Mesozooplankton wet, dry, carbon and nitrogen biomass and isotope data collected in the oceanic Gulf of Mexico on R/V Nancy Foster cruises NF1704 and NF1802 in May 2017 and May 2018

Website: https://www.bco-dmo.org/dataset/834967
Data Type: Cruise Results
Version: 2
Version Date: 2024-12-19

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
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Abstract
This dataset is from zooplankton net tows in the Gulf of Mexico on R/V Nancy Foster cruises in May 2017 and May 2018, which were part of a NOAA RESTORE project (aka: BLOOFINZ-GoM) led by Dr. John Lamkin to investigate the epipelagic marine nitrogen cycle, plankton dynamics, and impacts on growth and survival of larval Atlantic Bluefin Tuna (ABT). These data are meant to be used in inter-species, interregional comparisons to data from the BLOOFIN-IO study of larval Southern Bluefin Tuna in the Indian Ocean spawning region. This dataset contains mesozooplankton wet, dry, carbon, and nitrogen biomass.

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Coverage

Spatial Extent: **N**:28.3463 **E**:-84.3171 **S**:24.9727 **W**:-90.1851
Temporal Extent: 2017-05-10 - 2018-05-19

Methods & Sampling

This dataset is from zooplankton net tows in the Gulf of Mexico on R/V Nancy Foster cruises in May 2017 and May 2018, which were part of a NOAA RESTORE project (aka: BLOOFINZ-GoM) led by Dr. John Lamkin to investigate the epipelagic marine nitrogen cycle, plankton dynamics, and impacts on growth and survival of larval Atlantic Bluefin Tuna (ABT). These data are meant to be used in inter-species, interregional comparisons to data from the BLOOFIN-IO study of larval Southern Bluefin Tuna in the Indian Ocean spawning region.

Oblique net tows were taken to obtain estimates of mesozooplankton standing stocks and grazing over the depth range of the euphotic zone. Generally, we sampled during midday (1100-1400 h) and midnight (2200-0100 h) hours following a drogued drifter, allowing estimates of diel vertical migrant biomass by difference. We used a 1-m ring net with 202-µm Nitex mesh and a General Oceanics flow meter to measure volume filtered. Depth of tow was controlled by a depth sensor on the hydrowire. Net tow contents were anesthetized with ice-cold carbonated water and split with a Folsom splitter, with half preserved in 4% buffered formalin and half size-fractionated using nested sieves into five size classes: 0.2-0.5, 0.5-1, 1-2, 2-5 and >5 mm. Each size fraction was concentrated on a preweighed 202-m Nitex filter, rinsed with isotonic ammonium formate to remove sea salt, and frozen at -85°C for lab analysis.

In the laboratory, frozen size-fractioned zooplankton on the Nitex filters were thawed, set briefly on blotting paper to remove excess water, and weighed moist for total sample wet weight (WW). Wet samples were subsampled for gut pigment analyses by removing replicate portions of the biomass and recording weights before and after each subsampling (fraction of total WW removed). The remaining wet biomass on the filters was oven dried at 60°C for 24 h before weighing dry (DW:WW ratio). For each size fraction, zooplankton dry weight (mg m-2) was calculated from the measured WW (less initial filter weight), DW:WW ratio, measured volume and depth of tow, and fraction of sample analyzed. The remaining dried sample was subsequently scraped off the filter, ground to a power with a mortar and pestle, and subsampled by weight for carbon (C), nitrogen (N) and stable isotope (13C and 15N) analyses.

CN subsamples were weighed in small tin boats, packed into pellets, and analyzed by standard elemental analyzer, isotope ratio mass spectrometry (EA-IRMS) at the Isotope Biogeochemistry lab at Scripps Institution of Oceanography. The continuous flow system consisted of a Perkin Elmer CHN analyzer coupled to a Thermo/Finnigan Delta Plus IRMS. Acetanilide was used as the standard for instrument stability for both elemental and isotopic measurements on every run. C and N biomass estimates (mg m-2) were computed for each size fraction from C:DW and N:DW ratios. Stable isotope values are reported in standard delta (‰) notation relative to atmospheric N2 and Vienna Pee Dee Belemnite for carbon.

Data Processing Description

Data Processing:
For tow 15, size classes 0.5-1 and 1-2mm were combined. Biomass is partitioned between those size classes based on the mean for daytime tows during the NF1704 cruise

BCO-DMO Processing:
- renamed fields;
- added date/time field in ISO8601 format;
- converted Long from positive degrees west to negative degrees east.

Version History:
2021-01-11 - version 1 of dataset published with DOI.
2024-12-19 - version 2 of dataset published with DOI; this version includes a correction to the dry weight parameters. They were previously described as having units of "grams dry weight per square meter (g DW m-2)", which is not correct. The dry weight units are milligrams dry weight per square meter (mg DW m-2).

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Data Files

File
mesozoo_biomass.csv (Comma Separated Values (.csv), 14.55 KB) MD5:14733191dc0289ec0cd9143f8eaf0062   Primary data file for dataset ID 834967

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Related Publications

Landry, M. R., & Swalethorp, R. (2021). Mesozooplankton biomass, grazing and trophic structure in the bluefin tuna spawning area of the oceanic Gulf of Mexico. Journal of Plankton Research, 44(5), 677–691. https://doi.org/10.1093/plankt/fbab008
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Tow_ID	Tow identifier	unitless
Station	Station number	unitless
Cycle	Cycle number; each cycle is a multi-day experiment following a satellite tracked drifter.	unitless
Date	Date (Central Standard (GMT-6)); format: MM/DD/YYYY	unitless
Month	2-digit month of year	unitless
Day	2-digit day of month	unitless
Year	4-digit year	unitless
Julian_Day	Julian day	unitless
Lat	Latitude	degrees North
Long	Longitude	degrees East
Day_Night	Day or night indicator: 1 = day, 2 = night	unitless
Time_IN	Time in (Central Standard (GMT-6)); format: HH:MM:SS AM/PM	unitless
ISO_DateTime_Local	Date and time in formatted to ISO8601 standard (Central Standard (GMT-6)); format: YYYY-MM-DDThh:mm:ss	unitless
Tow_Duration	Tow duration; format: HH:MM	unitless

Depth	Depth	meters
Vol	Sample volume	cubic meters
WW_0d2_0d5_mm	Wet weight of the 0.2-0.5mm size class	grams wet weight per square meter (g WW m-2)
WW_0d5_1_mm	Wet weight of the 0.5-1mm size class	grams wet weight per square meter (g WW m-2)
WW_1_2_mm	Wet weight of the 1-2mm size class	grams wet weight per square meter (g WW m-2)
WW_2_5_mm	Wet weight of the 2-5mm size class	grams wet weight per square meter (g WW m-2)
WW_gt_5_mm	Wet weight of the >5mm size class	grams wet weight per square meter (g WW m-2)
WW_TOTAL	Total wet weight	grams wet weight per square meter (g WW m-2)
DW_0d2_0d5_mm	Dry weight of the 0.2-0.5mm size class	milligrams dry weight per square meter (mg DW m-2)
DW_0d5_1_mm	Dry weight of the 0.5-1mm size class	milligrams dry weight per square meter (mg DW m-2)
DW_1_2_mm	Dry weight of the 1-2mm size class	milligrams dry weight per square meter (mg DW m-2)
DW_2_5_mm	Dry weight of the 2-5mm size class	milligrams dry weight per square meter (mg DW m-2)
DW_gt_5_mm	Dry weight of the >5mm size class	milligrams dry weight per square meter (mg DW m-2)
DW_TOTAL	Total dry weight	milligrams dry weight per square meter (mg DW m-2)
C_0d2_0d5_mm	Carbon biomass of the 0.2-0.5mm size class	milligrams carbon per square meter (mg C m-2)
C_0d5_1_mm	Carbon biomass of the 0.5-1mm size class	milligrams carbon per square meter (mg C m-2)
C_1_2_mm	Carbon biomass of the 1-2mm size class	milligrams carbon per square meter (mg C m-2)
C_2_5_mm	Carbon biomass of the 2-5mm size class	milligrams carbon per square meter (mg C m-2)
C_gt_5_mm	Carbon biomass of the >5mm size class	milligrams carbon per square meter (mg C m-2)

C_TOTAL	Total Carbon biomass	milligrams carbon per square meter (mg C m-2)
N_0d2_0d5_mm	Nitrogen biomass of the 0.2-0.5mm size class	milligrams nitrogen per square meter (mg N m-2)
N_0d5_1_mm	Nitrogen biomass of the 0.5-1mm size class	milligrams nitrogen per square meter (mg N m-2)
N_1_2_mm	Nitrogen biomass of the 1-2mm size class	milligrams nitrogen per square meter (mg N m-2)
N_2_5_mm	Nitrogen biomass of the 2-5mm size class	milligrams nitrogen per square meter (mg N m-2)
N_gt_5_mm	Nitrogen biomass of the >5mm size class	milligrams nitrogen per square meter (mg N m-2)
N_TOTAL	Total Nitrogen biomass	milligrams nitrogen per square meter (mg N m-2)
C_N_0d2_0d5_mm	C:N ratio of the 0.2-0.5mm size class	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
C_N_0d5_1_mm	C:N ratio of the 0.5-1mm size class	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
C_N_1_2_mm	C:N ratio of the 1-2mm size class	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
C_N_2_5_mm	C:N ratio of the 2-5mm size class	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
C_N_gt_5_mm	C:N ratio of the >5mm size class	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
C_N_TOTAL	Total C:N ratio	milligrams carbon per milligram nitrogen (mg C (mg N)-1)
d13C_0d2_0d5_mm	Bulk 13C isotopic value (d13C) of the 0.2-0.5mm size class	delta 13C (‰)
d13C_0d5_1_mm	Bulk 13C isotopic value (d13C) of the 0.5-1mm size class	delta 13C (‰)
d13C_1_2_mm	Bulk 13C isotopic value (d13C) of the 1-2mm size class	delta 13C (‰)
d13C_2_5_mm	Bulk 13C isotopic value (d13C) ratio of the 2-5mm size class	delta 13C (‰)
d13C_gt_5_mm	Bulk 13C isotopic value (d13C) ratio of the >5mm size class	delta 13C (‰)

d15N_0d2_0d5_mm	Bulk 15N isotopic value (d15N) of the 0.2-0.5mm size class	delta 15N (‰)
d15N_0d5_1_mm	Bulk 15N isotopic value (d15N) of the 0.5-1mm size class	delta 15N (‰)
d15N_1_2_mm	Bulk 15N isotopic value (d15N) of the 1-2mm size class	delta 15N (‰)
d15N_2_5_mm	Bulk 15N isotopic value (d15N) ratio of the 2-5mm size class	delta 15N (‰)
d15N_gt_5_mm	Bulk 15N isotopic value (d15N) ratio of the >5mm size class	delta 15N (‰)

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Instruments

Dataset-specific Instrument Name	Perkin Elmer CHN analyzer
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	The continuous flow system consisted of a Perkin Elmer CHN analyzer coupled to a Thermo/Finnigan Delta Plus IRMS.
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

Dataset-specific Instrument Name	General Oceanics flow meter
Generic Instrument Name	Flow Meter
Dataset-specific Description	We used a 1-m ring net with 202-µm Nitex mesh and a General Oceanics flow meter to measure volume filtered.
Generic Instrument Description	General term for a sensor that quantifies the rate at which fluids (e.g. water or air) pass through sensor packages, instruments, or sampling devices. A flow meter may be mechanical, optical, electromagnetic, etc.

Dataset-specific Instrument Name	Folsom splitter
Generic Instrument Name	Folsom Plankton Splitter
Dataset-specific Description	Net tow contents were anesthetized with ice-cold carbonated water and split with a Folsom splitter.
Generic Instrument Description	A device for sub-sampling of plankton and ichthyoplankton samples by splitting, developed by Dr. Folsom of the Scripps Institute of Oceanography. Ideally suited for splitting plankton samples with minimal debris. A measured volume of plankton sample is placed in the undivided section of the drum. This is rotated 120 degrees to divide the stirred sample with a separating blade. Standard Methods suggests splitting until a subsample of 200-500 individuals is obtained.

Dataset-specific Instrument Name	Thermo/Finnigan Delta Plus IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The continuous flow system consisted of a Perkin Elmer CHN analyzer coupled to a Thermo/Finnigan Delta Plus IRMS.
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	1-m ring net
Generic Instrument Name	Ring Net
Dataset-specific Description	We used a 1-m ring net with 202-µm Nitex mesh and a General Oceanics flow meter to measure volume filtered.
Generic Instrument Description	A Ring Net is a generic plankton net, made by attaching a net of any mesh size to a metal ring of any diameter. There are 1 meter, .75 meter, .25 meter and .5 meter nets that are used regularly. The most common zooplankton ring net is 1 meter in diameter and of mesh size .333mm, also known as a 'meter net' (see Meter Net).

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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.

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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)	NA15OAR4320071

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