

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

Website: <https://www.bco-dmo.org/dataset/1004017>

Data Type: Other Field Results

Version: 1

Version Date: 2026-08-14

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 biogenic silica measurements of pyrosome fecal pellets collected during the cruise RR2105 on R/V Roger Revelle (CCE LTER P2107, July-August 2021) in the California Current Ecosystem.

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Coverage

Spatial Extent: N:36.5729 E:-120.9346 S:34.4768 W:-130.5453

Temporal Extent: 2021-07-29 - 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

Colonies for production and sinking experiments were collected from the upper 40 m of the water column using a vertically towed 202 μm net equipped with a 30 L non-filtering cod-end. Tows were preferentially conducted at night, as organisms exhibited distinct DVM behavior, which was possible during the Offshore cycle; however, for the transects we conducted, these tows were conducted whenever the ship arrived on station. For fecal pellet production experiments, colonies were gently transferred from the cod-end, ensuring that no air entered the common canal, and placed in an appropriately sized container (allowing the organisms to be submerged in typically ~ 500 mL, but we used containers of up to 1.5L for a handful of large specimens) filled with filtered 0.2 μm seawater for microscopic evaluation. Pellet production experiments were only conducted during the Offshore cycle and the two transects (CCT and AT), while fecal pellet sinking rate determinations were conducted during Onshore 2, Offshore, and one transect (CCT).

Fecal pellet production was measured following the methods described in Drits et al. (1992). Pyrosome colonies were transferred into containers filled with 0.2- μm -filtered seawater and placed under dissecting microscopes to visualize their common cloacal aperture. The number of fecal pellets produced was counted during continuous observations over 2 min. Initially, we observed colony defecation for 1 to 7 min while determining the count period length. Since we observed a noticeable decrease in production over time, beginning after the first ~ 2 -3 minutes, as noted by Drits et al. (1992), we conducted counts for 2 min immediately after transferring the colonies into the observation container.

For biogenic silica estimations, pellets ($n = 35$ -104) collected from the above production experiment, were transferred to a 47 mm diameter track-etched polycarbonate filter (Isopore™), then folded and placed in a cryogenic vial and placed in an oven at 60°C for 24h. Biogenic silica measurements were conducted as described below for water column samples. Biogenic silica concentrations from grouped pellets on the filter was then divided by the number of pellets to obtain individual bSi per pellet measurements.

Data Processing Description

For biogenic silica [KB1] analysis, seawater samples (0.25–1 L, depending on distance to shore, or biomass) were filtered under gentle vacuum through 0.8 μm pore size, 47 mm diameter track-etched polycarbonate filters (Isopore™). Filters were then folded into quarters (particulate matter inside-facing) and placed in cryovials with the caps slightly loosened, dried in an oven at 60° C for 24 h, and stored until their laboratory analysis (Brzezinski and Nelson 1989). On land, all biogenic particles filtered were digested at 95° C for 40 minutes in a 0.2 N NaOH solution (Paasche 1973; Brzezinski and Nelson 1995). This procedure specifically targets the dissolution of biogenic silica, so lithogenic silica interferences are essentially avoided (Krausse et al. 1983). The samples were digested in HF-cleaned 15 mL TPX® polymethylpentene tubes as recommended in Brzezinski and Nelson, 1995. Immediately after their digestion, the samples were cooled, neutralized with 1 N HCl and centrifuged for 10 minutes at 1200 $\times g$ (Brzezinski and Nelson, 1989). The reactive orthosilicic acid content of the supernatant is determined at 810nm via the colorimetric ammonium molybdate method described by Strickland and Parsons (1972). Sodium hexafluorosilicate (Na_2SiF_6) standard curves (0, 0.5, 5, 20, 50, 100 $\mu\text{mol L}^{-1}$) were made in deionized water. Standards were treated identically to samples.

bSi on the filter was calculated by computing bSi in μmoles in 20 mL (dividing abs (%) by slope and multiplying by 0.2.) and then multiplying by the dilution factor.

BCO-DMO Curation Notes

- Loaded data from Cawleyetal_2026_PelletbSi.csv, set, "nd", and "ND" as missing values
- Renamed columns: "Cycle; transect1=10; transect 2=20;" to Cycle_id, "day/sta" to day_sta_id, "lat [deg_north]" to latitude, "lon [deg_west]" to longitude, "abs [%]" to absorbance, "dilution factor" to dilution_factor, "bSi [μmoles in 20 mL]" to bSi, "bSi [μmoles on filter]" to bSi_filter, "pellets for filter" to pellets_for_filter
- Renamed table 1004017_v1_cawley_pelletbsi

Problem Description

N/A

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Data Files

File
1004017_v1_cawley_pelletbsi.csv (Comma Separated Values (.csv), 3.23 KB) MD5:74e36ed36cbd6d4af9138cc2e0da5e3b Primary data file for dataset ID 1004017, version 1

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Related Publications

Brzezinski, M. A., & Nelson, D. M. (1989). Seasonal changes in the silicon cycle within a Gulf Stream warm-core ring. Deep Sea Research Part A. Oceanographic Research Papers, 36(7), 1009–1030. doi:[10.1016/0198-0149\(89\)90075-7](https://doi.org/10.1016/0198-0149(89)90075-7)

Methods

Brzezinski, M. A., & Nelson, D. M. (1995). The annual silica cycle in the Sargasso Sea near Bermuda. Deep Sea Research Part I: Oceanographic Research Papers, 42(7), 1215–1237. doi:[10.1016/0967-0637\(95\)93592-3](https://doi.org/10.1016/0967-0637(95)93592-3)

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

Drits, A. V., Arashkevich, E. G., & Semenova, T. N. (1992). Pyrosoma atlanticum (Tunicata, Thaliacea): grazing impact on phytoplankton standing stock and role in organic carbon flux. Journal of Plankton Research, 14(6), 799–809. <https://doi.org/10.1093/plankt/14.6.799>

Results

KRAUSSE, G. L., SCHELSKE, C. L., & DAVIS, C. O. (1983). Comparison of three wet-alkaline methods of digestion of biogenic silica in water. Freshwater Biology, 13(1), 73–81. Portico. <https://doi.org/10.1111/j.1365-2427.1983.tb00658.x>

Methods

Paasche, E. (1973). Silicon and the ecology of marine plankton diatoms. I. Thalassiosira pseudonana (Cyclotella nana) grown in a chemostat with silicate as limiting nutrient. Marine Biology, 19(2), 117–126.

<https://doi.org/10.1007/bf00353582> <https://doi.org/10.1007/BF00353582>

Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.

Methods

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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: The "P2107 Pyrosome Fecal Pellet Sinking" dataset provides sinking-rate measurements associated with fecal pellets from the same experimental material used for biogenic silica

analyses in this dataset.

Cawley, G., Decima, M., Barbeau, K., Matthews, S., Llopis Monferrer, N., Padilla Villa, M. (2026) **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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-17 doi:10.26008/1912/bco-dmo.1003320.1 [[view at BCO-DMO](#)]

Relationship Description: Pyrosomes collected and characterized in the "P2107 Pyrosome Length and Abundance" dataset provided the biological material from which fecal pellets were produced and subsequently analyzed for biogenic silica in this 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: The "P2107 Pyrosome Fecal Pellet Composition" dataset provides complementary carbon and nitrogen measurements for fecal pellets associated with the biogenic silica analyses in this 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: Fecal pellets analyzed for biogenic silica in this dataset were generated during the "P2107 Pyrosome Fecal Pellet Production Measurements."

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Parameters

Parameter	Description	Units
Incubation	Incubation experiment identifier	unitless
Cycle_id	Sampling cycle identifier; Transect 1 = 10, Transect 2 = 20	unitless
day_sta_id	Day and/or station identifier	unitless
date	Date of Experiment	unitless
latitude	Latitude in decimal degrees north	decimal degrees
longitude	Longitude in decimal degrees west	decimal degrees
cycle	Sampling cycle number	unitless
station	Sampling station identifier	unitless
absorbance	Absorbance expressed as percent	percentage (%)
slope	Calibration curve slope used for calculation	unitless
dilution_factor	Dilution factor applied to sample	unitless
bSi	Biogenic silica concentration in 20 mL subsample	micromoles (μm)
bSi_filter	Total biogenic silica measured on filter	micromoles (μm)
pellets_for_filter	Number of pellets collected on filter	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Plankton Net
Dataset-specific Description	202 µm net equipped with a 30 L non-filtering cod-end
Generic Instrument Description	A Plankton Net is a generic term for a sampling net that is used to collect plankton. It is used only when detailed instrument documentation is not available.

Dataset-specific Instrument Name	Cary 300 UV-Vis spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	After alkaline digestion of biogenic silica from particulate material, dissolved silica concentrations were obtained using a colorimetric molybdate-blue method. The Cary 300 UV-Vis measured absorbance at 810 nm to calculate bSi concentrations from calibration standards and processed sample digests.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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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

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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.

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Funding

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

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