Phytoplankton growth and grazing rates from in situ incubated dilution experiments conducted on cruise RR2201 on R/V Roger Revelle from Jan to Feb 2022 in the Argo Basin region off NW Australia

Website: https://www.bco-dmo.org/dataset/969903
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2025-08-04

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
Landry, Michael R.	University of California-San Diego Scripps (UCSD-SIO)	Principal Investigator
Mickle, Audrey	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains pigment-based rate estimates of phytoplankton growth and microzooplankton grazing from in situ incubated dilution experiments conducted on cruise RR2201 on R/V Roger Revelle (BLOOFINZ-IO, January-February 2022) in the Argo Basin region off NW Australia.

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Coverage

Location: Northwest Australia, Argo Basin, 11-17S, 114-124E, depth 5000m
Spatial Extent: **N**:-15.349 **E**:118.142 **S**:-16.999 **W**:114.192
Temporal Extent: 2022-02-03 - 2022-02-21

Methods & Sampling

Dilution experiments were conducted during four “cycle” experiments on BLOOFINZ cruise RR2201. For each experiment, seawater was collected from Niskin bottles on early-morning CTD hydrocasts (~02:00 local time) at 6 depths in the euphotic zone. For each depth sampled, a two-treatment dilution experiment (Landry et al., 2008, 2011) was prepared, with one polycarbonate bottle (2.7 L) containing unfiltered seawater (100%) and the second (diluted) bottle consisting of ~33% whole seawater with filtered water from the same depth. Seawater was filtered directly from the Niskin bottles using a peristaltic pump, silicone tubing and an in-line 0.2 µm Suporcap (Pall Acro) filter capsule that had previously been acid washed (3.7% trace-metal grade HCl; Milli-Q and seawater rinses). All bottles were secured in coarse net bags clipped to the line of a drogued, satellite-

tracked drifter and incubated *in situ* for 24 h at the depth of collection. Initial and final samples (250 mL) for FlChl*a* were filtered onto GF/F filters and extracted with 90% acetone in a -20°C freezer for 24 h and analyzed on a Turner Designs model 10 fluorometer. Samples (2.3 L) for HPLC analyses of chlorophyll and carotenoid pigments were concentrated onto GF/F filters under low vacuum pressure, immediately frozen in liquid nitrogen and stored at -80°C. The samples were extracted for 2 h in 100% methanol, disrupted by sonication, clarified by GF/F filtration and analyzed (Agilent Technologies 1200 Series) at the analytical facility of the Institut de la Mer de Villefranche (CNRS-France).

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Data Files

File	
969903_v1_rr2201_phytoplankton_growth_grazing.csv	(Comma Separated Values (.csv), 11.50 KB) MD5:bd4eebfa9e81ca34cdbd585a05ba5bfa
Primary data file for dataset ID 969903, version 1	

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Related Publications

Landry, M. R., Brown, S. L., Rii, Y. M., Selph, K. E., Bidigare, R. R., Yang, E. J., & Simmons, M. P. (2008). Depth-stratified phytoplankton dynamics in Cyclone Opal, a subtropical mesoscale eddy. Deep Sea Research Part II: Topical Studies in Oceanography, 55(10-13), 1348–1359. doi:10.1016/j.dsr2.2008.02.001
Methods

Landry, M. R., Selph, K. E., Stukel, M. R., Swalethorp, R., Kelly, T. B., Beatty, J. L., & Quackenbush, C. R. (2021). Microbial food web dynamics in the oceanic Gulf of Mexico. Journal of Plankton Research. doi:10.1093/plankt/fbab021
Methods

Landry, M.R., M.R. Stukel, N. Yingling, K.E. Selph, S. Kranz, C.K. Fender, R. Swalethorp and R. Bhabu. (In review) Microbial food web dynamics in tropical waters of the bluefin tuna spawning region off northwestern Australia. Deep-Sea Res. II.
Results

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

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Parameters

Parameter	Description	Units
Cruise	Cruise experiments were conducted on	unitless
Event	Unique event number in UTC time as YYYYMMDD.mmss.###, where ### distinguishes events entered within the same minute	unitless
ISO_DateTime_UTC	Date and time (UTC) of CTD deployment in ISO 8601 format %Y-%m-%dT%H:%MZ	unitless

Latitude	Latitude (North is positive; South is negative)	decimal degrees
Longitude	Longitude (East is positive; West is negative)	decimal degrees
Cycle_Day	Lagrangian cycle experiments following a drogued drifter are noted as Cycle,Day, e.g., C1,D1, C1,D2, etc.	unitless
CTD_Cast	CTD cast number of initial water collection in Event Log	unitless
Exp	Dilution experiment number	unitless
Depth	Depth (meters) of initial seawater collection and in situ incubation	meters (m)
FLChla_um	Phytoplankton growth rate (per day) based on fluorometric measurement of chlorophyll a	per day (d-1)
FLChla_m	Grazing mortality rate (per day) based on fluorometric measurement of chlorophyll a	per day (d-1)
DVChla_um	Phytoplankton growth rate (per day) based on HPLC measurement of divinyl chlorophyll a	per day (d-1)
DVChla_m	Grazing mortality rate (per day) based on HPLC measurement of divinyl chlorophyll a	per day (d-1)
MVChla_um	Phytoplankton growth rate (per day) based on HPLC measurement of monovinyl chlorophyll a	per day (d-1)
MVChla_m	Grazing mortality rate (per day) based on HPLC measurement of monovinyl chlorophyll a	per day (d-1)
TChla_um	Phytoplankton growth rate (per day) based on HPLC measurement of total chlorophyll a	per day (d-1)
TChla_m	Grazing mortality rate (per day) based on HPLC measurement of total chlorophyll a	per day (d-1)
But_um	Phytoplankton growth rate (per day) based on HPLC measurement of 19′-butanoyloxyfucoxanthin	per day (d-1)
But_m	Grazing mortality rate (per day) based on HPLC measurement of 19′-butanoyloxyfucoxanthin	per day (d-1)

Fuco_um	Phytoplankton growth rate (per day) based on HPLC measurement of fucoxanthin	per day (d-1)
Fuco_m	Grazing mortality rate (per day) based on HPLC measurement of fucoxanthin	per day (d-1)
Hex_um	Phytoplankton growth rate (per day) based on HPLC measurement of 19′-hexanoyloxyfucoxanthin	per day (d-1)
Hex_m	Grazing mortality rate (per day) based on HPLC measurement of 19′-hexanoyloxyfucoxanthin	per day (d-1)

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Instruments

Dataset-specific Instrument Name	drogued, satellite-tracked drifter
Generic Instrument Name	Drifter Buoy
Dataset-specific Description	All bottles were secured in coarse net bags clipped to the line of a drogued, satellite-tracked drifter and incubated in situ for 24 h at the depth of collection.
Generic Instrument Description	Drifting buoys are free drifting platforms with a float or buoy that keep the drifter at the surface and underwater sails or socks that catch the current. These instruments sit at the surface of the ocean and are transported via near-surface ocean currents. They are not fixed to the ocean bottom, therefore they "drift" with the currents. For this reason, these instruments are referred to as drifters, or drifting buoys. The surface float contains sensors that measure different parameters, such as sea surface temperature, barometric pressure, salinity, wave height, etc. Data collected from these sensors are transmitted to satellites passing overhead, which are then relayed to land-based data centers. definition sources: https://mmisw.org/ont/ioos/platform/drifting_buoy and https://www.aoml.noaa.gov/phod/gdp/faq.php#drifter1

Dataset-specific Instrument Name	Turner Designs 10 fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Initial and final samples (250 mL) for FlChla were filtered onto GF/F filters and extracted with 90% acetone in a -20°C freezer for 24 h and analyzed on a Turner Designs model 10 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	High Performance Liquid Chromatography (Agilent Technologies 1200 Series)
Generic Instrument Name	High-Performance Liquid Chromatograph
Dataset-specific Description	The samples were extracted for 2 h in 100% methanol, disrupted by sonication, clarified by GF/F filtration and analyzed (Agilent Technologies 1200 Series) at the analytical facility of the Institut de la Mer de Villefranche (CNRS-France).
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	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	For each experiment, seawater was collected from Niskin bottles on early-morning CTD hydrocasts (~02:00 local time) at 6 depths in the euphotic zone.
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.

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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

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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

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