Phytoplankton and bacteria abundance from flow cytometry from samples collected in the Gulf of Mexico on R/V Nancy Foster cruises NF1704 and NF1802 in May 2017 and May 2018

Website: https://www.bco-dmo.org/dataset/835414
Data Type: Cruise Results
Version: 1
Version Date: 2021-01-05

Project
» Collaborative Research: Mesoscale variability in nitrogen sources and food-web dynamics supporting larval southern bluefin tuna in the eastern Indian Ocean (BLOOFINZ-IO)

Program
» Second International Indian Ocean Expedition (IIOE-2)

Contributors	Affiliation	Role
Selph, Karen E.	University of Hawaii at Manoa (SOEST)	Principal Investigator, Contact
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Phytoplankton and bacteria abundance from flow cytometry from samples collected in the Gulf of Mexico on R/V Nancy Foster cruises NF1704 and NF1802 in May 2017 and May 2018

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Coverage

Spatial Extent: **N**:28.3358 **E**:-84.434 **S**:24.96 **W**:-90.1775
Temporal Extent: 2017-05-11 - 2018-05-19

Dataset Description

This dataset is being discussed in Selph *et al.* 2021.

Methods & Sampling

This dataset is from CTD-based water collections of samples for phytoplankton and non-pigmented bacteria in the Gulf of Mexico on R/V Nancy Foster cruises in May 2017 and May 2018, which were part of a NOAA RESTORE project (aka: BLOOFINZ-GoM) led by Dr. John Lamkin to investigate the epipelagic marine nitrogen cycle, plankton dynamics, and impacts on growth and survival of larval Atlantic Bluefin Tuna (ABT). These data are meant to be used in inter-species, interregional comparisons to data from the BLOOFIN-IO study of larval

larval Southern Bluefin Tuna in the Indian Ocean spawning region. Flow cytometry results include abundances of phytoplankton taxa (*Prochlorococcus*, *Synechococcus*, Photosynthetic Eukaryotes) and non-pigmented bacteria (HBACT).

Flow cytometry samples were collected at sea from each CTD rosette on the NOAA Ship Nancy Foster (NF) from cruises from 30 April to 19 May 2017 and from 11 May to 30 May 2018. For phytoplankton and heterotrophic bacteria enumeration, 2 ml sample volumes are collected, preserved (0.5% paraformaldehyde, final concentration) and flash frozen in liquid nitrogen. On shore, the samples are transferred to a –80°C freezer for storage until analysis on the flow cytometer. Samples are thawed in batches, then stained with Hoechst 34442 (1 µg/ml, final concentration) (Monger and Landry, 1993; Campbell and Vaulot, 1993; Campbell et al., 1994).

Data Processing Description

The data generated is in the form of listmode files (FCS 2.0 format) acquired from the flow cytometer using Expo32 software (Beckman-Coulter). These data are processed, designating populations from their fluorescence and scatter signals, using FlowJo software (Tree Star, Inc., www.flowjo.com), which generates excel-spreadsheet files.

BCO-DMO processing info:

- Adjusted column headers to comply with database requirements
- Converted date to ISO format

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Data Files

File
flow_cytometry.csv (Comma Separated Values (.csv), 12.54 KB) MD5:394e977f3ca0b2bfb2cbbcbf36bb24a7 Primary data file for dataset ID 835414

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Related Publications

Campbell, L., & Vaulot, D. (1993). Photosynthetic picoplankton community structure in the subtropical North Pacific Ocean near Hawaii (station ALOHA). Deep Sea Research Part I: Oceanographic Research Papers, 40(10), 2043–2060. doi:10.1016/0967-0637(93)90044-4
Methods

Campbell, L., Nolla, H. A., & Vaulot, D. (1994). The importance of Prochlorococcus to community structure in the central North Pacific Ocean. Limnology and Oceanography, 39(4), 954–961. doi:10.4319/lo.1994.39.4.0954
Methods

Monger, B. C., & Landry, M. R. (1993). Flow Cytometric Analysis of Marine Bacteria with Hoechst 33342 †. Applied and Environmental Microbiology, 59(3), 905–911. doi:10.1128/aem.59.3.905-911.1993
Methods

Selph, K.E., Swalethorp, R., Stukel, M.R., Kelly, T.B., Knapp, A.N., Fleming, K., Hernandez, T., & Landry, M.R. (2021). Phytoplankton community composition and biomass in the oligotrophic Gulf of Mexico. Journal of Plankton Research. doi:10.1093/plankt/fbab006
Results

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Parameters

Parameter	Description	Units
Cruise	Cruise ID	unitless
Station	Station number	unitless
Date	Sampling date	unitless
Longitude	Station longitude, west is negative	decimal degrees
Latitude	Station latitude, south is negative	decimal degrees
CTD_Number	CTD cast number	unitless
Depth	Sample depth	meters (m)
Prochlorococcus	Prochlorococcus	cells per milliliters (cells/ml)
Synechococcus	Synechococcus	cells per milliliters (cells/ml)
Photosynthetic_eukaryotes	Photosynthetic eukaryotes	cells per milliliters (cells/ml)
Heterotrophic_bacteria	Heterotrophic bacteria	cells per milliliters (cells/ml)

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Instruments

Dataset-specific Instrument Name	Beckman-Coulter Altra
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	The flow cytometer used is a Beckman-Coulter Altra (operated by the SOEST Flow Cytometry Facility, www.soest.hawaii.edu/sfcf), mated to a Harvard Apparatus syringe pump for quantitative analyses, and it is equipped with two argon ion lasers, tuned to UV (200 mW) and 488 nm (1 W) excitation. Scatter (side and forward) and fluorescence signals are collected using filters as appropriate, including those for Hoechst-bound DNA, phycoerythrin and chlorophyll.
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. (from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm)

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Deployments

NF1802

Website	https://www.bco-dmo.org/deployment/834976
Platform	R/V Nancy Foster
Report	https://datadocs.bco-dmo.org/docs/302/BLOOFINZ_IO/data_docs/cruise_reports/NF1802_CRUISE_REPORT.pdf
Start Date	2018-04-27
End Date	2018-05-20
Description	R/V Nancy Foster cruise in May 2018 as part of a NOAA RESTORE project (aka: BLOOFINZ-GoM).

NF1704

Website	https://www.bco-dmo.org/deployment/834975
Platform	R/V Nancy Foster
Report	https://datadocs.bco-dmo.org/docs/302/BLOOFINZ_IO/data_docs/cruise_reports/NF1704_CRUISE_REPORT.pdf
Start Date	2017-05-07
End Date	2017-06-02
Description	R/V Nancy Foster cruise in May 2017 as part of a NOAA RESTORE project (aka: BLOOFINZ-GoM).

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Project Information

Collaborative Research: Mesoscale variability in nitrogen sources and food-web dynamics supporting larval southern bluefin tuna in the eastern Indian Ocean (BLOOFINZ-IO)

Coverage: Eastern Indian Ocean, Indonesian Throughflow area, and the Gulf of Mexico

NSF Award Abstract:
The small area between NW Australia and Indonesia in the eastern Indian Ocean (IO) is the only known spawning ground of Southern Bluefin Tuna (SBT), a critically endangered top marine predator. Adult SBT migrate thousands of miles each year from high latitude feeding areas to lay their eggs in these tropical waters, where food concentrations on average are below levels that can support optimal feeding and growth of their larvae. Many critical aspects of this habitat are poorly known, such as the main source of nitrogen nutrient that sustains system productivity, how the planktonic food web operates to produce the unusual types of zooplankton prey that tuna larvae prefer, and how environmental differences in habitat quality associated with ocean fronts and eddies might be utilized by adult spawning tuna to give their larvae a greater chance for rapid growth and survival success. This project investigates these questions on a 38-day expedition in early 2021, during the peak time of SBT spawning. This project is a US contribution to the 2nd International Indian Ocean Expedition (IIOE-2) that advances understanding of biogeochemical and ecological dynamics in the poorly studied eastern IO. This is the first detailed study of nitrogen and carbon cycling in the region linking Pacific and IO waters. The shared dietary preferences of SBT larvae with those of other large tuna and billfish species may also make the insights gained broadly applicable to understanding larval recruitment issues for top consumers in other marine ecosystems. New information from the study will enhance international management efforts for SBT. The shared larval dietary preferences of large tuna and billfish species may also extend the insights gained broadly to many other marine top consumers, including Atlantic bluefin tuna that spawn in US waters of the Gulf of Mexico. The end-to-end study approach, highlights connections among physical environmental variability, biogeochemistry, and plankton food webs leading to charismatic and economically valuable fish production, is the theme for developing educational tools and modules through the "scientists-in-the-schools" program of the Center for Ocean-Atmospheric Prediction Studies at Florida State

University, through a program for enhancing STEM learning pathways for underrepresented students in Hawaii, and through public outreach products for display at the Birch Aquarium in San Diego. The study also aims to support an immersive field experience to introduce talented high school students to marine research, with the goal of developing a sustainable marine-related educational program for underrepresented students in rural northwestern Florida.

Southern Bluefin Tuna (SBT) migrate long distances from high-latitude feeding grounds to spawn exclusively in a small oligotrophic area of the tropical eastern Indian Ocean (IO) that is rich in mesoscale structures, driven by complex currents and seasonally reversing monsoonal winds. To survive, SBT larvae must feed and grow rapidly under environmental conditions that challenge conventional understanding of food-web structure and functional relationships in poor open-ocean systems. The preferred prey of SBT larvae, cladocerans and Corycaeidae copepods, are poorly studied and have widely different implications for trophic transfer efficiencies to larvae. Differences in nitrogen sources - N fixation vs deep nitrate of Pacific origin - to sustain new production in the region also has implications for conditions that may select for prey types (notably cladocerans) that enhance transfer efficiency and growth rates of SBT larvae. The relative importance of these N sources for the IO ecosystem may affect SBT resiliency to projected increased ocean stratification. This research expedition investigates how mesoscale variability in new production, food-web structure and trophic fluxes affects feeding and growth conditions for SBT larvae. Sampling across mesoscale features tests hypothesized relationships linking variability in SBT larval feeding and prey preferences (gut contents), growth rates (otolith analyses) and trophic positions (TP) to the environmental conditions of waters selected by adult spawners. Trophic Positions of larvae and their prey are determined using Compound-Specific Isotope Analyses of Amino Acids (CSIA-AA). Lagrangian experiments investigate underlying process rates and relationships through measurements of water-column 14C productivity, N2 fixation, 15NO3- uptake and nitrification; community biomass and composition (flow cytometry, pigments, microscopy, in situ imaging, genetic analyses); and trophic fluxes through micro- and mesozooplankton grazing, remineralization and export. Biogeochemical and food web elements of the study are linked by CSIA-AA (N source, TP), 15N-constrained budgets and modeling. The project elements comprise an end-to-end coupled biogeochemistry-trophic study as has not been done previously for any pelagic ecosystem.

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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Program Information

Second International Indian Ocean Expedition (IIOE-2)

Website: https://web.whoi.edu/iioe2/

Coverage: Indian Ocean

Description from the program website:
The Second International Indian Ocean Expedition (IIOE-2) is a major global scientific program which will engage the international scientific community in collaborative oceanographic and atmospheric research from coastal environments to the deep sea over the period 2015-2020, revealing new information on the Indian Ocean (i.e. its currents, its influence upon the climate, its marine ecosystems) which is fundamental for future sustainable development and expansion of the Indian Ocean's blue economy. A large number of scientists from research institutions from around the Indian Ocean and beyond are planning their involvement in IIOE-2 in accordance with the overarching six scientific themes of the program. Already some large collaborative research projects are under development, and it is anticipated that by the time these projects are underway, many more will be in planning or about to commence as the scope and global engagement in IIOE-2 grows.

Focused research on the Indian Ocean has a number of benefits for all nations. The Indian Ocean is complex and drives the region's climate including extreme events (e.g. cyclones, droughts, severe rains, waves and storm surges). It is the source of important socio-economic resources (e.g. fisheries, oil and gas exploration/extraction, eco-tourism, and food and energy security) and is the background and focus of many of the region's human populations around its margins. Research and observations supported through IIOE-2 will result in an improved understanding of the ocean's physical and biological oceanography, and related air-

ocean climate interactions (both in the short-term and long-term). The IIOE-2's program will complement and harmonise with other regional programs underway and collectively the outcomes of IIOE-2 will be of huge benefit to individual and regional sustainable development as the information is a critical component of improved decision making in areas such as maritime services and safety, environmental management, climate monitoring and prediction, food and energy security.

IIOE-2 activities will also include a significant focus on building the capacity of all nations around the Indian Ocean to understand and apply observational data or research outputs for their own socio-economic requirements and decisions. IIOE-2 capacity building programs will therefore be focused on the translation of the science and information outputs for societal benefit and training of relevant individuals from surrounding nations in these areas.

A Steering Committee was established to support U.S. participation in IIOE-2. More information is available on their website at https://web.whoi.edu/iioe2/.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851558
National Oceanic and Atmospheric Administration (NOAA)	NA16NMF4320058

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