

Bacteria growth and grazing rates based on flow cytometry cell counts 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/969909>

Data Type: Cruise Results

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
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Abstract

This dataset contains growth and grazing rates of bacteria based on flow cytometry cell counts 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 - 2202-02-21

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 for flow cytometric analyses (1 mL) were preserved with 0.5% paraformaldehyde (v/v) and stored in the dark at 4°C until shipboard analysis, typically within several hours of collection. The samples were first stained with Hoechst 34580 (1 µg mL⁻¹) then enumerated at a flow rate of 50 µL min⁻¹ with a Beckman-Coulter CytoFLEX S cytometer with 4 lasers (Selph, 2021).

Data Processing Description

Growth rate (μ , d⁻¹) and microzooplankton grazing (m , d⁻¹) were calculated from each pair of dilution experiment bottles and population abundances of *Prochlorococcus* (Pro) and heterotrophic bacteria (Hbac) according to the following equations: $m = (k_d - k)/(1 - D)$ and $\mu = k + m$, where k_d and k are the measured net rates of change between initial and final concentrations in the diluted and undiluted treatments, respectively, and D is the portion of unfiltered water in the dilution treatment measured in initial diluted and undilute samples (Landry et al., 2008).

BCO-DMO Processing Description

- Imported "BLOOFINZ-IO_Growth and Grazing of Bacteria from flow cytometry_BCO-DMO Submission_Corrected.xlsx" into the BCO-DMO system
- Converted date to ISO 8601 format YYYY-MM-DD
- Replaced special characters in parameter names
- Exported file as "969909_v1_rr2201_bact_growth_grazing.csv"

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Data Files

File
969909_v1_rr2201_bact_growth_grazing.csv (Comma Separated Values (.csv), 7.74 KB) MD5:ebd58754d1d10196a7970112c2b6fede
Primary data file for dataset ID 969909, 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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1093/plankt/fbab006)

Methods

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Related Datasets

IsRelatedTo

Selph, K. E. (2024) **Abundances of phytoplankton and non-pigmented bacteria determined by flow cytometry from water samples collected on R/V Roger Revelle cruise RR2201 in the Eastern Indian Ocean during February and March 2022**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-09 doi:10.26008/1912/bco-dmo.916288.1 [[view at BCO-DMO](#)]

Relationship Description: The "CTD_Cast" and "Depth" columns in this dataset correspond to the "CTD_Number" and "depth" columns of this related dataset.

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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	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 of initial seawater collection and in situ incubation	meters (m)
Pro_um	Phytoplankton growth rate (per day) based on fluorometric measurement of chlorophyll a	per day (d-1)
Pro_m	Grazing mortality rate (per day) based on fluorometric measurement of chlorophyll a	per day (d-1)
Hbac_um	Phytoplankton growth rate (per day) based on HPLC measurement of divinyl chlorophyll a	per day (d-1)
Hbac_m	Grazing mortality rate (per day) based on HPLC measurement of divinyl chlorophyll a	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	Beckman-Coulter CytoFLEX S flow cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	The samples were first stained with Hoechst 34580 (1 $\mu\text{g mL}^{-1}$) then enumerated at a flow rate of 50 $\mu\text{L min}^{-1}$ with a Beckman-Coulter CytoFLEX S cytometer with 4 lasers (Selph, 2021).
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	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.

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 ^{14}C productivity, N_2 fixation, $^{15}\text{NO}_3^-$ 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), ^{15}N -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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