Phytoplankton carbon biomass by taxa from NOAA Ship R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Mexico, May 2017 and 2018

Website: https://www.bco-dmo.org/dataset/835741
Data Type: Cruise Results
Version: 1
Version Date: 2021-01-07

Project
» Collaborative Research: Mesoscale variability in nitrogen sources and food-web dynamics supporting larval southern bluefin tuna in the eastern Indian Ocean (BLOOFINZ-IO)
» Effects of Nitrogen Sources and Plankton Food-Web Dynamics on Habitat Quality for the Larvae of Atlantic Bluefin Tuna in the Gulf of Mexico (GoMex Tuna Foodweb B)

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

Contributors	Affiliation	Role
Selph, Karen E.	University of Hawai'i at Mānoa	Principal Investigator
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Abstract
Phytoplankton carbon biomass by taxa from NOAA Ship R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Mexico, May 2017 and 2018. These data were published in Selph et al. 2021.

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Coverage

Spatial Extent: **N**:28.3358 **E**:-87.3032 **S**:25.721 **W**:-90.1775
Temporal Extent: 2017-05-11 - 2018-05-18

Methods & Sampling

Phytoplankton samples for flow cytometry, HPLC and microscopy were collected pre-dawn from Niskin bottles mounted on a 24-place rosette system equipped with a Seabird SBE911 CTD and a Seapoint fluorometer.

Flow cytometry samples (2-mL) for pico-phytoplankton abundance were preserved (0.5% paraformaldehyde) and frozen in LN2, then stored at -80°C until shore-based analyses. On-shore, flow cytometry samples were thawed and stained for 1 h with the DNA stain Hoechst 33342 (1 µg/ml, Monger and Landry, 1993), then analyzed with a Beckman Coulter EPICS Altra flow cytometer (Selph et al., 2011). Listmode data were

processed using FlowJo (version 9.7.7, Treestar, Inc.) to delineate Prochlorococcus (PRO), Synechococcus (SYN), and eukaryotic phytoplankton (PEUK). PRO and SYN abundances were converted to carbon using 32 and 101 fg C/cell, respectively (Garrison et al., 2000; Brown et al., 2008). PEUK were mainly ≤2 µm cells, however some were larger and therefore microscopic counts for cells from 2-5 µm were subtracted from the total PEUK abundance, and the remaining cells were converted to carbon and scaled to be that of a cell twice the diameter of SYN (808 fg C/cell).

HPLC pigment samples (2.2-L) were filtered onto GF/F filters, frozen in LN2 and stored at -85°C until shore-based analyses. On shore, samples were sent to Horn Point Analytical Services Laboratory (University of Maryland Center for Environmental Science). There they were extracted, and analyzed using an automated 1100 HPLC system with Agilent temperature-controlled autosampler, Peltier temperature-controlled column oven compartment, PDA detector and ChemStation software. The HPLC method uses a C8 column and a reversed phase, methanol-based solvent system (Van Heukelem and Thomas, 2001; Hooker et al., 2012). MVCHLa and DVCHLa are detected at 665 nm. Carotenoid and xanthophyll accessory pigments are detected at 450 nm.

The pigments used for phytoplankton taxonomic identification were MVCHLa and DVCHLa (sum = TCHLa), monovinyl chlorophyll b (MVCHLb), divinyl chlorophyll b (DVCHLb), chlorophyll c3 (CHLc3), zeaxanthin (ZEAX), fucoxanthin (FUCO), 19'-hex-fucoxanthin (HEX), 19'-but-fucoxanthin (BUT), allophycocyanin (ALLO), peridinin (PER), neoxanthin (NEO), and prasinoxanthin (PRAS). Chlorophyll a contributions for PRO and SYN were subtracted from HPLC pigment data (estimated from flow cytometry and DVCHLa). Similarly, Trichodesmium MVCHLa was assigned from separately collected samples (Selph et al., 2021). The remaining HPLC pigments, except for ZEAX, were entered into the CHEMTAX program (v. 1.95, Wright, 2008) for partitioning into eukaryotic groups.

Initial pigment ratios (accessory pigment:MVCHLa) used in CHEMTAX were those of oceanic species (Higgens et al., 2011) and indicative of the following groups: chlorophytes (CHLOR), diatoms (DIAT), prymnesiophytes - type 6 (PRYM), pelagophytes (PELAG), cryptophytes (CRYPT), prasinophytes - type 3 (PRAS3), and dinoflagellates (A-DINO). Data were divided into 2 groups: shallower and deeper than 60 m, since some of the accessory pigments were only present in deep samples (NEO and ALLO) and the general pattern of pigments showed a different community at depth. The initial ratio matrix was randomized into 60 matrices (0.7 x random number between -0.5 and +0.5), which were then applied to the data sets (Supp. Table I). The resulting partitioning of MVCHLa into these phytoplankton taxa was used to estimate the percent of total carbon biomass in each group.

Microscopy samples from the top two depths (~80%I0 and 40%I0) and the bottom 2 depths (~5%I0 and 1%I0) sampled were used to estimate the biomass of eukaryotic phytoplankton taxa. Phytoplankton taxonomic structure was assessed to the extent possible, separating cells into dinoflagellates, diatoms, and unidentified flagellates. Microscope slides were prepared from 500 mL of preserved sample (260 µL alkaline Lugol's solution (0.1% final), 10 mL 10% buffered formalin, 500 µL 3% sodium thiosulfate; modified protocol from Sherr and Sherr, 1993), to which 1 mL 0.33% proflavine (w/v) and 1 mL of 4',6-diamidino-2-phenylindole (DAPI, 0.01 mg/mL) were added. For analysis of cells <10-µm, a slide was prepared from 50 mL subsamples filtered onto a 25-mm, 0.8-µm pore size, black PCTE filter and mounted on a glass slide. For larger (10- to ~50-µm) cells, the remaining sample was filtered onto a 25-mm, 8-µm pore size, black PCTE filter. Slides were frozen (-80°C) until image analysis as detailed in Taylor et al. (2015). Cell biovolumes (BV, µm3) were calculated from length (L) and width (W) according to Taylor et al. (2011). BV was converted to carbon (C, pg/cell) using C = 0.216 x BV0.939 for non-diatoms and C = 0.288 x BV0.811 for diatoms (Menden-Deuer and Lessard, 2000). The FCM-derived PEUK abundance were assumed to represent cells <5 µm, therefore 2-5 µm cells from microscopy were subtracted from total PEUK cells, leaving cells ≤2 µm (not counted with microscopy), and their carbon contents were added to the microscope slide-estimated carbon for a total phytoplankton community carbon estimate. These data were also used to determine carbon:chlorophyll (C:CHL) ratios at the depths where both measurements were taken. Missing intermediate depths (for carbon) were estimated using the 5%I0 C:CHL ratio.

Data Processing Description

Flow cytometry listmode files: On flow cytometer, listmode files are generated by Expo32 software (Beckman-Coulter); offline these listmode files were processed using FlowJo, version 9.7.7, Treestar, Inc.

HPLC: ChemStation software for generated raw data, whereas the program CHEMTAX was used for partitioning MVCHLa into taxonomic groups (CHEMTAX, v. 1.95,Wright, 2008).

Microscopy: Zeiss Axiovision software

BCO-DMO Processing Notes:
- data submitted in Excel file "GoM phytoplankton carbon.csv" extracted to csv
- added conventional header with dataset name, PI name, version date
- renamed columns to conform with BCO-DMO naming conventions (removed spaces and special characters)
- formatted Date to ISO (yyyy-mm-dd)
- replaced blank cells with no data value 'nd', the default missing data identifier in the BCO-DMO system.

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Data Files

File
gom_phyto_carbon.csv (Comma Separated Values (.csv), 6.82 KB) MD5:e592fd1a3211df4fbe015ae69abeab9d Primary data file for dataset ID 835741

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Related Publications

Brown, S. L., Landry, M. R., Selph, K. E., Jin Yang, E., Rii, Y. M., & Bidigare, R. R. (2008). Diatoms in the desert: Plankton community response to a mesoscale eddy in the subtropical North Pacific. Deep Sea Research Part II: Topical Studies in Oceanography, 55(10-13), 1321–1333. doi:10.1016/j.dsr2.2008.02.012
Methods

Garrison, D. L., Gowing, M. M., Hughes, M. P., Campbell, L., Caron, D. A., Dennett, M. R., … Smith, D. C. (2000). Microbial food web structure in the Arabian Sea: a US JGOFS study. Deep Sea Research Part II: Topical Studies in Oceanography, 47(7-8), 1387–1422. doi:10.1016/s0967-0645(99)00148-4 https://doi.org/10.1016/S0967-0645(99)00148-4
Methods

Gerard, T., Lamkin, J. T., Kelly, T. B., Knapp, A. N., Laiz-Carrión, R., Malca, E., Selph, K. E., Shiroza, A., Shropshire, T. A., Stukel, M. R., Swalethorp, R., Yingling, N., & Landry, M. R. (2022). Bluefin Larvae in Oligotrophic Ocean Foodwebs, investigations of nutrients to zooplankton: overview of the BLOOFINZ-Gulf of Mexico program. Journal of Plankton Research, 44(5), 600–617. https://doi.org/10.1093/plankt/fbac038
Methods

Higgins, HW and Wright, SW and Schluter, L, Quantitative interpretation of chemotaxonomic pigment data, Phytoplankton Pigments: Characterization, Chemotaxonomy and Applications in Oceanography, Cambridge University Press, S Roy, C A. Llewellyn, ES Egeland and G Johnsen (ed), United Kingdom, pp. 257-313. ISBN 9780511732263 (2011) [Research Book Chapter]
Methods

Hooker, S. B., Clementson, L., Thomas, C. S., Schlüter, L., Allerup, M., Ras, J., Claustre, H., Normandeau, C. et al. (2012) The fifth SeaWiFS HPLC analysis round-robin experiment (SeaHARRE-5). NASA/TM-2012-217503, NASA Greenbelt, MD, 98 p.
Methods

Menden-Deuer, S., & Lessard, E. J. (2000). Carbon to volume relationships for dinoflagellates, diatoms, and other protist plankton. Limnology and Oceanography, 45(3), 569–579. doi:10.4319/lo.2000.45.3.0569
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., Landry, M. R., Taylor, A. G., Yang, E.-J., Measures, C. I., Yang, J., … Bidigare, R. R. (2011). Spatially-resolved taxon-specific phytoplankton production and grazing dynamics in relation to iron distributions in the Equatorial Pacific between 110 and 140°W. Deep Sea Research Part II: Topical Studies in Oceanography, 58(3-4), 358–377. doi:10.1016/j.dsr2.2010.08.014

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
Methods

Sherr, B. F. and E. B. Sherr (1993) Preservation and storage of samples for enumeration of heterotrophic protists. In Kemp, P. F., Sherr, B. F., Sherr, E. B. and Cole, J. J. (eds.) Handbook of Methods in Aquatic Microbial Ecology. CRC Press, pp. 207-212 https://isbnsearch.org/isbn/9780367449858
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Taylor, A. G., Landry, M. R., Selph, K. E., & Wokuluk, J. J. (2015). Temporal and spatial patterns of microbial community biomass and composition in the Southern California Current Ecosystem. Deep Sea Research Part II: Topical Studies in Oceanography, 112, 117–128. doi:10.1016/j.dsr2.2014.02.006
Methods

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Methods

Taylor, A. G., Landry, M. R., Selph, K. E., & Yang, E. J. (2011). Biomass, size structure and depth distributions of the microbial community in the eastern equatorial Pacific. Deep Sea Research Part II: Topical Studies in Oceanography, 58(3-4), 342–357. doi:10.1016/j.dsr2.2010.08.017
Methods

Van Heukelem, L., & Thomas, C. S. (2001). Computer-assisted high-performance liquid chromatography method development with applications to the isolation and analysis of phytoplankton pigments. Journal of Chromatography A, 910(1), 31–49. doi:10.1016/s0378-4347(00)00603-4
Methods

Wright, S. (2008). Chemtax version 1.95 for calculating the taxonomic composition of phytoplankton populations [Data set]. Australian Antarctic Data Centre. https://doi.org/10.4225/15/59FFF1C5EA8FC https://doi.org/10.4225/15/59fff1c5ea8fc
Methods

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Related Datasets

IsRelatedTo

Selph, K. E. (2021) **Fluorometer data (volts) from CTD casts from NOAA Ship R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Mexico, May 2017 and 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-01-07 doi:10.26008/1912/bco-dmo.835566.1 [view at BCO-DMO]

Selph, K. E. (2021) **Pigment data by phytoplankton taxa from CTD casts from NOAA Ship R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Mexico, May 2017 and 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-01-07 doi:10.26008/1912/bco-dmo.835619.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Cruise	cruise identifier	unitless

Station	station identifier	unitless
Date	cast date, UTC	unitless
Lon	latitude; north is positive	decimal degrees
Lat	longitude; east is positive	decimal degrees
Cycle	Series of stations following a Lagrangian drift array, as described in Gerard et al., 2021.	unitless
CTD	cast number	unitless
Depth	depth	meters
PRO	Prochlorococcus biomass	micrograms Carbon/liter (ug C/L)
SYN	Synechococcus biomass	micrograms Carbon/liter (ug C/L)
PRYM	Prymnesiophytes-Type 6 biomass	micrograms Carbon/liter (ug C/L)
DIAT	Diatom biomass	micrograms Carbon/liter (ug C/L)
A_DINO	Autotrophic dinoflagellates biomass	micrograms Carbon/liter (ug C/L)
PELAG	Pelagophytes biomass	micrograms Carbon/liter (ug C/L)
CHLOR	Chlorophytes biomass	micrograms Carbon/liter (ug C/L)
PRAS3	Prasinophytes-Type 3 biomass	micrograms Carbon/liter (ug C/L)
CRYPT	Cryptophytes biomass	micrograms Carbon/liter (ug C/L)
interp	Interpolated Data flag: Y (Yes); N (No). Interpolated data refers to carbon biomass data calculated from HPLC pigment data multiplied by the carbon:chlorophyll (C:CHL) ratio of the deepest available data. For instance, for CTD 8, the C:CHL ratio of the 70 m (5% of incident irradiance) sample was multiplied by the HPLC pigment data of the 25 and 50 m samples to obtain C for those samples.	unitless

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Instruments

Dataset-specific Instrument Name	Beckman Coulter EPICS Altra flow cytometer
Generic Instrument Name	Flow Cytometer
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)

Dataset-specific Instrument Name	HPLC
Generic Instrument Name	High-Performance Liquid Chromatograph
Dataset-specific Description	Automated 1100 HPLC system with Agilent temperature-controlled autosampler, Peltier temperature-controlled column oven compartment, PDA detector and ChemStation software.
Generic Instrument Description	A High-performance liquid chromatograph (HPLC) is a type of liquid chromatography used to separate compounds that are dissolved in solution. HPLC instruments consist of a reservoir of the mobile phase, a pump, an injector, a separation column, and a detector. Compounds are separated by high pressure pumping of the sample mixture onto a column packed with microspheres coated with the stationary phase. The different components in the mixture pass through the column at different rates due to differences in their partitioning behavior between the mobile liquid phase and the stationary phase.

Dataset-specific Instrument Name	Dissecting microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Dissecting microscope (10X-30X) with a NightSea SFA adaptor and Royal Blue light head (EX 440-460 nm, EM >500 nm); Olympus BX-41 epifluorescence microscope (200X, EX 450-480 nm, dichroic 500 nm, EM >515 nm); Chlorophyll fluorescence of Trichodesmium - 10AU fluorometer.
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".

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Deployments

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).

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).

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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.

Effects of Nitrogen Sources and Plankton Food-Web Dynamics on Habitat Quality for the Larvae of Atlantic Bluefin Tuna in the Gulf of Mexico (GoMex Tuna Foodweb B)

Coverage: Gulf of Mexico

Amendment #136: Current stock assessments for the Gulf of Mexico require better ecosystem understanding to effectively evaluate how bottom-up processes limit or enhance Atlantic Bluefin Tuna recruitment. The objective of this proposal is to elucidate the underlying mechanisms that link variability in nitrogen sources and food-web fluxes in the Gulf of Mexico to habitat quality, feeding, growth and survival for Atlantic Bluefin Tuna larvae. This proposal addresses the Program Priority: Comprehensive understanding of living coastal and marine resources, food web dynamics, habitat utilization, protected areas, and carbon flows, specifically "(d) Food web structure and dynamics, trophic linkages, and/or predator-prey relationships, especially projects that develop and/or apply new techniques or technologies".

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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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