Pyrosome count and length data collected from the cruise RR2105 on R/V Roger Revelle in the California Current Ecosystem from July to August 2021

Website: https://www.bco-dmo.org/dataset/1003320
Data Type: Other Field Results
Version: 1
Version Date: 2026-08-17

Project
» Collaborative Research: Assessing the causes of the pyrosome invasion and persistence in the California Current Ecosystem (Pyrosomes in the CCE)

Contributors	Affiliation	Role
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Abstract
This dataset contains pyrosome count and length data from bongo net tows conducted during the cruise RR2105 on R/V Roger Revelle (CCE LTER P2107, July-August 2021) in the California Current Ecosystem.

Table of Contents

Coverage

Spatial Extent: **N**:36.4606 **E**:-120.8285 **S**:34.5039 **W**:-130.5483
Temporal Extent: 2021-07-22 - 2021-08-11

Dataset Description

Samples were collected on CCE-NSF process cruise (OCE-1637632, Project: California Current Ecosystem Long Term Ecological Research Site).

Methods & Sampling

Pyrosomes were collected for abundance and size-structure estimates using a double-oblique tow with a Bongo frame equipped with paired 202 µm nets, a temperature-depth logger, and a General Oceanics flow meter affixed to the Starboard net. Bongo tows were conducted twice daily for day and night sampling, at approximately 1000 h and 2200 h, following standard CalCOFI protocols (Bowlin et al. 2009). The average tow time (± SD) was 23 ± 3 min, the average depth of sampling was 206 ± 14 m, and the average volume filtered was 290 ± 28 m3. Upon retrieval, the cod-end contents of the starboard net were gently transferred to a bucket and anesthetized with carbonated water to prevent regurgitation of gut contents (Kleppel and Pieper 1984). All pyrosomes were removed from the tow and rinsed to remove any hitchhiking zooplankton. The pyrosomes were then imaged, counted, and split into the respective subsamples. Depending on which pyrosomes were measured, the split factor accounts for the fraction or the whole percentage that the counts, and thus the lengths, represent of the tow.

Data Processing Description

Pyrosomes were carefully removed and rinsed with filtered seawater to remove any attached zooplankton, placed in a black bin equipped with a ruler, and imaged from above with an iPhone, ensuring a ruler was included in the image (n=1384 to the nearest mm). Images were reported in cm, but our resolution allowed the measurement to the nearest mm, using the ruler in the image. Images were used to quantify population size-structure using ImageJ.

BCO-DMO Curation Notes

* Imported the file and treated blank cells and “nd” as missing values.
* Converted the Date column from M/D/YY format to the standard ISO date format YYYY-MM-DD.
* Unpivoted the "Total Pyrosome Lengths" column and all numbered columns matching pattern "(N)" into a single "pyrosome_length" value column, creating a new "pyrosome_index" key column indicating which original column each value came from (0 for "Total Pyrosome Lengths", otherwise the number in parentheses) into long format & filtered out rows where pyrosome_length was null (unnecessary rows after unpivot, original data didn't always have the same amount of measurements.)
* Exported the cleaned and standardized tables as CSV files.

[table of contents | back to top]

Data Files

File	
1003320_v1_pyrosomes_count_length.csv	(Comma Separated Values (.csv), 93.20 KB) MD5:866c1a3c387ad327ee95ec4465e4a380
Primary data file for dataset ID 1003320, version 1	

[table of contents | back to top]

Supplemental Files

File

haul_summary.csv (Comma Separated Values (.csv), 2.83 KB)
MD5:da826a7dad7876649eaeacf90baeea1e

This table contains counts and summary information for the bongo net tows. The Haul column identifies the tow in this summary table and main dataset table.
Haul depth is estimated based on wire out and sustained angle (210 meters).

Parameter descriptions:
Column Name,Description,Units,Missing Data Identifier
STALINE,Cruise Identifier,unitless,
Cycle,4-5 day sampling location period,unitless,
Day,Day within sampling location,unitless,
Haul,Sequential tow number for all bongo net tows,unitless,
Date,Date of sampling event,unitless,
Latitude,Latitude of sampling location,decimal degrees,
Longitude,Longitude of sampling location,decimal degrees,
STB Volume Water Strained (m3),Volume of water filtered by net,m3,
Count,Number of pyrosomes counted in the subsample (see Fraction Represented column).,# of pyrosomes,
Fraction Represented,"Subsample fraction of the total sample from one bongo net in the tow. Example: '2' represents 200% of the sample (when using second bongo net in tow not just one), or '.25' means 25% of one bongo net sample. All pyrosomes in the subsample were counted and measured (lengths reported in the main data table of this dataset).",unitless,
Depth,Average tow depth. Haul depth is estimated based on wire out and sustained angle (210 meters).,m,

[table of contents | back to top]

Related Publications

Bowlin, N.M., Watson, W., Charter, R.L., and Manion, S.M. (2009). Ichthyoplankton and station data for surface (manta) and oblique (bongo) plankton tows for California Cooperative Oceanic Fisheries Investigations survey cruises and California Current Ecosystem Survey in 2006. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-442. Available at https://repository.library.noaa.gov/view/noaa/3707
Methods

Cawley G.F., Matthews, S.A., Llopis-Monferrer, N., Padilla Villa, M., Barbeau, K., & Décima, M.R. (in review). Pyrosoma atlanticum fecal pellet production in the California Current: implications for grazing and carbon export dynamics. In review with Minor Revisions for Limnology and Oceanography.
Results

Kleppel, G. S., & Pieper, R. E. (1984). Phytoplankton pigments in the gut contents of planktonic copepods from coastal waters off southern California. Marine Biology, 78(2), 193–198. https://doi.org/10.1007/bf00394700 https://doi.org/10.1007/BF00394700
Methods

[table of contents | back to top]

Related Datasets

IsRelatedTo

Cawley, G., Decima, M., Barbeau, K., Matthews, S., Llopis Monferrer, N. (2026) **Pyrosome fecal pellet sinking measurements collected from the cruise RR2105 on R/V Roger Revelle in the California Current Ecosystem from July to August 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-17 doi:10.26008/1912/bco-dmo.1003542.1 [view at BCO-DMO]
Relationship Description: Pyrosomes represented in this dataset provided individuals whose fecal pellets were used in the "P2107 Pyrosome Fecal Pellet Sinking" experiments.

Cawley, G., Decima, M., Barbeau, K., Matthews, S., Llopis Monferrer, N., Padilla Villa, M. (2026) **Pyrosome fecal pellet biogenic silica measurements collected from the cruise RR2105 on R/V Roger Revelle in the California Current Ecosystem from July to August 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-14 doi:10.26008/1912/bco-

dmo.1004017.1 [view at BCO-DMO]
Relationship Description: Fecal pellets produced by pyrosomes represented in the "P2107 Pyrosome Length and Abundance" dataset were analyzed for biogenic silica in the "P2107 Pyrosome Pellet bSi" dataset.

Cawley, G., Decima, M., Barbeau, K., Matthews, S., Llopis Monferrer, N., Padilla Villa, M. (2026) **Pyrosome fecal pellet composition measurements collected from the cruise RR2105 on R/V Roger Revelle in the California Current Ecosystem from July to August 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-17 doi:10.26008/1912/bco-dmo.1004254.1 [view at BCO-DMO]
Relationship Description: Pyrosomes represented in this dataset provided individuals whose fecal pellets were later analyzed for carbon and nitrogen content in the "P2107 Pyrosome Fecal Pellet Composition" dataset.

Cawley, G., Decima, M., Barbeau, K., Matthews, S., Llopis Monferrer, N., Padilla Villa, M. (2026) **Pyrosome fecal pellet production measurements collected from the cruise RR2105 on R/V Roger Revelle in the California Current Ecosystem from July to August 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-17 doi:10.26008/1912/bco-dmo.1003881.1 [view at BCO-DMO]
Relationship Description: Pyrosomes collected and characterized in this dataset provided individuals used in the "P2107 Pyrosome Fecal Pellet Production Measurements" experiments.

[table of contents | back to top]

Parameters

Parameter	Description	Units
STALINE	Cruise Identifier	unitless
Cycle	4-5 day sampling location period	unitless
Day	Day within sampling location	unitless
Haul	Sequential tow number for all bongo net tows	unitless
Date	Date of sampling event	unitless
Latitude	Latitude of sampling location	decimal degrees
Longitude	Longitude of sampling location	decimal degrees
pyrosome_index	Sequential number for the pyrosome in the bongo net subsample that was counted and measured. See haul summary table for fraction of total sample from which pyrosome counts and lengths are reported here.	unitless
pyrosome_length	Measured lengths of counted pyrosomes in the bongo net subsample. See haul summary table for fraction of total sample from which pyrosome lengths are reported here.	cm

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Bongo Net
Dataset-specific Description	Bongo net with 202-µm mesh to collect pyrosomes and other zooplankton
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	General Oceanics
Generic Instrument Name	Flow Meter
Dataset-specific Description	General Oceanics flow meter to measure volume filtered
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.

[table of contents | back to top]

Deployments

RR2105

Website	https://www.bco-dmo.org/deployment/926884
Platform	R/V Roger Revelle
Start Date	2021-07-13
End Date	2021-08-13
Description	California Current Ecosystem Long Term Ecological Research Process Cruise, CCE LTER III. Also referred to as "P2107". See more information from R2R: https://www.rvdata.us/search/cruise/RR2105

[table of contents | back to top]

Project Information

Collaborative Research: Assessing the causes of the pyrosome invasion and persistence in the California Current Ecosystem (Pyrosomes in the CCE)

Coverage: California Current ecosystem off the U.S. West Coast

NSF Award Abstract:
A key component of the ocean food web is comprised of floating animals, or zooplankton, that transfer energy from phytoplankton to fish, whales, and birds. Zooplankton include many different types of organisms that can be broadly categorized as crustacean or gelatinous, with most fish and whales preferring crustaceans as a fat-rich food source over gelatinous animals, which are higher in water content. Historically, the California Current ecosystem off the U.S. West Coast has been dominated by crustacean zooplankton, such as krill and copepods, but in 2014 there were huge abundances of a type of colonial, gelatinous zooplankton known as pyrosomes, which caused widespread damage to fisheries by fouling fishing gear and dominating catch. Although the arrival of pyrosomes coincided with an extensive marine heatwave, lower abundances have since persisted despite a return to cooler ocean temperatures. Analysis of time series data from the California Cooperative Oceanic Fisheries Investigations (CalCOFI) indicate that pyrosomes were also observed in the California Current many decades ago when the ocean was not particularly warm. This study combines analysis of past samples from CalCOFI, ocean circulation models, and biological models to understand the causes of these quickly growing pyrosome populations in the California Current. It supports training for undergraduate and graduate students. In addition, the project is reaching K-12 students through a unique partnership with the San Diego County Office of Education that is developing Next Generation Science Standards (NGSS)-aligned resources for middle and high school science teachers in California. The educational resources are being disseminated through the California Science Project and California Environmental Literacy Initiative. Public outreach in San Diego (CA) is through the Enhancing Your Horizons San Diego conference and the San Diego Regional Competition of the National Ocean Sciences Bowl, and in Santa Cruz (CA) through the Seymour Marine Discovery Center.

Predicting how ecosystems respond to accelerating climate change is a major challenge. The recent appearance of the pyrosome Pyrosoma atlanticum in the California Current is a major perturbation to the ecosystem, and the cause remains unknown. Both ocean physics and plankton food-web dynamics are key determinants of variability in pelagic community composition in this ecosystem, yet unraveling the degree to which variability in physics (through warming and advection) combines with shifting biological interactions (through nutrient cycling and altered food-web dynamics) to determine composition and function is complicated. This project combines the analysis of past historical samples from seven decades of the CalCOFI time series, data-assimilative and non-data assimilative ocean circulation models, and biological population models to determine the role ocean physics and biological interactions have played in shaping pyrosome abundance, trophic dynamics, and population growth and mortality in the California Current. This novel framework is providing mechanistic understanding that is required to predict how plankton communities respond to 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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2329559
NSF Division of Ocean Sciences (NSF OCE)	OCE-2224726

[table of contents | back to top]