Large phytoplankton chain lengths from BIOSWOT-Med Zooglider deployment in the Northwest Mediterranean Sea during March to May 2023

Website: https://www.bco-dmo.org/dataset/999115
Data Type: Cruise Results
Version: 1
Version Date: 2026-05-22

Project
» Zooglider assessment of zooplankton frontal gradients across the BIOSWOT-Med region (BIOSWOT-Med)

Contributors	Affiliation	Role
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Abstract
These data are based on deployment of the Scripps Zooglider in collaboration with the French-led BIOSWOT-Med study in the Northwestern Mediterranean Sea in Spring 2023. This study was one of the Adopt-a-Crossover field studies carried out around the world in synchrony with the launch by NASA/CNES of the new SWOT satellite for enhanced ocean altimetry. We deployed Zooglider on 30 March 2023 from Palma, Majorca using a small craft, then navigated it remotely to the BIOSWOT-Med study region. Initially Zooglider sampled to the east of Majorca and south of Menorca. Then we recovered Zooglider at sea, transported it to the center of an anticyclonic eddy north of Menorca, and redeployed it, navigating it from the eddy center across the eddy periphery. We then recovered it at sea on 8 May 2023, for a total mission duration of 40 days. Zooglider data were telemetered back to our server each time the vehicle surfaced and the data were immediately posted on our public website, available to all BIOSWOT-Med participants and any member of the general public. The data archived here are length measurements from 5 different groups of highly elongate phytoplankton chains (Guinardia spp., Proboscia spp., Diatom chains with cell lengths much greater than cell widths, diatom chains with cell lengths approximately equal to cell widths, and Trichodesmium filaments) from in situ images taken with Zooglider's shadowgraph Zoocam. Data were typically acquired in Zooglider dives between approximately 420 meters depth and the sea surface, apart from initial and final Zooglider dives that were somewhat shallower.

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Coverage

Location: Northwest Mediterranean Sea
Spatial Extent: **N**:40.9832 **E**:5.4071 **S**:39.32251 **W**:2.53681
Temporal Extent: 2023-03-30 - 2023-05-08

Methods & Sampling

Zooglider was deployed in the western Mediterranean Sea between 20 March and 8 May 2023 as a part of the BioSWOT-Med program (Doglioli et al. 2024). It was initially released off the coast of Majorca, navigated to south of Menorca, then recovered at sea and redeployed in the center of an anticyclonic eddy north of Menorca. The shadowgraph imaging Zoocam on *Zooglider* was activated for dives 1-8 (Majorca, 30 March), dives 245-314 (south of Menorca, 24 April–3 May), and dives 353-389 (eddy, 4-8 May). *Zooglider* ascended at ~10 centimeters per second (cm/s) and the Zoocam sampled at 1 Hz throughout ascent, providing an image approximately every 10 cm of vertical travel. The 15 cm light path of the Zoocam is illuminated with a red LED (620-630 nm), imaging 250 milliliters (mL) per frame. Further details are in Ohman et al. (2018).

After flatfielding, Regions of Interest (ROIs) were segmented using a two step Canny edge detector (Ellen 2018, Ohman et al. 2018). ROIs were pre-classified using a Convolutional Neural Network (Ellen and Ohman 2024), then the classification of ROIs manually verified. In this verification process we observed numerous phytoplankton chains whose morphology was familiar, but whose dimensions were much greater than expected. We retrieved a subset of phytoplankton chains whose feret diameter was $\geq$ 2 millimeters (mm) for closer manual inspection. These ROIs were measured manually with an on-screen digital tool.

Data Processing Description

Data were tabulated and summary statistics calculated for each phytoplankton group.

BCO-DMO Processing Description

- Imported location data from CSV file "962204_v1_ohman_dive_record_zooglider_bioswot.csv", a related dataset from the same project.
- Imported phytoplankton data from original file "Giant_Phytoplankton_Measurements_v1.xlsx" into the BCO-DMO system, removing empty rows and treating "NaN" as missing values (missing values are empty/blank in the final CSV file).
- Joined location data into the phytoplankton table using "Dive_number" (source) matched to "Dive" (target) in half-outer mode, adding "latitude_mid_ascent_75" and "longitude_mid_ascent_75" columns.
- Renamed columns to comply with BCO-DMO naming conventions.
- Combined "Date" and "Time_CET" fields to create "ISO_DateTime_CET" datetime column formatted as %Y-%m-%dT%H:%M:%S (ISO 8601).
- Combined "Date" and "Time_CET" fields (input timezone CET) to create "ISO_DateTime_UTC" datetime column formatted as "%Y-%m-%dT%H:%M:%SZ" (ISO 8601), converted to UTC.
- Removed original "Date" and "Time_CET" columns.
- Applied a typo correction in the Taxon column: "Guindardia" replaced with "Guinardia".
- Saved the final file as "999115_v1_long_phytopl_chain_length_zoogl.csv".

Problem Description

On occasion a phytoplankton chain extended beyond the field of view of the Zoocam, in which case the measurement was recorded with the comment "partially cropped."

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Data Files

File
999115_v1_long_phytopl_chain_length_zoogl.csv (Comma Separated Values (.csv), 27.88 KB) MD5:ddfc6c2b00a33056822146aba3ed5382 Primary data file for dataset ID 999115, version 1

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Related Publications

Doglioli Andrea, & Gregori Gérald. (2023). BioSWOT-Med cruise, L'Atalante R/V Sismer. https://doi.org/10.17600/18002392
Methods

Ellen, J. S., & Ohman, M. D. (2024). Beyond transfer learning: Leveraging ancillary images in automated classification of plankton. Limnology and Oceanography: Methods, 22(12), 943–952. Portico. https://doi.org/10.1002/lom3.10648
Methods

Ohman, M. D., Davis, R. E., Sherman, J. T., Grindley, K. R., Whitmore, B. M., Nickels, C. F., & Ellen, J. S. (2018). Zooglider: An autonomous vehicle for optical and acoustic sensing of zooplankton. Limnology and Oceanography: Methods, 17(1), 69–86. Portico. https://doi.org/10.1002/lom3.10301
Methods

Sherman, J., Davis, R. E., Owens, W. B., & Valdes, J. (2001). The autonomous underwater glider “Spray.” IEEE Journal of Oceanic Engineering, 26(4), 437–446. https://doi.org/10.1109/48.972076
Methods

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Related Datasets

IsRelatedTo

Ohman, M. D., Gastauer, S., & Ellen, J. S. (2026). *CTD Data for BioSWOT-Med Zooglider deployment in the Northwestern Mediterranean Sea, March-May 2023* (Version 1) [Dataset]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.971065.1

Ohman, M. D., Gastauer, S., & Ellen, J. S. (2026). *Particle counts for BioSWOT-Med Zooglider deployment in the Northwestern Mediterranean Sea, March-May 2023* (Version 1) [Dataset]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.982626.1 https://doi.org/10.26008/1912/bco-dmo.982626.1

Ohman, M. D., Gastauer, S., & Ellen, J. S. (2026). *Zooglider dive record from the BIOSWOT-Med cruise in the Northwestern Mediterranean Sea, March-May 2023* (Version 1) [Dataset]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.962204.1

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Parameters

Parameter	Description	Units
Taxon	One of 5 categories of elongate phytoplankton chains whose total length was measured	unitless
Dive	Zooglider dive number	unitless
latitude_mid_ascent_75	Latitude of mid-point of dive during ascent in decimal degrees; positive values indicate northern coordinates	decimal degrees
longitude_mid_ascent_75	Longitude of mid-point of dive during ascent in decimal degrees; positive values indicate eastern coordinates	decimal degrees
ISO_DateTime_CET	Date and time of Zooglider dive (Central European Time) in ISO 8601 format	unitless
ISO_DateTime_UTC	Date and time of Zooglider dive (UTC) in ISO 8601 format	unitless
Pressure_db	Pressure at which phytoplankton chain was imaged	decibars
Total_length_mm	Total length of phytoplankton chain	millimeters (mm)
Comments	Comments or notes. On occasion, a phytoplankton chain extended beyond the field of view of the Zoocam, in which case the measurement was recorded with the comment "partially cropped."	unitless

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Instruments

Dataset-specific Instrument Name	Zooglider SN51
Generic Instrument Name	Zooglider
Dataset-specific Description	Zooglider SN51, manufactured at the Scripps Institution of Oceanography
Generic Instrument Description	Zooglider, designed and built at the Scripps Institution of Oceanography, as described in Ohman et al. (2019. Limnology and Oceanography-Methods 17: 69-86 doi 10.1002/lom3.10301). It is based on a Spray glider hull (Sherman et al. 2002. IEEE Journal of Oceanic Engineering 26: 437-446 doi 10.1109/48.972076), modified with custom optical and acoustic sampling instruments.

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Deployments

BioSWOT-Med

Website	https://www.bco-dmo.org/deployment/962207
Platform	R/V L'Atalante
Start Date	2023-04-21
End Date	2023-05-15
Description	French-led BIOSWOT-Med study in the Northwestern Mediterranean Sea in Spring 2023. This study was one of the Adopt-a-Crossover field studies carried out around the world in synchrony with the launch by NASA/CNES of the new SWOT satellite for enhanced ocean altimetry.

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Project Information

Zooglider assessment of zooplankton frontal gradients across the BIOSWOT-Med region (BIOSWOT-Med)

Coverage: NW Mediterranean Sea

NSF Award Abstract:
Ocean fronts are regions of sharp horizontal discontinuities that can alter phytoplankton growth rates and community composition, zooplankton distributions and grazing activity, and predator foraging success. This study is using Zooglider, an autonomous ocean sampler equipped with a range of sensors and capitalizing on a unique opportunity to investigate frontal gradients and plankton communities in the western Mediterranean Sea. It is timed to coincide with a rapid crossover phase of a new NASA satellite mission. The combination of satellite and field-collected data will provide high resolution of the bio-physical consequences of oceanic frontal processes. The project incorporates training for graduate and undergraduate students as well as public outreach. Results are broadly communicated by partnering with a major public aquarium that serves 450,000 visitors per year, including by exhibiting novel porcelain 'Zooware' meant to convey the sensory experience of exploring the ocean's planktonic fauna.

This project focuses on advancing understanding of frontal processes in the western Mediterranean Sea, at a 'crossover' site where NASA's new Surface Water Ocean Topography (SWOT) satellite is making high-frequency sea surface height measurements using a high-resolution sensor. Measurements from the SWOT satellite are resolving small changes in sea-surface height, making it possible to follow the development and temporal progression of ocean frontal systems. The investigator is assessing the consequences of these frontal systems by testing the hypotheses that 1) zooplankton, marine snow particles, and predators are altered in these ocean frontal regions with a size-dependent or trait-dependent response; 2) particle-grazing zooplankton are more closely associated with layers of marine snow than with layers of living phytoplankton; 3) vertical thin layers of zooplankton are more likely to form in frontal than non-frontal regions; and 4) higher predators such as zooplanktivorous fish and marine mammals are more detectable in frontal regions The project makes use of an autonomous ocean instrument, the Zooglider. It includes a shadowgraph imaging Zoocam for resolving zooplankton and marine snow; a dual frequency Zonar to resolve mesozooplankton and larger sources of acoustic backscatter; and a sensitive hydrophone for recording ambient sounds, especially from marine mammals and fishes. These autonomous measurements are coordinated with complementary measurements from a ship-based sampling program, other autonomous vehicles, and satellite remote sensing.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2243190

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