MOCNESS net data from R/V Sally Ride cruise SR2114 in the Eastern Tropical Pacific from December 2021 to January 2022

Website: https://www.bco-dmo.org/dataset/930162
Data Type: Cruise Results
Version: 1
Version Date: 2024-09-06

Project
» Collaborative Research: Multiyear autonomous measurement of N-loss in the ETNP ODZ (N-loss in the ETNP ODZ)

Contributors	Affiliation	Role
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Abstract
This dataset includes the environmental data (salinity, temperature, oxygen, density, depth) from the eight MOCNESS tows on the SR2114 expedition onboard the R/V Sally Ride in December 2021 to January 2022. It also includes the larval abundance of the most abundant species and the zooplankton biovolume, as well as the larval abundance by development stage. These results are published in Gutierrez Bravo, et al. (2024).

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Coverage

Location: Eastern Tropical North Pacific
Spatial Extent: **N**:21.86359 **E**:-89.14579 **S**:8.65747 **W**:-114.66639
Temporal Extent: 2021-12-26 - 2022-01-17

Methods & Sampling

Data were collected on R/V Sally Ride cruise SR2114 in the Eastern Tropical North Pacific from December 2021 to January 2022.

The MOCNESS was equipped with 10 nets of 1 square meter (m^2) mouth opening and 333 micrometer (µm) mesh size, a SeaBird SBE9+ CTD, a SeaBird SBE 43 dissolved oxygen (DO) sensor, and flow meter and angle sensors. The MOCNESS tows were performed at locations of particular biological interest (see Figure 1 of Gutiérrez-Bravo, et al. (2024)), such as the CRTD (M1), San Jose submarine canyon (M2), the center (M3, M5) and borders (M4, M6) of two anticyclonic eddies (abbreviated ACE-1 and ACE-2), and across the northern portion of the OMZ (M7 and M8).

Using manufacturer software (SBE Data Processing), CTD data were filtered and aligned. CTD-rosette data

were binned to 1-meter depth and MOCNESS data were binned to 10 seconds. Conservative Temperature and Absolute Salinity were calculated. CTD-rosette data were used to construct hydrographic sections, while MOCNESS sensor data were used to describe the environmental conditions of zooplankton samples.

The MOCNESS tows were performed at 1.5-2 knots net speed and at a 40-50° net angle. A horizontal net tow strategy was followed to sample selected dissolved oxygen (DO) concentrations (oxypleths) in five sampling levels: 1) the oxic level (~200 micromoles per kilogram (µmol/kg), near surface), 2) the hypoxic (~100 µmol/kg) and 3) suboxic (~10 µmol/kg) levels in the upper core boundary, 4) the anoxic core level (<1 µmol/kg, at the center of the anoxic core), and 5) the deep level (~10 µmol/kg in the lower boundary below the anoxic core). The remaining 5 MONCESS nets were opened during transitions between target depths and were not used for this study. This horizontal sampling protocol allows for discrete, punctual sampling events, but cannot provide continuous, vertically-integrated abundances as oblique tows would (Wiebe et al. 2015). An example of the configuration of horizontal sampling levels along the water column is shown in Figure 2 of Gutiérrez-Bravo, et al. (2024). The oxic, hypoxic, and suboxic levels were sampled for ~10 minutes (~500 cubic meters (m^3) filtered volume). The deep and anoxic levels were sampled for ~20 minutes (~1000 m^3 filtered volume) to obtain sufficient sample material.

Due to time constraints and to eliminate any differences between stations caused by the phase of diel vertical migration, all the net deployments were performed during nighttime. Hence, the sampling results reflect nighttime distributions only.

Sample handling:
Gelatinous organisms, non-planktonic groups, and excess water were removed from the samples after they were retrieved from the cod ends. The samples were preserved with Ethanol 96%. At least two ethanol changes were performed during the cruise and a third was performed on land.

Zooplankton biovolume was measured by the displacement method (Steedman 1976) and standardized to milliliters per 1000 cubic meters (mL/1000 m^3) by dividing the zooplankton displacement volume (mL) by the volume of water filtered by the net (m^3).

Fish larvae and juveniles were separated and counted under a stereoscope. Fish larvae were identified to the most specific taxonomic level possible, using a specialized bibliography (Evseenko 1990; Moser 1996; Aceves-Medina et al. 1999, 2003; Evseenko and Shtaut 2000; Richards 2005; Jiménez-Rosenberg et al. 2006; González-Navarro et al. 2013; Silva-Segundo et al. 2021). The larval stages (preflexion, flexion, postflexion, and transformation) were defined according to Moser (1996). Preflexion and flexion larvae were considered "early larval stages" as they both lack fully-developed fins. Larval abundances were standardized to larvae per 1000 cubic meters (larvae/1000 m^3) and were considered absolute abundances.

Juveniles and adults were separated, counted, and identified to family level, except for the *Gonostomatidae*, that were represented entirely by the genus *Cyclothone*. Adult abundances were standardized to fish per 1000 cubic meters (fish/1000 m^3). Because the increased swimming ability of adult fish could affect fishing efficiency, abundances were considered relative, and should not be compared with the absolute abundances of fish larvae.

BCO-DMO Processing Description

- Created a table of the MOCNESS numbers and dates provided by the submitter.
- Imported original file "Net_data.xlsx" into the BCO-DMO system.
- Checked species names in WoRMS. All valid except "Opistonema spp." (a misspelling which has been corrected to "Opisthonema spp." in the final csv file)
- Renamed fields to comply with BCO-DMO naming conventions.
- Added the MOCNESS dates to the primary data table in YYYY-MM-DD format.
- Sorted data by MOC_Num then Stratum.
- Rounded fields:
-- Latitude and Longitude to 5 decimal places
-- All other number fields to 6 decimal places
- Saved the final file as "930162_v1_sr2114_moc_net_data.csv".

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Data Files

File
930162_v1_sr2114_moc_net_data.csv (Comma Separated Values (.csv), 8.68 KB) MD5:f0dd8e346dfdf3310535094706ac8e99 Primary data file for dataset ID 930162, version 1

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Related Publications

Aceves-Medina G, Saldierna-Martínez RJ, González EA. Distribution and abundance of Syacium ovale larvae (Pleuronectiformes: Paralichthyidae) in the Gulf of California. Rev Biol Trop. 2003 Jun;51(2):561-70. PMID: 15162748.
Methods

Aceves-Medina, Gerardo & González, Enrique & Ricardo, Saldierna. (1999). Larval development of Symphurus williamsi (Cynoglossidae: Pleuronectiformes) from the Gulf of California. Fishery Bulletin. 592. 738-745.
Methods

Evseenko, S. A., & Shtaut, M. I. (2000). Early Stages of Development of Two Species of Tongue Soles--Symphurus chabanaudi and S. prolatinaris (Cynoglossidae, Pleuronectiformes) from Central Eastern Pacific. Journal of Ichthyology, 40(9), 751-761.
Methods

Evseenko, S.A. (1990). Unusual larvae of the marine tonguefish, Symphurus sp.(Cynoglossidae), from central waters of the eastern Pacific. Vopr Ikhtiol, 30, 682-686.
Methods

González-Navarro, E. A., Saldierna-Martínez, R. J., Aceves-Medina, G., & Jiménez-Rosenberg, S. P. A. (2013). Identification atlas of fish larvae of the Elopomorpha subdivision of the Mexican Pacific. CICIMAR Oceánides, 28(2), 7-40.
Methods

Gutiérrez-Bravo, J. G., Sánchez-Velasco, L., Jiménez-Rosenberg, S. P. A., Altabet, M. A., Méndez-Mendez, S., & Cambronero-Solano, S. (2024). Anoxic waters constrain the vertical distribution of fish developmental stages in an oxygen minimum zone. Limnology and Oceanography. Portico. https://doi.org/10.1002/lno.12594
Results

Jiménez-Rosenberg, S. P. A., González-Navarro, E. A., & Saldierna-Martínez, R. J. (2006). Larval, prejuvenile and juvenile development of Eucinostomus currani. Journal of Fish Biology, 69(1), 28–37. Portico. https://doi.org/10.1111/j.0022-1112.2006.01029.x
Methods

Moser, H. G. (Ed.). (1996). The early stages of fishes in the California Current region. US Department of the Interior, Minerals Management Service, Pacific OCS Region.
Methods

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

Silva-Segundo, C. A., Funes-Rodríguez, R., Gómez-Gutiérrez, J., Gallegos-Simental, G., Hernández-Trujillo, S., & Blanco-Jarvio, A. (2021). DNA barcoding and taxonomic validation of Caranx spp. larvae. Journal of the Marine Biological Association of the United Kingdom, 101(2), 399–407. https://doi.org/10.1017/s0025315421000205 https://doi.org/10.1017/S0025315421000205
Methods

Steedman, H. F. (1976). Zooplankton fixation and preservation. Unesco Press. ISBN: 92-3-101272-x
Methods

Wiebe, P. H., Allison, D., Kennedy, M., & Moncoiffé, G. (2014). A vocabulary for the configuration of net tows for collecting plankton and micronekton. Journal of Plankton Research, 37(1), 21–27. https://doi.org/10.1093/plankt/fbu101
Methods

Parameters

Parameter	Description	Units
Station	Station number in cruise SR2114	unitless
Event	Event number at the station	unitless
MOC_Num	Sequential MOCNESS number	unitless
Date	Date of the sampling event	unitless
NBf	Number of nets fired	unitless
Stratum	Sampling location (see Gutierrez Bravo et al. 2024 for details)	unitless
Distance	Distance along the cruise track	kilometers (km)
Density00	Density anomaly	grams per kilogram (g/kg)
DepSM	Depth	meters (m)
Latitude	Latitude of the sampling event	decimal degrees
Longitude	Longitude of the sampling event	decimal degrees
Sbox0Mm_Kg	Mean oxygen from SBE in the whole net tow	micromoles per kilogram (umol/kg)
Sal00	Salinity	PSU
T090C	Temperature	degrees Celsius
Gsw_saA0	Conservative temperature	degrees Celsius
Gsw_ctA0	Absolute salinity	PSU
Biovolume	Zooplankton biovolume measured by displacement method	milliliters per 1000 cubic meters
Larval_Abundance	Total larval abundance standardized to larvae 1000 m^-3	larvae per 1000 cubic meters
Auxis_sp	Larval abundance of Auxis sp.	larvae per 1000 cubic meters
Benthosema_panamense	Larval abundance of Benthosema panamense	larvae per 1000 cubic meters
Bregmaceros_bathymaster	Larval abundance of Bregmaceros bathymaster	larvae per 1000 cubic meters
Cyclothone_sp	Larval abundance of Cyclothone sp.	larvae per 1000 cubic meters
Diaphus_pacificus	Larval abundance of Diaphus pacificus	larvae per 1000 cubic meters
Diogenichthys_laternatus	Larval abundance of Diogenichthys laternatus	larvae per 1000 cubic meters
Dormitator_latifrons	Larval abundance of Dormitator latifrons	larvae per 1000 cubic meters
Ophidion_sp	Larval abundance of Ophidion sp.	larvae per 1000 cubic meters
Opisthonema_spp	Larval abundance of Opisthonema spp.	larvae per 1000 cubic meters
Syacium_spp	Larval abundance of Syacium spp.	larvae per 1000 cubic meters

Vinciguerria_lucetia	Larval abundance of Vinciguerria B10lucetia	larvae per 1000 cubic meters
Preflexion	Abundance in the preflexion stage	larvae per 1000 cubic meters
Flexion	Abundance in the flexion stage	larvae per 1000 cubic meters
Postflexion	Abundance in the postflexion stage	larvae per 1000 cubic meters
Transformation	Abundance in the transformation stage	larvae per 1000 cubic meters
Juv_Adult	Abundance of juveniles and adults	larvae per 1000 cubic meters

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Instruments

Dataset-specific Instrument Name	MOCNESS, SeaBird SBE9+ CTD
Generic Instrument Name	CTD MOCNESS
Dataset-specific Description	The MOCNESS was equipped with 10 nets of 1 m^2 mouth opening and 333 µm mesh size, a SeaBird SBE9+ CTD, a SeaBird SBE 43 DO sensor, and flow meter and angle sensors.
Generic Instrument Description	The CTD part of the MOCNESS includes 1) a pressure (depth) sensor which is a thermally isolated titanium strain gauge with a standard range of 0-5000 decibars full scale, 2) A Sea Bird temperature sensor whose frequency output is measured and sent to the surface for logging and conversion to temperature by the software in the MOCNESS computer (The system allows better than 1 milli-degree resolution at 10 Hz sampling rate), and 3) A Sea Bird conductivity sensor whose output frequency is measured and sent to the surface for logging and conversion to conductivity by the software in the computer (The system allows better than 1 micro mho/cm at 10 Hz sampling rate). The data rate depends on the speed of the computer and the quality of the cable. With a good cable, the system can operate at 2400 baud, sampling all variables at 2 times per second. One sample every 4 seconds is the default, although the hardware can operate much faster. (From The MOCNESS Manual)

Dataset-specific Instrument Name	flow meter
Generic Instrument Name	Flow Meter
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	SeaBird SBE 43 DO sensor
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

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Deployments

SR2114

Website	https://www.bco-dmo.org/deployment/931391
Platform	R/V Sally Ride
Start Date	2021-12-23
End Date	2022-01-21
Description	Additional cruise information is available from R2R: https://www.rvdata.us/search/cruise/SR2114

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Project Information

Collaborative Research: Multiyear autonomous measurement of N-loss in the ETNP ODZ (N-loss in the ETNP ODZ)

NSF Award Abstract:
Several regions of the deep ocean naturally contain almost no oxygen. Because of this lack of oxygen, microbes living in these regions live in ways that differ from those in oxygenated waters consuming nitrate ions instead of oxygen for respiration. Use of nitrate for microbial respiration results in the production of nitrogen gas which is called denitrification. The resulting removal of nitrate has consequences for the whole ocean as nitrogen is an important nutrient controlling plant growth; however, whereas plants can use nitrogen in the form of nitrate, they cannot, with a few exceptions, use nitrogen gas. There remains a number of uncertainties regarding how much denitrification occurs in the ocean, what controls it, and how it varies in time and space. Traditional studies of ocean denitrification have been limited by the time ships can be at sea and the relatively small proportion of the ocean they can observe. Our project plans to remedy this problem by using vehicles called floats that can operate autonomously in the ocean for three years or more as they drift with currents over hundreds of kilometers. We will outfit ten floats with sensors to measure oxygen and nitrogen gas which will be placed throughout the oxygen-depleted region of the Pacific Ocean to the west of Mexico. This is the largest such region in the ocean from which we have two years of results from a prototype float which validated our approach. This study may well transform our understanding of ocean denitrification and ultimately benefit society as a whole through greater confidence in predictions of the ocean's nitrogen cycle and capacity to fix carbon dioxide under current and future conditions. Application and further development of float systems using commercially available technology will directly benefit successor studies, and more broadly showcase the use of water-following platforms to tackle difficult oceanographic problems. Advances from this study are expected to carry over to other disciplines including ocean biogeochemical modeling. Outreach activities, support for an early career scientist, and student training are included in the project. For the outreach activities, the investigators plan to tie into well-established after-school programs serving underrepresented populations in Massachusetts and established opportunities for public presentations using float related display materials at the University of Washington.

Oxygen deficient zones (ODZs), despite constituting a small fraction of total oceanic volume, play important roles in regulating global ocean carbon and nitrogen cycles including hosting 30 to 50% of the global loss of fixed nitrogen. Unfortunately, current uncertainty in ODZ nitrogen loss derives from substantial temporal and spatial variability in rates that remain under-sampled by ship-based measurements. While local regulation of nitrogen loss by oxygen and organic matter availability are well accepted, temporal/spatial variability in the nitrogen flux is likely a result of the influence of physical forcings such as remote ventilation, seasonal variability, and mesoscale eddies. Understanding how the impact of physical forcings on nitrogen loss as mediated through oxygen and organic flux will be required to fully understand the causes and consequences of any future ODZ expansion. To improve our understanding of ODZ nitrogen loss, we will carry out a multiyear, autonomous float-based observational program to address outstanding questions regarding bioavailable nitrogen loss in ODZs. As the largest ODZ and region of our pilot deployments, our operation area will be the Eastern Tropical N. Pacific (ETNP) where our study will determine over a multi-year period, in-situ nM-level oxygen and biogenic nitrogen on float profiles spanning geographic gradients in oxygen and surface productivity. For the first time, our study will also determine in situ nitrogen loss rates from changes in nitrogen concentration during 1 to 2 week Lagrangian float drifts along a constant density surface. A pilot 2 yr float deployment in the ETNP documents our ability to do so. Critically, our float-based approach more closely matches the frequency and distribution of observations to the expected variability in biogenic nitrogen production as compared to prior work and will dramatically increase the data density for this region by acquiring >500 profiles/drifts for nitrogen and >1000 profiles for nM oxygen.

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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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851361

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