the effects of climate change and ocean acidification. To date, the assumption has been that corals will not be able to adapt because the rates of anthropogenically driven ocean acidification and climate change are too high. But there is little experimental evidence to evaluate that assumption. Recent models highlight the critical importance of that assumption in determining coral extinction risk, and several recent studies (including a couple of recent ones from Grottoli's group) indicate that previous studies may have underestimated the potential for corals to acclimatize or adapt to global change. Here, quantitative, empirical estimates of the potential for long-term coral acclimatization and adaptation under global change scenarios will be made. The proposed study includes ~97% of the corals in the Hawaiian archipelago, yielding extensive spatial and biological relevance for the study. Lastly, this research brings together the expertise of Grottoli at OSU (coral physiologist and biogeochemist), Toonen at UH (marine molecular biologist), and McCulloch at UWA (geochemist) in a unique collaboration that blends a large suite of genetic, physiological, and biogeochemical tools to build an unprecedentedly comprehensive picture of coral adaptation and acclimation to global change. Thus, this work has the potential to transform our conceptual and empirical understanding of how corals respond to rapid environmental change.

Broader Impacts: Half of the species in the Hawaiian archipelago are endemic, making Hawaiian coral reefs a high priority for biodiversity conservation. Results from the proposed work will be used for adaptive management plans that collaborator Dr. Toonen is involved in with the goal of preserving Hawaiian coral biodiversity in a UNESCO World Heritage Site -- the Papahānaumokuākea Marine National Monument (PMNM). PMNM encompasses the northwestern Hawaiian Islands, is renowned as one of the most pristine and highly protected coral reefs remaining on the planet, is the single largest conservation area under the U.S. flag, and one of the largest marine conservation areas in the world. This project will provide a bridge between short-term, single-species studies and longer-term, multi-species responses to global change in reef community settings. Findings from this work will be communicated at scientific meetings, through peer-reviewed journal publications, and via press releases. Grottoli will also bring her research and enthusiasm for marine science into her classrooms and onto the podium when giving general audience and professional talks. She has an established track record of recruiting and promoting under-represented students and will continue to do so. This project will recruit 3 undergrads and 2 high school students for supported senior thesis/independent research and provide an environment that will foster their passion and skills necessary to pursue career options in STEM disciplines.

[[table of contents](#) | [back to top](#)]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459536

[[table of contents](#) | [back to top](#)]