Indian Ocean Sediment Trap Data collected from R/V Roger Revelle Cruise RR2201 in the Eastern Indian Ocean (Argo Basin) during February 2022 (BLOOFINZ-IO project)

Website: https://www.bco-dmo.org/dataset/944902
Data Type: Cruise Results
Version: 1
Version Date: 2024-12-03

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
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Abstract
The dataset contains sediment trap data collected from the R/V Roger Revelle during cruise RR2201 in the Eastern Indian Ocean (Argo Basin) from February 2022. The data, part of the BLOOFINZ-IO project, includes measurements of particulate organic carbon, nitrogen flux, carbon and nitrogen isotopes, chlorophyll a, and phaeopigment flux. The sediment traps were deployed using VERTEX-style surface-tethered systems, with samples processed for isotope analysis and other biochemical analyses.

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Coverage

Location: Argo Basin, Indian Ocean
Spatial Extent: **N**:-15.34 **E**:118.14 **S**:-16.91 **W**:114.19
Temporal Extent: 2022-02-03 - 2022-02-24

Dataset Description

The temporal bounds of this dataset represent the date when the sediment traps were initially deployed, through the last recovery date. The geospatial bounds also encompass the coordinates of trap all deployments and recoveries.

Methods & Sampling

Data comes from VERTEX-style, surface-tethered, drifting sediment trap deployments. Particle interceptor tubes were deployed on cross-pieces with 8 tubes attached. Tubes were deployed with a dense formaldehyde brine created by adding NaCl and formaldehyde to filtered seawater. After recovery, overlying seawater was removed from each cruise by gentle suction. Tubes were then gravity filtered through a 100-micron nitex mesh filter, and the 100-micron filters were carefully analyzed under a stereomicroscope and all metazoan zooplankton “swimmers” were removed from the sample. Material remaining on the 100-micron filters (i.e., sinking material) was then imaged with a macrophotography rig and subsequently rinsed back into the original sample tube (i.e., re-combined with the <100-micron sinking material). Samples were then separated and filtered onto different types of filters for a suite of different analyses including: particulate organic carbon flux, particulate nitrogen flux, carbon and nitrogen isotopes, and chlorophyll *a* and phaeopigment flux.

Samples for particulate organic carbon flux were vacuum filtered through pre-combusted GF/F filters at low pressure. Samples were then frozen at -80C and stored for the duration of the cruise. These were then dried out for shipping. On land, they were acidified by fuming with hydrochloric acid (HCl). Samples were then thoroughly dried and packed into pre-combusted tin cups. They were analyzed by isotope ratio mass spectrometer at the UC Davis Stable Isotope Facility for carbon, nitrogen, carbon isotopes, and nitrogen isotopes.

Samples for Chl a and phaeopigments were filtered onto GF/F filters, extracted in acetone, and analyzed by the acidification method using a Turner 10-AU fluorometer.

BCO-DMO Processing Description

- Units removed from the primary data file (originally units were included in row 2).
- Special characters removed from parameter names and replaced with more interoperable character equivalents (spaces were replaced with underscores ("_") and "σ" were replaced with "sigma").
- Datetime formats associated with trap deployments and recoveries were converted from %m/%d/%y %H:%M to %Y-%m-%d %H:%M.

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Related Publications

Kehinde, O., Bourassa, M., Kranz, S., Landry, M. R., Kelly, T., & Stukel, M. R. (2023). Lateral Advection of Particulate Organic Matter in the Eastern Indian Ocean. Journal of Geophysical Research: Oceans, 128(5). Portico. https://doi.org/10.1029/2023jc019723 https://doi.org/10.1029/2023JC019723
Results

Stukel, M. R., Kelly, T. B., Landry, M. R., Selph, K. E., & Swalethorp, R. (2021). Sinking carbon, nitrogen, and pigment flux within and beneath the euphotic zone in the oligotrophic, open-ocean Gulf of Mexico. Journal of Plankton Research. doi:10.1093/plankt/fbab001
Methods

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Parameters

Parameter	Description	Units
Cruise	Name of cruise associated with the trap deployment.	unitless
Cycle	Lagrangrian experiment number.	unitless
Depth	Depth of trap deployment.	meters (m)

Date_Deployed	Datetime of trap deployment (local).	unitless
Date_Recovered	Datetime of trap recovery (local).	unitless
Duration	Duration of deployment.	days
Deployment_Latitude	Latitude of trap deployment in decimal degrees; a negative value indicates a Southern coordinate.	decimal degrees
Deployment_Longitude	Longitude of trap deployment in decimal degrees; a positive value indicates an Eastern coordinate.	decimal degrees
Recovery_Latitude	Latitude of trap recovery in decimal degrees; a negative value indicates a Southern coordinate.	decimal degrees
Recovery_Longitude	Longitude of trap recovery in decimal degrees; a positive value indicates an Eastern coordinate.	decimal degrees
Corg	Particulate organic carbon flux.	mg C m-2 d-1
sigma_Corg	Standard deviation of Corg flux.	mg C m-2 d-1
Norg	Particulate nitrogen flux.	mg N m-2 d-1
sigma_Norg	Standard deviation of N flux.	mg N m-2 d-1
d13C	Delta 13C of sinking particles.	units
sigma_d13C	Standard deviation of delta 13C.	units
d15N	Delta 15N of sinking particles.	units
sigma_d15N	Standard deviation of _15N.	units
Chl	Chlorophyll flux.	mg Chl a m-2 d-1
sigma_Chl	Standard deviation of chl flux.	mg Chl a m-2 d-1
Phaeo	Phaeopigment Flux.	mg Chl a equivalents m-2 d-1

sigma_Phaeo	standard deviation of Phaeo flux mg Chl a equivalents.	m-2 d-1

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Instruments

Dataset-specific Instrument Name	Macrophotography Rig
Generic Instrument Name	Camera
Dataset-specific Description	After all metazoan zooplankton "swimmers" were removed from the filtered sample, the material remaining on the 100-micron filters (i.e., sinking material) was then imaged with a macrophotography rig and subsequently rinsed back into the original sample tube (i.e., re-combined with the
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Turner 10-AU Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Processed samples for Chl a and phaeopigments were filtered onto GF/F filters, extracted in acetone, and analyzed via the acidification method using a Turner 10-AU fluorometer.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Isotope Ratio Mass Spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Samples were analyzed by isotope ratio mass spectrometer at the UC Davis Stable Isotope Facility for carbon, nitrogen, carbon isotopes, and nitrogen isotopes.
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	Stereomicroscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	After gravity filtering tube contents through 100-micron nitex mesh filters, these filters were carefully analyzed under a stereomicroscope and all metazoan zooplankton “swimmers” were removed from the sample.
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	VERTEX-style Drifting Sediment Traps
Generic Instrument Name	Sediment Trap
Dataset-specific Description	Data comes from VERTEX-style, surface-tethered, drifting sediment trap deployments. Particle interceptor tubes were deployed on cross-pieces with 8 tubes attached. Tubes were deployed with a dense formaldehyde brine created by adding NaCl and formaldehyde to filtered seawater.
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

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Deployments

RR2201

Website	https://www.bco-dmo.org/deployment/916293
Platform	R/V Roger Revelle
Start Date	2022-01-20
End Date	2022-03-14
Description	See more information at R2R: https://www.rvdata.us/search/cruise/RR2201

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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-1851347

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