Sediment trap carbon, nitrogen, and isotope, pigment, and 234Th flux from deployments 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/836216
Data Type: Cruise Results
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
Sediment trap carbon, nitrogen, and isotope, pigment, and 234Th flux from deployments during R/V Nancy Foster cruises NF1704 and NF1802 in the Gulf of Maine in May of 2017 and 2018.

Table of Contents

Coverage

Spatial Extent: **N**:28.36 **E**:-87.22 **S**:25.43 **W**:-90.19
Temporal Extent: 2017-05-10 - 2018-05-14

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:

Data comes from VERTEX-style, surface-tethered, drifting sediment trap deployments. Particle interceptor tubes were deployed on cross-pieces with 8 tubes attached. Tubes were deployed with a dense formaldehyde brine created by adding NaCl and formaldehyde to filtered seawater. After recovery, overlying seawater was removed from each cruise by gentle suction. Tubes were then gravity filtered through a 100-micron nitex mesh filter, and the 100-micron filters were carefully analyzed under a stereomicroscope and all metazoan zooplankton "swimmers" were removed from the sample. Material remaining on the 100-micron filters (i.e., sinking material) was then imaged with a macrophotography rig and subsequently rinsed back into the original sample tube (i.e., re-combined with the <100-micron sinking material). Samples were then separated and filtered onto different types of filters for a suite of different analyses including: particulate organic carbon flux, particulate nitrogen flux, carbon and nitrogen isotopes, chlorophyll *a* and phaeopigment flux, and 234Th flux.

Sampling and analytical procedures:

Samples for particulate organic carbon flux were vacuum filtered through pre-combusted GF/F filters at low pressure. Samples were then frozen at -80C and stored for the duration of the cruise. They were then dried out for shipping. On land they were acidified by fuming with HCl. Samples were then thoroughly dried and packed into pre-combusted tin cups. They were analyzed by isotope ratio mass spectrometer at the UC Davis Stable Isotope Facility for carbon, nitrogen, carbon isotopes, and nitrogen isotopes.

Samples for Chl a and phaeopigments were filtered onto GF/F filters, extracted in acetone, and analyzed by the acidification method using a Turner 10-AU fluorometer.

Samples for 234Th were filtered onto quartz (QMA) filters, mounted in RISO filter holders, and analyzed using a low-background RISO beta multi-counter.

Processing Description

BCO-DMO Data Manager Processing Notes:
* Data in original excel file "SedTrap.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

[table of contents | back to top]

Related Publications

Stukel, M. R., Kelly, T. B., Landry, M. R., Selph, K. E., & Swalethorp, R. (2021). Sinking carbon, nitrogen, and pigment flux within and beneath the euphotic zone in the oligotrophic, open-ocean Gulf of Mexico. Journal of Plankton Research. doi:10.1093/plankt/fbab001
Results

Parameters

Parameter	Description	Units
Cruise	Name of cruise	unitless
Cycle	Lagrangian Experiment Number	unitless
Depth	Depth	meters (m)
Date_Deployed	Deployment date and time in format %m/%d/%y %H:%M (e.g. 5/13/17 12:50). Local time zone varies between US/Eastern and US/Central over the course of this dataset.	unitless
Date_Recovered	Recovery date and time in format %m/%d/%y %H:%M (e.g. 5/13/17 12:50). Local time zone varies between US/Eastern and US/Central over the course of this dataset.	unitless
Duration	Duration of deployment in decimal days.	days
Deployment_Lat	Latitude of deployment	decimal degrees
Deployment_Lon	Longitude of deployment	decimal degrees
Recovery_Lat	Latitude of recovery	decimal degrees
Recovery_Lon	Longitude of recovery	decimal degrees
C_org	Particulate organic carbon flux	milligrams of carbon per square meter per day (mg C m-2 d-1)
Sigma_C_org	Standard deviation of replicated organic carbon flux measurements	milligrams of carbon per square meter per day (mg C m-2 d-1)
N_org	Particulate nitrogen flux	milligrams of nitrogen per square meter per day (mg N m-2 d-1)
Sigma_N_org	Standard deviation of replicated nitrogen flux measurements	milligrams of nitrogen per square meter per day (mg N m-2 d-1)
d13C	d13C of sinking particles	per mil (0/00)
Sigma_d13C	Standard deviation of replicated d13C of sinking particle measurements	per mil (0/00)
d15N	d15N of sinking particles	per mil (0/00)
Sigma_d15N	Standard deviation of replicated d15N of sinking particle measurements.	per mil (0/00)
Chl	Chlorophyll Flux (Chl a)	milligrams of chlorophyll a per square meter per day (mg Chl a m-2 d-1)
Sigma_Chl	Standard deviation of replicated chlorophyll flux (Chl a) measurements.	milligrams of chlorophyll a per square meter per day (mg Chl a m-2 d-1)

Phaeo	Phaeopigment flux	milligrams of Chl a equivalents per square meter per day (mg Chl a m-2 d-1)
Sigma_Phaeo	Standard deviation of replicated phaeopigment flux measurements.	milligrams of Chl a equivalents per square meter per day (mg Chl a m-2 d-1)
Th234	Thorium234 (234Th) flux	disintegrations per minute per square meter per day (dpm m-2 d-1)
Sigma_Th234	Standard deviation of replicated thorium234 (234Th) flux measurements	disintegrations per minute per square meter per day (dpm m-2 d-1)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Turner Designs Fluorometer 10-AU
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer. (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA)

Dataset-specific Instrument Name	
Generic Instrument Name	Sediment Trap
Dataset-specific Description	VERTEX-style, surface-tethered, drifting sediment trap deployments.
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

Dataset-specific Instrument Name	low-background RISO beta multi-counter
Generic Instrument Name	GM multicounter
Generic Instrument Description	A gas flow multicounter (GM multicounter) is used for counting low-level beta doses. GM multicounters can be used for gas proportional counting of 32Si to 32P. For more information about GM multicounter usage see Krause et. al. 2011 .

[table of contents | back to top]

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).

[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.

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".

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

[table of contents | back to top]