Thermal growth for Skeletonema species as analyzed in Anderson and Rynearson, 2020

Website: https://www.bco-dmo.org/dataset/774996
Data Type: experimental
Version: 1
Version Date: 2019-08-12

Project
» Dimensions: Collaborative Research: Genetic, functional and phylogenetic diversity determines marine phytoplankton community responses to changing temperature and nutrients (Phytoplankton Community Responses)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
Rynearson, Tatiana	University of Rhode Island (URI-GSO)	Principal Investigator
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Abstract
Thermal growth rates for 24 strains representing 5 species from the diatom genus Skeletonema, as analyzed in Anderson and Rynearson, 2020. Strains were grown at temperatures ranging from -2 to 36C to assess how inter- and intraspecific thermal trait variability could explain diatom community dynamics.

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Coverage

Spatial Extent: **N**:41.566 **E**:14.15 **S**:40.9 **W**:-73.064
Temporal Extent: 1956-05-09 - 2016-07-05

Dataset Description

This dataset includes experimental thermal growth measurements from five Skeletonema species. Strains were collected at Narragansett Bay, Rhode Island and obtained from the National Center for Marine Algae and Microbiota (NCMA/CCMP), and grown at varying temperatures.

Acquisition Description

Complete methods outlined in Anderson and Rynearson, 2020, in press.

Thermal growth measurements: Daily measurements of in vivo Chlorophyll a fluorescence were measured and used to calculate specific growth rates (Gotelli 1995). Following Boyd et al. (2013), a growth rate was determined for each strain at each temperature using a minimum of three serial replicates. Statistical analyses were utilized to ensure fit and similarity of regression (R2, F statistic, F-test; Zar 1996) among replicate growth rates.

All data processing was carried out in R 3.4.1(R-Core-Team 2015).

Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- re-formatted date from m/d/yyyy to yyyy-mm-dd
- reduced number of significant digits of Growth from up to 9 , to 4

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Related Publications

Anderson, S. I., & Rynearson, T. A. (in press). Variability Approaching the Thermal Limits Can Drive Diatom Community Dynamics. Limnology and Oceanography.

Boyd, P. W., Rynearson, T. A., Armstrong, E. A., Fu, F., Hayashi, K., Hu, Z., … Thomas, M. K. (2013). Marine Phytoplankton Temperature versus Growth Responses from Polar to Tropical Waters – Outcome of a Scientific Community-Wide Study. PLoS ONE, 8(5), e63091. doi:10.1371/journal.pone.0063091

Gotelli, N. J. (1995). A Primer of Ecology, 206 p.

R Core Team (2018) R: A language and environment for statistical computing (R Foundation for Statistical Computing, Vienna, Austria).

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Parameters

Parameter	Description	Units
Species	Species	unitless
Strain	Strain	unitless
GenBank	GenBank Accession Number associated with each strain	unitless
Collection_date	Date of collection from the environment; formatted as yyyy-mm-dd	unitless
Isolation_Lat	Latitude of strain isolation; north is positive	degrees
Isolation_Lon	Longitude of strain isolation; east is positive	degrees
Isolation_Temperature	Sea surface temperature (SST) at time and position of isolation	degrees C
Temperature	Experimental temperature at which measurements were recorded	degrees C
Growth	Specific growth rate recoded at temperature	per day

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Instruments

Dataset-specific Instrument Name	10-AU Fluorometer (Turner Designs, San Jose, CA)
Generic Instrument Name	Turner Designs Fluorometer -10-AU
Dataset-specific Description	Used for thermal growth measurements.
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer. (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA)

Dataset-specific Instrument Name	Eclipse E800 microscope (Nikon, Tokyo, Japan)
Generic Instrument Name	Microscope-Optical
Dataset-specific Description	Used t measure cell volume.
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Microplate Reader (Spectramax M Series, Molecular Devices, Sunnyvale, CA)
Generic Instrument Name	plate reader
Generic Instrument Description	Plate readers (also known as microplate readers) are laboratory instruments designed to detect biological, chemical or physical events of samples in microtiter plates. They are widely used in research, drug discovery, bioassay validation, quality control and manufacturing processes in the pharmaceutical and biotechnological industry and academic organizations. Sample reactions can be assayed in 6-1536 well format microtiter plates. The most common microplate format used in academic research laboratories or clinical diagnostic laboratories is 96-well (8 by 12 matrix) with a typical reaction volume between 100 and 200 uL per well. Higher density microplates (384- or 1536-well microplates) are typically used for screening applications, when throughput (number of samples per day processed) and assay cost per sample become critical parameters, with a typical assay volume between 5 and 50 µL per well. Common detection modes for microplate assays are absorbance, fluorescence intensity, luminescence, time-resolved fluorescence, and fluorescence polarization. From: http://en.wikipedia.org/wiki/Plate_reader, 2014-09-0-23.

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Project Information

Dimensions: Collaborative Research: Genetic, functional and phylogenetic diversity determines marine phytoplankton community responses to changing temperature and nutrients (Phytoplankton Community Responses)

Coverage: Narragansett Bay, RI and Bermuda, Bermuda Atlantic Time-series Study (BATS)

NSF Award Abstract: Photosynthetic marine microbes, phytoplankton, contribute half of global primary production, form the base of most aquatic food webs and are major players in global biogeochemical cycles. Understanding their community composition is important because it affects higher trophic levels, the cycling of energy and elements and is sensitive to global

environmental change. This project will investigate how phytoplankton communities respond to two major global change stressors in aquatic systems: warming and changes in nutrient availability. The researchers will work in two marine systems with a long history of environmental monitoring, the temperate Narragansett Bay estuary in Rhode Island and a subtropical North Atlantic site near Bermuda. They will use field sampling and laboratory experiments with multiple species and varieties of phytoplankton to assess the diversity in their responses to different temperatures under high and low nutrient concentrations. If the diversity of responses is high within species, then that species may have a better chance to adapt to rising temperatures and persist in the future. Some species may already be able to grow at high temperatures; consequently, they may become more abundant as the ocean warms. The researchers will incorporate this response information in mathematical models to predict how phytoplankton assemblages would reorganize under future climate scenarios. Graduate students and postdoctoral associates will be trained in diverse scientific approaches and techniques such as shipboard sampling, laboratory experiments, genomic analyses and mathematical modeling. The results of the project will be incorporated into K-12 teaching, including an advanced placement environmental science class for underrepresented minorities in Los Angeles, data exercises for rural schools in Michigan and disseminated to the public through an environmental journalism institute based in Rhode Island. Predicting how ecological communities will respond to a changing environment requires knowledge of genetic, phylogenetic and functional diversity within and across species. This project will investigate how the interaction of phylogenetic, genetic and functional diversity in thermal traits within and across a broad range of species determines the responses of marine phytoplankton communities to rising temperature and changing nutrient regimes. High genetic and functional diversity within a species may allow evolutionary adaptation of that species to warming. If the phylogenetic and functional diversity is higher across species, species sorting and ecological community reorganization is likely. Different marine sites may have a different balance of genetic and functional diversity within and across species and, thus, different contribution of evolutionary and ecological responses to changing climate. The research will be conducted at two long-term time series sites in the Atlantic Ocean, the Narragansett Bay Long-Term Plankton Time Series and the Bermuda Atlantic Time Series (BATS) station. The goal is to assess intra- and inter-specific genetic and functional diversity in thermal responses at contrasting nutrient concentrations for a representative range of species in communities at the two sites in different seasons, and use this information to parameterize eco-evolutionary models embedded into biogeochemical ocean models to predict responses of phytoplankton communities to projected rising temperatures under realistic nutrient conditions. Model predictions will be informed by and tested with field data, including the long-term data series available for both sites and in community temperature manipulation experiments. This project will provide novel information on existing intraspecific genetic and functional thermal diversity for many ecologically and biogeochemically important phytoplankton species, estimate generation of new genetic and functional diversity in evolution experiments, and develop and

parameterize novel eco-evolutionary models interfaced with ocean biogeochemical models to predict future phytoplankton community structure. The project will also characterize the interaction of two major global change stressors, warming and changing nutrient concentrations, as they affect phytoplankton diversity at functional, genetic, and phylogenetic levels. In addition, the project will develop novel modeling methodology that will be broadly applicable to understanding how other types of complex ecological communities may adapt to a rapidly warming world.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program) Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF] The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1638834

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