

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

Website: <https://www.bco-dmo.org/dataset/1003542>

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 fecal pellet sinking measurements conducted 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:36.5643 E:-123.1012 S:34.477 W:-130.5418

Temporal Extent: 2021-07-31 - 2021-08-09

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).

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

To measure sinking rates, we took subsamples of both fresh and aged pellets and sank them in an acrylic tank. Pellets were first imaged with a Zeiss Stemi 508 stereomicroscope equipped with a Canon EOS 77D camera to estimate their size. The major and minor axes of the fecal pellets were measured using Image J ($n = 237$ pellets), with measurements down to the nearest 1 μm . After imaging, pellets were transferred to an acrylic container to estimate the sinking rate. The sinking container was 6.5 x 4 x 16.5 cm, and had marked lines at 0, 5, and 10 cm. Each pellet was gently transferred with a pipette and placed above the starting line to account for any acceleration caused by the pipette's release. The stopwatch started when the pellet crossed the 0 cm line, and the time was recorded when the pellet reached the marked lines at 5 and 10 cm. A total of 247 pellet sinking rates were obtained following this approach.

BCO-DMO Curation Notes

- * Loaded `Cawleyetal\_2026\_PelletSinking.csv` treated empty strings and 'nd' as missing values.
- * Formatted the `time` column by zero-padding values to four digits: `930` became `0930`, `500` became `0500`, and `0` became `0000`, `20` became `0020`
- * Combined `Year`, `Month`, `Day`, and padded time into a new `ISO\_DateTime\_UTC` column using `%Y`, `%m`, `%d`, and `%H%M`, and formatted the result as `%Y-%m-%dT%H:%M`.
- * Renamed columns to remove special characters and spaces.
- * Renamed the table from `cawleyetal\_2026\_pelletsinking` to `1003542\_v1\_sinkingrate`.

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Data Files

File
1003542_v1_sinkingrate.csv (Comma Separated Values (.csv), 25.10 KB) MD5:06a9b5c66c68d289a4c16486f7403ebc
Primary data file for dataset ID 1003542, version 1

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Supplemental Files

File	
Pellet Sinking Photos.zip	(ZIP Archive (ZIP), 1.03 GB) MD5:4caef8277888a7e261807ac8dab8e684
Images included in the dataset. Filenames correspond to the entries in the "Image_ID" column, allowing users to easily match each image to its corresponding dataset entry.	

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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

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Related Datasets

IsRelatedTo

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 individuals whose fecal pellets were later used in sinking-rate 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 from the same experimental material were analyzed for biogenic silica, providing complementary composition measurements for interpreting pellet sinking characteristics.

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 from the same experimental material were analyzed for carbon and nitrogen content, providing complementary composition measurements for interpreting pellet sinking characteristics.

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 used in the "P2107 Pyrosome Fecal Pellet Sinking" experiments were generated during the "P2107 Pyrosome Fecal Pellet Production Measurements."

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Parameters

Parameter	Description	Units
Cruise	Research cruise identifier	unitless
Year	Year of sample collection	unitless
Month	Month of sample collection	unitless
Day	Day of sample collection	unitless
time	Time of sampling collection (timezone: PST, Pacific Standard Time) in hhmm notation.	unitless
ISO_DateTime_Local	DateTime of sample collection (timezone: PST, Pacific Standard Time) in ISO format. Only when sampling time was available	unitless
Cycle_Transect	Combined cycle and transect identifier	unitless
Cycle	Sampling cycle identifier	unitless
Day_Station	Day and/or station identifier	unitless
Latitude	Latitude of sampling location (decimal degrees)	decimal degrees
Longitude	Longitude of sampling location (decimal degrees)	decimal degrees
Incubation	Incubation experiment identifier	unitless
AgedvsFresh	Classification of pellet as aged or fresh	unitless
Hours_Aged	Estimated age of pellet in hours	unitless
Pellet_No	Pellet identifier number	unitless
Image_ID	Image file name.	unitless
Time1	Observation or measurement time point	unitless

Time2	Secondary observation or measurement time point	unitless
Major_um	Major axis length of pellet in micrometers	um
Minor_um	Minor axis length of pellet in micrometers	um

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Instruments

Dataset-specific Instrument Name	Canon EOS 77D
Generic Instrument Name	Camera
Dataset-specific Description	Zeiss Stemi 508 stereomicroscope equipped with a Canon EOS 77D camera.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Zeiss Stemi 508
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Zeiss Stemi 508 stereomicroscope (equipped with a Canon EOS 77D camera)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Reeve Net
Generic Instrument Name	Reeve Net
Dataset-specific Description	Reeve 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)

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

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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