Carbon and nitrogen stable isotope measurements of gelatinous zooplankton and larval fish in the Northern California Current from March 2022 to August 2023

Website: https://www.bco-dmo.org/dataset/986609
Data Type: Cruise Results
Version: 1
Version Date: 2025-12-01

Project
» Collaborative Research: Plankton size spectra and trophic links in a dynamic ocean (Plankton Size Spectra)

Contributors	Affiliation	Role
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Abstract
These data include carbon and nitrogen stable isotope measurements of gelatinous zooplankton and larval fish collected during four research cruises in the Northern California Current from March 2022 to August 2023. Also included are carbon and nitrogen contents, organism counts, sizes and volumes, wet weights, dry weights, and ash-free dry weights. The roles of gelatinous zooplankton and larval fish in marine food webs are not well understood. These data examine the trophic roles of these organisms across two seasons in a highly productive coastal system and contribute to food web modelling efforts.

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Coverage

Location: Northern California Current
Spatial Extent: **N**:47.10322598 **E**:-124.0210926 **S**:42.50035202 **W**:-126.4546705
Temporal Extent: 2022-03-02 - 2025-02-26

Methods & Sampling

Gelatinous zooplankton and larval fish were collected using MOCNESS (Multiple Opening/Closing Net and Environmental Sensing System) tows in 25-meter (m) depth increments in the upper 100m of the water

column (nets: 1 square meter (m²) with 333-micrometer (µm) mesh and 4 m² with 1000 µm mesh). Organisms in each tow were grouped by lowest visually identifiable taxon. Maximum and minimum lengths of individuals in each group were measured with a ruler and the volume of each sample of grouped individuals was measured by displacement. Samples were frozen at -20 degrees Celsius (°C) prior to preparation for stable isotope analysis.

Wet weight of each grouped sample was measured upon thawing the sample. Samples were dried at 60°C, then dry weights were measured. Samples were then crushed and homogenized using an agate mortar and pestle. Stable isotope compositions and carbon and nitrogen contents were measured by elemental analyzer-isotope ratio mass spectrometry (EA-IRMS) at the UC Davis Stable Isotope Facility. Ash-free dry weights were determined by weighing samples before and after combusting dried samples at 500°C.

BCO-DMO Processing Description

- Imported original file "NCC_GZ_isotopes.csv" into the BCO-DMO system.
- Converted date column to YYYY-MM-DD format.
- Marked "X" as a missing data value (missing data are empty/blank in the final CSV file).
- Saved the final file as "986609_v1_ncc_gz_isotopes.csv".

Problem Description

Ash-free dry weight was only measured for a subset of samples that had sufficient mass remaining after stable isotope analysis.

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Data Files

File	
986609_v1_ncc_gz_isotopes.csv	(Comma Separated Values (.csv), 160.81 KB) MD5:2de696075cdce19f1307bdebdf90176f
Primary data file for dataset ID 986609, version 1	

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Related Datasets

IsRelatedTo

Cowen, R. K., Conser, E., Sponaugle, S., Sutherland, K. R., & Corrales Ugalde, M. (2024). Environmental sensor data from an underwater imaging system (ISIIS-3) collected during R/V Langseth cruise MGL2207 July 20-28 2022 and R/V Sally Ride cruise SR2317 August 10-20 2023 in the Northern California Current (Version 1) [Data set]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.942686.1

Sutherland, K. R., Cowen, R. K., Sponaugle, S., & Yesmin, F. (2024). Gelatinous zooplankton observations during four research cruises (SKQ202204S, MGL2207, SKQ202303S, SR2317) carried out in the Northern California Current from March 2022 to August 2023 (Version 1) [Data set]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.923337.1

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Parameters

Parameter	Description	Units
animal_type	Organism type; grouped as Fish, Gelatinous zooplankton, or Octopus	unitless
phylum	Phylum	unitless
class	Class (left blank if not identified to class level)	unitless
order	Order (left blank if not identified to order level)	unitless
family	Family (left blank if not identified to family level)	unitless
genus	Genus (left blank if not identified to genus level)	unitless
species	Species (left blank if not identified to species level)	unitless
sample_full	Unique sample name for each grouped organism sample. (###-seasonyear transectstation taxon)	unitless
d13C	Carbon stable isotope composition (‰ vs. VPDB). Calibrated against international standards and corrected for instrument linearity and drift using in-house reference materials by UCD SIF. StDev of reference materials 0.10‰, StDev of gelatinous zooplankton standards 0.169‰.	per mil vs. VPDB
C_ug	Carbon content in measured sample of dried powdered tissue, calculated from IRMS peak area.	micrograms (µg)
d15N	Nitrogen stable isotope composition (‰ vs. Air). Calibrated against international standards and corrected for instrument linearity and drift using in-house reference materials by UCD SIF. StDev of reference materials 0.15‰, StDev of gelatinous zooplankton standards, 0.374‰.	per mil vs. Air
N_ug	Nitrogen content in measured sample of dried powdered tissue, calculated from IRMS peak area.	micrograms (µg)
sample_weight_mg	Weight of dried powder sample tissue analyzed for d13C, d15N, C contents, and N contents	milligrams (mg)
season	Season when samples were collected (Winter=Feb/March, Summer=July/Aug)	unitless

cruise	Cruise identifier: W22=Winter 2022, S22=Summer 2022, W23=Winter 2023, S23=Summer 2023	unitless
year	Year when samples were collected	unitless
collection_date	Date when samples were collected	unitless
transect	Sampling transect identifier: GH=Grays Harbor, CR=Columbia River, CM=Cape Meares, NH= Newport hydrographic ,HH=Heceta Head, RR= Rogue River	unitless
station	Location along transect: 1=closet nearshore; 6=furthest offshore	unitless
lat	Latitude of net tow start location	decimal degrees
long	Longitude of net tow start location	decimal degrees
moc	Net type: 1=Moc1, 1m2 opening 333um mesh; 4=Moc4, 4m2 opening 1000um mesh	unitless
collection_depth_m_min	Minimum depth of range sampled by the MOCNESS net	meters (m)
collection_depth_m_max	Maximum depth of range sampled by the MOCNESS net	meters (m)
life_stage	Life/development stage of organism(s) in sample	unitless
number_of_individuals	Number of individual organisms included in the grouped sample	individual organisms
length_min_mm	Minimum length of individual organisms in each grouped sample (bell diameter for medusae)	millimeters (mm)
length_max_mm	Maximum length of individual organisms in each grouped sample (bell diameter for medusae)	millimeters (mm)
vol_ml	Total volume of all organisms in grouped sample	milliliters (mL)
notes	Notes about the sample or measurements	unitless
wet_weight_g	Total weight of all organisms in grouped sample upon thawing	grams (g)

dry_weight_g	Total weight of all organisms in grouped sample after drying at 60°C	grams (g)
afdw_perc_of_dw	Ash-free dry weight as a percentage of the dry weight (material lost after combustion at 500°C)	percent (%)
ash_perc_of_dw	Ash percentage of the dry weight (material retained after combustion at 500°C)	percent (%)

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Instruments

Dataset-specific Instrument Name	Sercon Europa ANCA-GSL elemental analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Sercon Europa ANCA-GSL elemental analyzer interfaced to a Sercon Europa 20-20 IRMS (Sercon Ltd., Cheshire, United Kingdom): 70 samples were analyzed for C and N contents and stable isotope compositions using this EA-IRMS system.
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.

Dataset-specific Instrument Name	Elementar vario MICRO cube elemental analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Elementar vario MICRO cube elemental analyzer (Elementar Analysensysteme GmbH, Langenselbold, Germany) interfaced to a Sercon Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, United Kingdom): 70 samples were analyzed for C and N contents and stable isotope compositions using this EA-IRMS system.
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.

Dataset-specific Instrument Name	Elementar vario EL cube elemental analyzer
Generic Instrument Name	Elementar Vario EL Cube elemental analyzer
Dataset-specific Description	Elementar vario EL cube elemental analyzer interfaced to an Elementar VisION IRMS (Elementar Analysensysteme GmbH, Langenselbold, Germany): 527 samples were analyzed for C and N contents and stable isotope compositions using this EA-IRMS system.
Generic Instrument Description	A laboratory instrument used for quantifying organic elements. It can measure C, H, N and S and optionally O, Cl and TIC. It was first developed in 2006 as a successor to the vario EL III. It uses a high-temperature combustion unit that is able to complete sample digestion at up to 1200 deg C (or 1800 deg C at the point of combustion when tin foil is used) and a jet injection of oxygen directly to the sample during combustion. Separation of gas components are performed on up to 3 gas-selective columns which trap gases until they are heated up and the prior gas peak has reached the baseline during detection. It uses a Thermal Conductivity Detector (TCD) as standard. An infrared (IR) detector for sulfur and oxygen and electrochemical detector for chlorine are optionally available. The instrument can measure C / N elemental ratios of up to 12,000:1 and provides an elemental detection limit of < 40 ppm (TCD).

Dataset-specific Instrument Name	Sercon Europa 20-20 IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Sercon Europa ANCA-GSL elemental analyzer interfaced to a Sercon Europa 20-20 IRMS (Sercon Ltd., Cheshire, United Kingdom): 70 samples were analyzed for C and N contents and stable isotope compositions using this EA-IRMS system.
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	Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS)
Generic Instrument Name	MOCNESS
Dataset-specific Description	Net system used to collect samples: samples were collected includes five nets with 1m2 opening and 333um mesh, and five with 4m2 opening and 1000um mesh.
Generic Instrument Description	The Multiple Opening/Closing Net and Environmental Sensing System or MOCNESS is a family of net systems based on the Tucker Trawl principle. There are currently 8 different sizes of MOCNESS in existence which are designed for capture of different size ranges of zooplankton and micro-nekton Each system is designated according to the size of the net mouth opening and in two cases, the number of nets it carries. The original MOCNESS (Wiebe et al, 1976) was a redesigned and improved version of a system described by Frost and McCrone (1974). (from MOCNESS manual)

Dataset-specific Instrument Name	Mettler Toledo MS105 Analytical Balance
Generic Instrument Name	scale or balance
Dataset-specific Description	Used to measure wet weights, dry weights, and ash weights
Generic Instrument Description	Devices that determine the mass or weight of a sample.

Dataset-specific Instrument Name	Mettler Toledo WXTS3DU Microbalance
Generic Instrument Name	scale or balance
Dataset-specific Description	Used to weigh samples for stable isotope analysis
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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Deployments

SKQ202204S

Website	https://www.bco-dmo.org/deployment/923356
Platform	R/V Sikuliaq
Start Date	2022-03-01
End Date	2022-03-12
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SKQ202204S

SKQ202303S

Website	https://www.bco-dmo.org/deployment/914489
Platform	R/V Sikuliaq
Start Date	2023-02-16
End Date	2023-03-01
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SKQ202303S

SR2317

Website	https://www.bco-dmo.org/deployment/923378
Platform	R/V Sally Ride
Start Date	2023-08-09
End Date	2023-08-21
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SR2317

MGL2207

Website	https://www.bco-dmo.org/deployment/923370
Platform	R/V Marcus G. Langseth
Start Date	2022-07-18
End Date	2022-07-30

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Project Information

Collaborative Research: Plankton size spectra and trophic links in a dynamic ocean (Plankton Size Spectra)

Website: http://hmsc.oregonstate.edu/research-labs/planktonlab/current-research

Coverage: Northern California Current

NSF Award Abstract:
Marine plankton form the base of most ocean food webs that support valuable fisheries. This highly diverse and complex community is composed of organisms that drift with ocean currents. Planktonic organisms remain understudied: they are difficult to sample given that their sizes span more than six orders of magnitude from less than one micron to meters. Yet, understanding how these communities respond to climate change, and ultimately how these responses affect valuable fisheries, and therefore food security, is critical. Because many ecological and physiological processes are dictated by relative size, the theory of size spectra (i.e., the relationship between size and organism abundance as it drives ecosystem properties such as food webs) provides a valuable framework for forecasting climate change impacts on marine ecosystems. A deeper understanding of the scope and nature of variability in size spectra under contrasting environmental conditions is needed. The dynamic, highly productive northern California Current off Oregon and Washington, during the summer and winter seasons, produces a patchwork of oceanographic conditions including those associated with hypoxia and ocean acidification. This study is sampling the plankton communities in this region to investigate how gradients of temperature, nutrients, dissolved oxygen, and pH conditions impact size spectra. The broader impacts include the training of students, building scientific resources, and outreach to broader communities. Undergraduate and graduate students are being trained in oceanography, field research and new technologies. The automated image analysis pipeline developed as part of the project is openly accessible to the oceanographic community and the image data are available through the novel Global Plankton Imagery Library, an open-access repository for plankton imagery. Size spectra data from this study are shared directly with ecosystem modelers. The project's flagship outreach activity is the collaboration with the Sitka Center for Art and Ecology and the hosting of an Artist-At-Sea Program. A professional artist is competitively selected to join the research cruises and to create artistic products that give a unique voice to oceanographic research and the organisms under study. The artwork is being assembled into a traveling public Art Exhibit with planned displays at the Sitka Center, Oregon State University's Hatfield Marine Science Center, University of Oregon's Charleston Marine Life Center and centers located in underserved coastal communities. Finally, imagery data from the project are being shared via the Plankton Portal, a public website developed in partnership with the Citizen Science Alliance's Zooniverse, that invites citizen scientists to participate in classifying plankton images.

The coupling of in situ plankton imagery and morphometric data allows quantifying scales of variation in plankton size spectra as well as testing predictions of how changes in environmental conditions (notably, temperature, nutrients, oxygen, pH) correlate with shifts in size spectra to reveal functional consequences to the food web. Plankton size spectra are being compared across environmental conditions by sampling in a habitat with steep environmental gradients and during two contrasting seasons. Planktonic organisms spanning 10 orders of magnitude in biomass are sampled using two complementary high-resolution imaging systems: the In Situ Ichthyoplankton Imaging System (ISIIS) and the Laser In-Situ Scattering and Transmissometry (LISST) particle imager. High-throughput image analysis software is used to create size distributions together with taxonomic classification. Depth-discrete meso-zooplankton samples are collected in parallel to examine community shifts in carbon, obtain length-to-carbon conversions and calibrate image data. The normalized biomass size spectra computed from the image data are tested for deviations from expected patterns. The plankton collections are also being analyzed for diet and reproductive status of gelatinous zooplankton, and diet and daily growth rate of representative larval fishes. These two groups have been historically understudied yet play central roles in ecosystem function. The data are being used to examine how these organisms are impacted by environmental conditions, and how they affect plankton size spectra. This study is foundational to the understanding of marine ecosystems within the context of climate change.

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-2125408
NSF Division of Ocean Sciences (NSF OCE)	OCE-2125407

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