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

Website: https://www.bco-dmo.org/dataset/1003881
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
Barbeau, Katherine	University of California-San Diego Scripps (UCSD-SIO)	Principal Investigator
Decima, Moira	University of California-San Diego Scripps (UCSD-SIO)	Principal Investigator
Llopis Monferrer, Natalia	Université de Bretagne Occidentale	Scientist
Matthews, Stephanie	University of California-San Diego Scripps (UCSD-SIO)	Scientist
Cawley, Grace	University of California-San Diego Scripps (UCSD-SIO)	Student, Contact
Padilla Villa, Minerva	University of California-San Diego Scripps (UCSD-SIO)	Student
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains pyrosome fecal pellet production measurements conducted during the cruise RR2105 on R/V Roger Revelle (CCE LTER P2107, July-August 2021) in the California Current Ecosystem.

Table of Contents

- Dataset Description
  - Methods & Sampling
  - Data Processing Description
  - BCO-DMO Curation Notes
  - Problem Description
- Data Files
- Related Publications
- Related Datasets
- Parameters
- Instruments
- Deployments
- Project Information
- Funding

Dataset Description

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

Methods & Sampling

Pyrosome 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 of the organism, 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. Pellet counts were recorded cumulatively at each observation time point, with each time value representing elapsed observation time in minutes. Interval-specific pellet production was then calculated as the difference between consecutive cumulative counts. For example, the number of pellets produced between Time 1 and Time 2 was calculated by subtracting the cumulative pellet count at Time 1 from the cumulative count at Time 2. Therefore, pellet production values represent the number of pellets produced during each elapsed observation interval, rather than the total number present at each time point. After the production experiments were concluded, pellets were collected for sinking and aging experiments. A subsample of the produced pellets was allowed to sit in natural seawater for 24 and 48 hours and evaluated for sinking rates; these were referred to as ‘aged’ pellets.

Data Processing Description

Max_Pellets is the value that represents the most pellets produced in one minute of the 1-7 minute production experiments. Min_pellets is the value that represents the least amount of pellets produced in one minute of the 1-7 minute production experiments. max and min pellets per hour are Max_pellet values or min_pellet value multiplied by 60 minutes.

BCO-DMO Curation Notes

- Loaded Cawleyetal_2026_PelletProduction.csv with empty and "nd" values interpreted as missing data
- Renamed columns to remove spaces and use underscores
- Output table to 1003881_v1_productionmeasurements.csv

Problem Description

Production values were measured from individual pyrosome colonies. In some cases, specimen identification numbers (“Pyrosome number”) used to track individual colonies were incompletely documented. All reported values represent single-colony measurements. Identification numbers followed by a question mark indicate uncertainty in specimen tracking only and do not affect the associated production measurements.

[table of contents | back to top]

Data Files

File	
1003881_v1_productionmeasurements.csv	(Comma Separated Values (.csv), 12.56 KB) MD5:4bbe5c49c72ba494e4f714d807dfea70
Primary data file for dataset ID 1003881, version 1	

[table of contents | back to top]

Related Publications

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

[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: Fecal pellets generated during the production measurements were subsequently used in experiments measuring fecal pellet sinking rates.

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: Individuals collected as part of the "P2107 Pyrosome Length and Abundance" dataset were selected for laboratory observations in which fecal pellet production was measured.

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 generated during these production measurements were subsequently analyzed for biogenic silica.

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: Fecal pellets generated during these production measurements were subsequently analyzed for carbon and nitrogen content.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cycle	Sampling cycle identifier	unitless
Date	Date of incubation experiment	unitless

Incubation	Incubation experiment identifier	unitless
Pyrosome_number	Specimen tracking identifier; ? indicates uncertain specimen identity but does not affect production measurements	unitless
Time_1	Elapsed observation time at each cumulative pellet count	min (minutes)
Pellets_1	Cumulative number of pellets produced up to each observation time	unitless
Pellets_Per_Time_1	Number of pellets produced during each observation interval ending at the corresponding time point	unitless
Time_2	Elapsed observation time at each cumulative pellet count	min (minutes)
Pellets_2	Cumulative number of pellets produced up to each observation time	unitless
Pellets_Per_Time_2	Number of pellets produced during each observation interval ending at the corresponding time point	unitless
Time_3	Elapsed observation time at each cumulative pellet count	min (minutes)
Pellets_3	Cumulative number of pellets produced up to each observation time	unitless
Pellets_Per_Time_3	Number of pellets produced during each observation interval ending at the corresponding time point	unitless
Time_4	Elapsed observation time at each cumulative pellet count	min (minutes)
Pellets_4	Cumulative number of pellets produced up to each observation time	unitless
Pellets_Per_Time_4	Number of pellets produced during each observation interval ending at the corresponding time point	unitless
Max_Pellets	Maximum number of pellets produced across intervals	unitless
pellets_per_hour_max	Maximum hourly pellet production rate	pellets per hour
Min_Pellets	Minimum number of pellets produced across intervals	unitless

pellets_per_hour_min	Minimum hourly pellet production rate	pellets per hour
Length_cm	Length of pyrosome specimen	cm (centimeter)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Salp Net
Generic Instrument Name	Reeve Net
Dataset-specific Description	Reeve net (Salp Net) - 202 µm net equipped with a 30 L non-filtering cod-end
Generic Instrument Description	A Reeve Net is a conventional ring net with a very large acrylic cylindrical cod-end (30 liters) designed to collect fragile gelatinous animals. The net is lowered to a particular depth and then hauled slowly back to the surface (5-10 m/min). Reeve (1981) also described a double net system with no bridle and flotation at the net mouth that is attached to a roller mechanism that rides on a tow wire. The roller system is locked in place by a pressure release device. Once below a set pressure, the roller and nets are released and they float slowly up the wire, gently collecting the zooplankton, without being influenced by the motion of the vessel and associated vertical wire movements. (from Wiebe and Benfield, 2003)

[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]