Water column inorganic nutrient concentration and nitrate+nitrite d15N and d18O measurements from R/V Roger Revelle cruise RR2201 in the Argo Basin in the Indian Ocean from February to March of 2022

Website: https://www.bco-dmo.org/dataset/952591
Data Type: Cruise Results
Version: 1
Version Date: 2025-02-10

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
Kranz, Sven A.	Florida State University (FSU)	Principal Investigator
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Abstract
This dataset includes water column inorganic nutrient concentration and nitrate+nitrite d15N and d18O measurements from a February 2022 cruise in the Argo Basin (NW of Australia (Lat: -15, Lon 114). Water column samples were collected by Niskin bottle on a CTD rosette in the Argo basin in the Eastern Indian Ocean/Indonesian throughflow (NW of Australia) on board the R/V Roger Revelle during cruise RR2201 (BLOOFINZ-IO). Samples were collected between February 4th 2022 and March 2nd 2022.

Table of Contents

Coverage

Location: Argo basin in the Eastern Indian Ocean/Indonesian
Spatial Extent: **N**:-13.010074 **E**:121.497699 **S**:-17.126302 **W**:114.135104
Temporal Extent: 2022-02-03 - 2022-03-02

Dataset Description

See the section "Related Datasets" on this page for related CTD downcast and bottle data mentioned in the metadata for this dataset.

The RR2201 cruise report can be found at http://hdl.handle.net/1834/43464.

Methods & Sampling

Water column samples were collected by Niskin bottle on a CTD rosette (“CTD profile”) during 4 pseudo-Lagrangian cycles (Cycle 1 to Cycle 4)and via Go-flo bottles during a subsequent transect (Argo-stations). All samples were filtered into pre-washed HDPE bottles using a 0.2 µm (Pall Acro Pack) filter capsule. Nutrient bottles were taken in duplicates for analysis of inorganic nutrients ((A-sample) and NO3-isotopes (B-sample). All samples were frozen at -20 °C until analysis.

Inorganic nutrients (NO3, NO2, POx, NH4, Si) were measured through UCSD/Scripps. Nutrient analyses are performed on a Seal Analytical continuous-flow AutoAnalyzer 3 (AA3); https://scripps.ucsd.edu/ships/shipboard-technical-support/odf/chemistry-services/nutrients. The detection limits for the methods/instrumentation are (in micro moles/liter): NO3+NO2 = 0.02; PO4 = 0.02; Sil = 0.5; NO2 = 0.02; NH4 = 0.1

NO3 isotope samples were prepared by thawing the 'to-be-analyzed' samples and removing any nitrite using the method described by Granger and Siegman 2009. Nitrate was measured prior and after acidification and refrozen for shipping. The analysis was performed at the UC-Davis Isotope Facility using the "NO3 Analysis by Bacteria Denitrification" - https://stableisotopefacility.ucdavis.edu/nitrate-no3-water.

Accepted Precision: 0.4 ‰ for ^{15}N; 0.5 ‰ for ^{18}O

Data Processing Description

Data presented here are raw data. Filters were applied for samples with notes of "contamination" and "overfilled" - these data were set to 'NA' values (see BCO-DMO Processing section for more information about how missing data values will appear depending upon the format you download).

BCO-DMO Processing Description

* Data table from submitted file "RR2201_nutrient_CTD_Cycles_BCO_DMO_2024.csv" was imported into the BCO-DMO data system for this dataset. Values "NA" imported as missing data values. Table will appear as Data File: 952591_v1_bloofinz-io-nutirents-and-isotopes.csv (along with other download format options).

Missing Data Identifiers:
* In the BCO-DMO data system missing data identifiers are displayed according to the format of data you access. For example, in csv files it will be blank (null) values. In Matlab .mat files it will be NaN values. When viewing data online at BCO-DMO, the missing value will be shown as blank (null) values.

* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]

* Date converted to ISO 8601 format

* GPS datetime with timezone (UTC) column added in ISO 8601 format "GPS_DateTime_UTC". Since "date" column (TZ undocumented) column did not match the UTC date (compared to event id), the GPS_DateTime_UTC column relied GPS time and the date event number not the "date" column. BCO-DMO data manager will reach out to submitter to find out what time zone "date" column was recorded in and add that information to the Parameters section if it can be found.

* cycle and Cycle columns renamed for clarity if a user renames all to lowercase. cycle-> cycle_label, Cycle-> Cycle_number

* Data submitter clarified the "Seafloor" and "depth" columns were in meters(m). Units added to the parameters section.

Problem Description

Gaps in sampling due to overfilling before freezing, lost samples and contamination issues (due to replaced Niskin bottle) are indicated in the notes column.

[table of contents | back to top]

Data Files

File
952591_v1_bloofinz-io-nutirents-and-isotopes.csv (Comma Separated Values (.csv), 50.58 KB) MD5:6a9fd1e63c6cf01c5c461cc6ebad4bd6 Primary data file for dataset ID 952591, version 1

[table of contents | back to top]

Related Publications

Granger, J., & Sigman, D. M. (2009). Removal of nitrite with sulfamic acid for nitrate N and O isotope analysis with the denitrifier method. Rapid Communications in Mass Spectrometry, 23(23), 3753–3762. doi:10.1002/rcm.4307
Methods

Landry, M. R. (2025). R/V Roger Revelle Cruise RR2201 BLOOFINZ-IO Cruise Report. Eastern Indian Ocean larval tuna habitat study 20 January – 14 March 2022. http://hdl.handle.net/1834/43464
General

Scripps Institution of Oceanography. (2025). Dissolved inorganic nutrients. Retrieved February 10, 2025, from https://scripps.ucsd.edu/ships/shipboard-technical-support/odf/chemistry-services/nutrients
Methods

The Regents of the University of California, Davis campus (2020) (n.d.). Nitrate (NO3) in water: NO3 Analysis by Bacteria Denitrification. Stable Isotope Facility. University of California, Davis. Retrieved February 10, 2025, from https://stableisotopefacility.ucdavis.edu/nitrate-no3-water
Methods

[table of contents | back to top]

Related Datasets

IsRelatedTo

Kelly, T., Kranz, S. A. (2025) **CTD bottle data collected from R/V Roger Revelle cruise RR2201 in the Argo Basin in the Indian Ocean from February to March of 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-02-10 doi:10.26008/1912/bco-dmo.952687.1 [view at BCO-DMO]
Relationship Description: Data from the same CTD casts and bottle samples from RR2201. See the Project page for other data collected as part of this project.

Kelly, T., Kranz, S. A. (2025) **CTD downcast data collected from R/V Roger Revelle cruise RR2201 in the Argo Basin in the Indian Ocean from February to March of 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-02-10 doi:10.26008/1912/bco-dmo.952677.1 [view at BCO-DMO]
Relationship Description: Data from the same CTD casts and bottle samples from RR2201. See the Project page for other data collected as part of this project.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Project	indicates the cruise ID	unitless
Nutrient_bottle	progressive numbering system of sampling bottles (for internal use)	unitless
CTD_cast	based on CTD log of the cruise	unitless
CTD_bottle	Niskin bottle number	unitless
depth	depth of sample	meters (m)
CTD_comment	Array depth indicates samples were taken at the same depth than all in-situ arrays for e.g. 14C uptake, NO3 uptake and N2 fixation), DEEP indicates samples taken from a deep profile, HIGH_Res indicates samples taken with a finer depth resolution	unitless
date	date of sampling. Date in local time zone (Perth/Australia)	unitless
cycle_day	indicates the Lagrangian cycle number and the day of the cycle (e.g. C1_D2: Cycle 1 Day 2), 'b' indicates a second profile during a day, 'HS' indicates a high resolution sample during a cycle	unitless
cycle_label	Descriptive label for the Lagrangian cycle	unitless
Cycle_number	indicates the number of the Lagrangian cycle	unitless
Day_cycle	indicates the day of the cycle	unitless
Event	indicates the ships event-number - indicating date and hour (UTC) (YYYYMMDD.hhmm.001)	unitless
GPS_Time	indicates the time of CTD rosette deployment (UTC time). 12hour time with AM|PM.	unitless
GPS_DateTime_UTC	Datetime with timezone for the CTD rosette deployment (UTC timezone as Z). ISO 8601 format (24 hr time).	unitless
Instrument	indicates the instrument used	unitless
Action	indicates what was done at that time/day (here deployment)	unitless

Station	(redundant-for plotting purpose) - indicating the cycle and day of cycle	unitless
Latitude	Latitude of sampling	decimal degrees
Longitude	Longitude of sampling	decimal degrees
Seafloor	Seafloor depth as taken from depth sensor.	meters (m)
Author	indicates the scientist who logged the event	unitless
NO3	Nitrate concentration	micromolar (uM)
PO4	Phosphate concentration	micromolar (uM)
SIL	silicic acid concentration	micromolar (uM)
NO2	Nitrite concentration	micromolar (uM)
NH4	Ammonium concentration.	micromolar (uM)
d15N	isotopic (d15N) composition of the N in NO3	permille (0/00)
d18O	isotopic (d18O) composition of O in NO3	permille (0/00)
iso_ID_1	internal identifier 1	unitless
iso_ID_2	internal identifier 2	unitless
iso_ID_3	internal identifier 3	unitless
notes	includes notes from during the cruise and while inspecting samples	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Bottle
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Seal Analytical continuous-flow AutoAnalyzer 3
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	Inorganic nutrients (NO3, NO2, POx, NH4, Si) were measured through UCSD/Scripps. Nutrient analyses are performed on a Seal Analytical continuous-flow AutoAnalyzer 3 (AA3); https://scripps.ucsd.edu/ships/shipboard-technical-support/odf/chemistry.... The detection limits for the methods/instrumentation are (in micro moles/liter): NO3+NO2 = 0.02; PO4 = 0.02; Sil = 0.5; NO2 = 0.02; NH4 = 0.1
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

[table of contents | back to top]

Deployments

RR2201

Website	https://www.bco-dmo.org/deployment/916293
Platform	R/V Roger Revelle
Report	http://hdl.handle.net/1834/43464
Start Date	2022-01-20
End Date	2022-03-14
Description	See more information at R2R: https://www.rvdata.us/search/cruise/RR2201

[table of contents | back to top]

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.

[table of contents | back to top]

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/.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851558
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851347
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851381
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851395
NSF Division of Ocean Sciences (NSF OCE)	OCE-2404504

[table of contents | back to top]