Larval fish counts and larval tuna counts with corresponding plankton net type and geographic coordinates from R/V Roger Revelle cruise RR2201 (BLOOFINZ-IO, January-March 2022) in the Argo Basin region off NW Australia

Website: https://www.bco-dmo.org/dataset/958726
Data Type: Cruise Results
Version: 1
Version Date: 2025-05-05

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
Malca, Estrella	University of Miami	Principal Investigator
Die, David J.	University of Miami	Co-Principal Investigator
Laiz Carrion, Raul	Spanish Institution of Oceanography	Scientist
Quintanilla, Jose Maria	Spanish National Research Council (IEO-CSIC)	Scientist
Carr, Madeline	University of Miami	Student
Feltz, Amy	University of Miami	Student
Jivanjee, Alejandro A.	University of Miami	Student
Lashley, Crawford Lewis	University of Miami	Student
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains larval fish counts and larval tuna counts with corresponding plankton net type and geographic coordinates from cruise RR2201 of R/V Roger Revelle (BLOOFINZ-IO, January-March 2022) in the Argo Basin region off northwestern Australia.

Table of Contents

Coverage

Location: Northwest Australia, Argo Basin

Spatial Extent: **N**:-13.002801 **E**:121.502794 **S**:-17.17 **W**:113.9674
Temporal Extent: 2022-01-31 - 2022-03-02

Methods & Sampling

Larval tuna sampling was done by three net systems fished in the upper 25-30 meters (m) of the water column. The main gear utilized was the Bongo90. Standard larval sampling was done with 10-minute (~2 knots) oblique hauls in the upper 25 m of the water column using a dual 90-centimeter (cm) diameter bongo frame with 505-micrometer (µm) mesh nets (Laiz-Carrion et al., 2015). Filtered volumes were calculated with mechanical flowmeters (2030R, General Oceanics Inc.) centered in each net mouth. Bongo90 tows were generally done with a smaller "mini-bongo" net (20-cm diameter mouth; 200 and 50-µm mesh nets with flowmeters) attached above the larger nets to sample zooplankton prey (Shiroza et al., 2021). A second net, the 'Black Widow' was the name given to a modified Bongo90 frame with black-dyed nets (1000 µm mesh), was towed at higher speed at night with a depressor (and without the mini-bongo) to collect larger, more evasive larvae. The Black Widow net was lost due to a break in the Kevlar line on tow 54 (Cycle 2, 9 February).The third net utilized was the neuston net. The neuston was a square single-frame coarse-mesh net (1 square meter, with 1000-µm mesh) that was towed at the sea surface. Although operated at lower speed (≤2 kts) than the Black Widow, it was also successful in collecting larger larvae after the widow was lost.

Freshly collected samples (one side of the bongo net collections or the Neuston) were put on ice and live sorted and sized to species and developmental stage (preflexion, flexion, postflexion) at-sea following Richards et al., 2005. Sorted specimens were numbered and either frozen or EtOH preserved in individual vials for later analyses of gut contents (feeding), otolith microstructure (growth), and isotopic composition (trophic position). The second sides of bongo net collections were preserved whole by a multi-step process that replaced residual water with (ethyl ethanol 95%, EtOH) after 24 hours. Shipboard sorting yielded over 3700 larval tuna specimens, dominated (~86%) by southern bluefin tuna (SBT, *Thunnus maccoyii)* which were most abundant along the southern margin of the Argo Basin compared to the central basin. Yellowfin tuna (YFT, *T. albacares*) was second in relative abundance (~7%), and the remainder were relatively equally divided among T. albacore tuna (ALB, T*. alalunga*), big eye tuna (BET, *T. obesus),* and skipjack tuna (SKJ, *Katsuwonus pelamis)*. A mass of freshly spawned eggs sampled on one occasion and subsequently confirmed to be SBT by genetic analysis will be important in isotopic interpretation of larval trophic position by providing a correction for the maternal contribution.

Laboratory analysis at the University of Miami was conducted by first measuring plankton displacement volume and wet weight of plankton samples. Next, the preservative (EtOH) was buffered by adding 125 milliliters (mL) of Tris buffer to a 5-gallon carboy. All plankton jars were transferred into buffered EtOH, and subsequent vials contained buffered EtOH. Next, a thorough examination of the right side (R) Bongo90 plankton samples was conducted under 0.63 - 4x magnification using a stereomicroscope to make sure that shipboard sorting did not miss any scombrid larvae. All larval fish were removed from a subset (n=67) of tows and from a 1/4 aliquot split (n=21) of Bongo90 samples. Scombrid larvae were identified to the lowest taxonomic level possible, and were labelled as '*Thunnus Sp.*' when species-level identification was not possible. Scombrid larvae were removed from an additional 38 sets of tows without removing other taxa to expedite sample processing of scombrid larvae for collaborative projects.

Over 2400 *Thunnus* larvae were individually examined, assigned a developmental stage, and given a unique identification number; a subset (n=480) was measured and photographed. Larval scombrids were shipped to collaborators for stomach content identification, prey preference analysis, otolith removal for ageing, genetics (PCR multiplex-identification, genome mapping), isotope analysis, and compound-specific isotope analysis.

Data Processing Description

Larval counts were logged in a datasheet and uploaded to a central database in Excel. Quality control was performed multiple times at each step of the lab data collection process.

BCO-DMO Processing Description

- Imported original file "OCE-1851395_Malca_Larvaltunacounts.xlsx" into the BCO-DMO system.
- Created columns for date and time from the Event_No column.

- Created column for date-time (UTC) in ISO8601 format.
- Saved the final file as "958726_v1_bloofinz-io_larval_tuna_counts_and_abundances.csv".
(Note that in the final file, missing data or N/A data are blank/empty.)

Problem Description

At sea, the cNODE transponder (MINI34) was not a reliable depth recorder; therefore, live-depth measurements were not possible. The Black Widow was lost due to the kevlar wire breaking, it was replaced by the Neuston net that had a similar mesh size.

[table of contents | back to top]

Data Files

File	
958726_v1_bloofinz-io_larval_tuna_counts_and_abundances.csv	(Comma Separated Values (.csv), 33.50 KB) MD5:22bc7a1ca113def3046983b936babd5c
Primary data file for dataset ID 958726, version 1	

[table of contents | back to top]

Related Publications

Laiz-Carrión, R., Gerard, T., Uriarte, A., Malca, E., Quintanilla, J. M., Muhling, B. A., Alemany, F., Privoznik, S. L., Shiroza, A., Lamkin, J. T., & García, A. (2015). Correction: Trophic Ecology of Atlantic Bluefin Tuna (Thunnusthynnus) Larvae from the Gulf of Mexico and NW Mediterranean Spawning Grounds: A Comparative Stable Isotope Study. PLOS ONE, 10(9), e0138638. https://doi.org/10.1371/journal.pone.0138638
Methods

Nishikawa, Y., Rimmer, D. W., & CSIRO Marine Laboratories. (1987). Identification of larval tunas, billfishes and other scombroid fishes (Suborder Scombroidei): an illustrated guide. Commonwealth Scientific and Industrial Research Organisation, Marine Research Laboratories. https://isbnsearch.org/isbn/0643042938
Methods

Richards, W. J. (Ed.). (2005). Early Stages of Atlantic Fishes. https://doi.org/10.1201/9780203500217
Methods

Shiroza, A., Malca, E., Lamkin, J. T., Gerard, T., Landry, M. R., Stukel, M. R., Laiz-Carrión, R., & Swalethorp, R. (2021). Active prey selection in developing larvae of Atlantic bluefin tuna (Thunnus thynnus) in spawning grounds of the Gulf of Mexico. Journal of Plankton Research, 44(5), 728–746. https://doi.org/10.1093/plankt/fbab020
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Event_No	Event number from event logger on Roger Revelle	unitless
ISO_DateTime_UTC	Date and time (UTC) in ISO 8601 format	unitless

Date	Date	unitless
Time	Time (UTC)	unitless
Latitude	Decimal latitude	decimal degrees
Longitude	Decimal latitude	decimal degrees
Tow	Tuna team tow number 001-189 in sequential order	unitless
Net_Type	Type of net: Bongo90 (0.90 x 0.90 cm), Widow (0.9 x 0.9 cm), or Neuston (1m2)	unitless
Mesh	Mesh size: 505 or 1000	microns
Side	Right, R or Left, L. Neustons will have a blank side.	unitless
Tow_Depth	Maximum depth of Net_type	meters (m)
Tow_Vol	Volume filtered by net calculated by multiplying mouth area x flowmeter counts x constant	cubic meters (m3)
Sample_ID	Unique six digit identifier for Net_Type	unitless
Cycle	RR2201 experimental cycles 1-4	unitless
Sample_Status	"Tunas (ship)" indicates that all Scombrid (Tuna family) were counted aboard the ship; "Tunas (ship, lab)" indicates that all Scombrids were counted first aboard the sihp and completed in the lab; "All (ship,lab)" indicates all fish larvae counted in 100% of sample starting on the ship and completed in the lab; "All (ship, lab 1/4)" indicates tunas were counted and removed on the ship and the lab while all other larval fish were counted in 1/4 of the sample in lab.	unitless
SBT_Count	Southern bluefin tuna (SBT) Thunnus maccoyii counts	individuals
ALB_Count	Albacore tuna (ALB) Thunnus alalunga counts	individuals
YFT_Count	Yellowfin tuna (YFT) Thunnus albacares counts	individuals
BET_Count	Bigeye tuna (BET) Thunnus obesus counts	individuals

Thun_Count	Scombridae larvae, tunas identified to genus level only, Thunnus Sp.	individuals
SKJ_Count	Skipjack tuna (SKJ) Katsuwonus pelamis counts	individuals
Tuna_Count	Scombridae (tuna) counts, includes all larvae from the genus Thunnus and Katsuwonus	individuals
Fish_Count	Larval fish counts, "lab 1/4" are counts x 4	individuals
SBT_1000m3	SBT_Count / Tow_Vol x 1000	individuals per 1000 cubic meters
ALB_1000m3	ALB_Count / Tow_Vol x 1000	individuals per 1000 cubic meters
YFT_1000m3	YFT_Count / Tow_Vol x 1000	individuals per 1000 cubic meters
BET_1000m3	BET_Count / Tow_Vol x 1000	individuals per 1000 cubic meters
Thun_1000m3	Thun_Count / Tow_Vol x 1000	individuals per 1000 cubic meters
SKJ_1000m3	SKJ _Count / Tow_Vol x 1000	individuals per 1000 cubic meters
Tuna_1000m3	Tuna _Count / Tow_Vol x 1000	individuals per 1000 cubic meters
Fish_1000m3	Fish _Count / Tow_Vol x 1000	individuals per 1000 cubic meters

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Bongo90
Generic Instrument Name	Bongo Net
Dataset-specific Description	Bongo90 (a dual 90-cm diameter bongo frame with 505-µm mesh nets) and 'Black Widow', a modified Bongo90 frame with black-dyed nets with 1000 µm mesh.
Generic Instrument Description	A Bongo Net consists of paired plankton nets, typically with a 60 cm diameter mouth opening and varying mesh sizes, 10 to 1000 micron. The Bongo Frame was designed by the National Marine Fisheries Service for use in the MARMAP program. It consists of two cylindrical collars connected with a yoke so that replicate samples are collected at the same time. Variations in models are designed for either vertical hauls (OI-2500 = NMFS Pairovet-Style, MARMAP Bongo, CalVET) or both oblique and vertical hauls (Aquatic Research). The OI-1200 has an opening and closing mechanism that allows discrete "known-depth" sampling. This model is large enough to filter water at the rate of 47.5 m3/minute when towing at a speed of two knots. More information: Ocean Instruments, Aquatic Research, Sea-Gear

Dataset-specific Instrument Name	mechanical flowmeters (2030R, General Oceanics Inc.)
Generic Instrument Name	Mechanical Flowmeter
Dataset-specific Description	The Bongo90, Black Widow, and the Neuston net had mechanical flowmeters (2030R, General Oceanics Inc.) centered in the middle to measure the amount of water filtered by each net.
Generic Instrument Description	Manufactured by General Oceanics, a mechanical flow meter is used with plankton tows to determine the volume of water which flows through the net. Flow meters are also used in rivers, estuaries, canals, sewer outfalls, pipes, and harbor entrances to determine water velocity and flow distance information.

Dataset-specific Instrument Name	neuston net
Generic Instrument Name	Neuston Net
Dataset-specific Description	the neuston was a square single-frame coarse-mesh net (1 m2, with 1000-µm mesh)
Generic Instrument Description	Neuston Nets are nets that collect zooplankton that live in the top few centimeters of the sea surface (the neuston layer). This specialized net has a rectangular mouth opening usually 2 or 3 times as wide as deep, i.e. 1 meter by 1/2 meter or 60 cm by 20 cm, with sometimes hollow piping construction to aid in flotation. They are generally towed half submerged at 1-2 kts from the side of the vessel on a boom to avoid the ship's wake.

Dataset-specific Instrument Name	Sensus Ultra U-15763, Reefnet Inc.
Generic Instrument Name	Reefnet Sensus Ultra
Dataset-specific Description	Depth was measured initially live with a cNODE transpoder (MINI34), however the depth reading was not reliable, and a dive logging device (Sensus Ultra U-15763, Reefnet Inc.) was attached to the Bongo90 frame. Depth was recorded after the tow was completed, and the amount of winch cable released was recorded at each cast.
Generic Instrument Description	The ReefNet Sensus Ultra is a compact temperature and depth logging sensor designed for use as a dive computer. Depths between 0 and 500 feet are measured with precision better than 0.5 inches of water, and accuracy of +/-12 inches. Temperature is measured between -20 degrees C and + 40 degrees C, with precision of 0.01 degrees C, and accuracy of +/-0.8 degrees C. The sampling interval is configurable from 1 second to over 18 hours, with storage capacity of one year at 60-second sampling resolution.

[table of contents | back to top]

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

[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.

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.

[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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851395

[table of contents | back to top]