

Net primary production by H13CO3- uptake from in-situ incubations conducted during R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Maine in May of 2017 and 2018

Website: <https://www.bco-dmo.org/dataset/836209>

Data Type: Cruise Results, experimental

Version: 1

Version Date: 2021-01-14

Project

» [Collaborative Research: Mesoscale variability in nitrogen sources and food-web dynamics supporting larval southern bluefin tuna in the eastern Indian Ocean](#) (BLOOFINZ-IO)

» [Effects of Nitrogen Sources and Plankton Food-Web Dynamics on Habitat Quality for the Larvae of Atlantic Bluefin Tuna in the Gulf of Mexico](#) (GoMex Tuna Foodweb B)

Program

» [Second International Indian Ocean Expedition](#) (IIOE-2)

Contributors	Affiliation	Role
Stukel, Michael	Florida State University (FSU)	Principal Investigator
Kelly, Thomas	Florida State University (FSU)	Co-Principal Investigator

Abstract

Net primary production by H13CO3- uptake from in-situ incubations conducted during R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Maine in May of 2017 and 2018.

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Coverage

Spatial Extent: N:28.3358 E:-87.3032 S:25.7211 W:-90.1779

Temporal Extent: 2017-05-11 - 2018-05-18

Dataset Description

In addition to the funding sources listed in the "Funding Source" section, this dataset was partially funded by:

National Oceanic and Atmospheric Administration's RESTORE Program Grant (Project Title: Effects of nitrogen sources and plankton food-web dynamics on habitat quality for the larvae of Atlantic bluefin tuna

in the Gulf of Mexico) under federal funding opportunity NOAA-NOS-NCCOS-2017-2004875, including NOAA JIMAR Cooperative Agreement, award #NA16NMF4320058, NOAA CIMAS Cooperative Agreement, award #NA15OAR4320064, and NOAA CIMEAS Cooperative Agreement, award #NA15OAR4320071.

Acquisition Description

Methodology:

Net primary productivity (NPP) rates were measured at 6 depths spanning the euphotic zone (surface to deep chlorophyll maximum). Four incubation bottles (2.7 L) per depth were filled from Niskin rosettes (three light bottles, one dark bottle). All bottles were spiked with $\text{H}^{13}\text{CO}_3^-$ (final concentration of 154 or 196 $\mu\text{mol L}^{-1}$ on NF17 and NF18, respectively). Two light bottles were spiked with $^{15}\text{NO}_3^-$ (final concentration of 10 or 8 nmol L^{-1} on NF17 and NF18, respectively) for nitrate uptake rate measurements. Bottles were then incubated for 24 h on an in situ incubation array (Landry et al. 2009). Upon recovery, incubations were immediately vacuum filtered onto pre-combusted 25-mm GF/F filters in the dark. Filters were rinsed with filtered seawater, wrapped in foil and stored at 80°C. On land, samples were fumigated with HCl vapor to remove inorganic carbon, dried, and placed inside a tin cup for C/N and isotopic analysis at the UC Davis stable isotope facility. Because no statistically significant difference in $\text{H}^{13}\text{CO}_3^-$ uptake were detected between bottles spiked with $^{15}\text{NO}_3^-$ and those without, NPP is reported as the average of the $\text{H}^{13}\text{CO}_3^-$ uptake in the three light bottles corrected for dark bottle $\text{H}^{13}\text{CO}_3^-$ uptake. For additional details, see Yingling et al. (submitted).

Sampling and Analytical Procedures:

Net primary productivity (NPP) rates were measured at 6 depths spanning the euphotic zone (surface to deep chlorophyll maximum). Four incubation bottles (2.7 L) per depth were filled from Niskin rosettes (three light bottles, one dark bottle). All bottles were spiked with $\text{H}^{13}\text{CO}_3^-$ (final concentration of 154 or 196 $\mu\text{mol L}^{-1}$ on NF17 and NF18, respectively). Two light bottles were spiked with $^{15}\text{NO}_3^-$ (final concentration of 10 or 8 nmol L^{-1} on NF17 and NF18, respectively) for nitrate uptake rate measurements. Bottles were then incubated for 24 h on an in situ incubation array (Landry et al. 2009). Upon recovery, incubations were immediately vacuum filtered onto pre-combusted 25-mm GF/F filters in the dark. Filters were rinsed with filtered seawater, wrapped in foil and stored at 80°C. On land, samples were fumigated with HCl vapor to remove inorganic carbon, dried, and placed inside a tin cup for C/N and isotopic analysis at the UC Davis stable isotope facility. Because no statistically significant difference in $\text{H}^{13}\text{CO}_3^-$ uptake were detected between bottles spiked with $^{15}\text{NO}_3^-$ and those without, NPP is reported as the average of the $\text{H}^{13}\text{CO}_3^-$ uptake in the three light bottles corrected for dark bottle $\text{H}^{13}\text{CO}_3^-$ uptake. For additional details, see Yingling et al. (submitted).

Processing Description

BCO-DMO Data Manager Processing Notes:

- * Data in original excel file "Net Primary Production.xlsx" exported as csv with the formatting that was set in Excel.
- * modified parameter names to conform with BCO-DMO naming conventions: only A-Za-z0-9 and underscore allowed. Can not start with a number. (spaces, +, and - changed to underscores).
- * Converted Date format to ISO 8601 format yyyy-mm-dd

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Related Publications

Landry, M. R., Ohman, M. D., Goericke, R., Stukel, M. R., & Tsyklevich, K. (2009). Lagrangian studies of phytoplankton growth and grazing relationships in a coastal upwelling ecosystem off Southern California.

Methods

Yingling, N., Kelly, T. B., Selph, K. E., Landry, M. R., Knapp, A. N., Kranz, S. A. and Stukel, M. R. (2021) Taxon-specific phytoplankton growth, nutrient limitation, and light limitation in the oligotrophic Gulf of Mexico. J. Plank. Res. pre-print doi: [10.1101/2021.03.01.433426](https://doi.org/10.1101/2021.03.01.433426)

Results

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Parameters

Parameter	Description	Units
Cruise	Name of cruise	unitless
Cycle	Lagrangian Experiment Number	unitless
Date	Date of collection and incubation	unitless
Cast	CTD-Niskin rosette cast number	unitless
lon	Longitude	decimal degrees
lat	Latitude	decimal degrees
Depth	Depth	meters (m)
NPP	Primary productivity	micromoles of carbon per liter per day ($\mu\text{mol C L}^{-1} \text{d}^{-1}$)
st_dev	Standard deviation of replicated primary production measurements.	micromoles of carbon per liter per day ($\mu\text{mol C L}^{-1} \text{d}^{-1}$)

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Instruments

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	
Generic Instrument Name	CTD profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column and permits scientists observe the physical properties in real time via a conducting cable connecting the CTD to a deck unit and computer on the ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This instrument designation is used when specific make and model are not known.

Dataset-specific Instrument Name	PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	PDZ Europa ANCA-GSL elemental analyzer interfaced to a PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK). C/N and isotopic analysis at the UC Davis stable isotope facility.
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	PDZ Europa ANCA-GSL elemental analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	PDZ Europa ANCA-GSL elemental analyzer interfaced to a PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK). C/N and isotopic analysis at the UC Davis stable isotope facility.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

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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 ^{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.

Effects of Nitrogen Sources and Plankton Food-Web Dynamics on Habitat Quality for the Larvae of Atlantic Bluefin Tuna in the Gulf of Mexico (GoMex Tuna Foodweb B)

Coverage: Gulf of Mexico

Amendment #136: Current stock assessments for the Gulf of Mexico require better ecosystem understanding to effectively evaluate how bottom-up processes limit or enhance Atlantic Bluefin Tuna recruitment. The objective of this proposal is to elucidate the underlying mechanisms that link variability in nitrogen sources and food-web fluxes in the Gulf of Mexico to habitat quality, feeding, growth and survival for Atlantic Bluefin Tuna larvae. This proposal addresses the Program Priority: Comprehensive understanding of living coastal and marine resources, food web dynamics, habitat utilization, protected areas, and carbon flows, specifically "(d) Food web structure and dynamics, trophic linkages, and/or predator-prey relationships, especially projects that develop and/or apply new techniques or technologies".

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/>.

Funding

Funding Source	Award
National Oceanic and Atmospheric Administration (NOAA)	NA16NMF4320058
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851347

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