Particle counts for BioSWOT-Med Zooglider deployment in the Northwestern Mediterranean Sea, March-May 2023

Website: https://www.bco-dmo.org/dataset/982626
Version: 1
Version Date: 2025-08-13

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

Contributors	Affiliation	Role
Ohman, Mark D.	University of California-San Diego Scripps (UCSD-SIO)	Principal Investigator, Contact
Ellen, Jeffrey S.	Naval Information Warfare Center Pacific (NIWC Pacific)	Scientist
Gastauer, Sven	Thünen Institute of Sea Fisheries (TI-SF)	Scientist
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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, Majora 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 the data recovered from the Zooglider at the end of the mission. They include enumerations of 25 categories of planktonic organisms, plus enumerations of particles between 0.25-0.45 mm Equivalent Circular Diameter. Data were typically acquired in Zooglider dives between approximately 420 m depth and the sea surface, apart from initial and final Zooglider dives that were somewhat shallower.

Table of Contents

Coverage

Location: Northwestern Mediterranean
Spatial Extent: **N**:40.98484 **E**:5.40935 **S**:39.32042 **W**:2.53681
Temporal Extent: 2023-03-30 - 2023-05-08

Dataset Description

This dataset is part of a larger collaborative study called BIOSWOT-Med in the Northwestern Mediterranean Sea. The Scripps Zooglider was deployed in collaboration with a French-led team aboard the R/V L'Atalante from March to May 2023.

Data from the Zooglider mission include: CTD, Zonar, Particle counts from Zoocam images and Zooglider dive record data (see related datasets).

Methods & Sampling

Data were acquired in 351 *Zooglider* dive profiles in the Northwestern Mediterranean, usually from approximately 420 m depth to the sea surface. These dives are numbered 1-314 and 353-389. The intervening numbers (315-353) refer to time periods when the *Zooglider* was in transit onboard R/V L'Atalante, during which time no in situ data were acquired. CTD and Chl-*a* fluorometer data were recorded on all dives when *Zooglider* was immersed. Zonar data were not acquired on odd-numbered dives from 47-241 (inclusive). Zoocam (shadowgraph imaging) data were acquired on a total of 115 dives (dives 1-8, 245-314, and 353-389). The Zoocam was powered off during intervening dives in order to conserve memory storage.

Zooglider was moving at approximately 15 cm s-1 horizontally and 10 cm s-1 vertically while sampling, at an average angle of 16-18° off the horizontal. All sampling was done only on the *Zooglider* ascents. During descents, ultraviolet LEDs were powered intermittently and wipers activated to remove any biofouling materials on the optical surfaces.

Zoocam sampling was conducted at 1 Hz. The Zoocam has an image volume of 250 mL, illuminated by red light centered at 620-630 nm.

Sampling details may be found in Ohman et al. (2019). The parallel BIOSWOT-Med sampling program aboard the French research vessel *L'Atalante*, including other autonomous instruments is described in Doglioli and Gérald. (2023) (see related publications).

Data Processing Description

Regions of Interest (ROIs) werer segmented as detailed in Ohman et al. (2019). ROIs were initially classified using a Machine Learning algorithm employing Convolutional Neural Networks (cf. Ellen and Ohman 2024). Then classifications were manually corrected and assigned to 25 reproducible categories of organisms and suspended particles. These abundances were corrected for imaged volume and expressed as numbers of individuals per liter. If tentacles occluded the optical surfaces for a significant portion of a dive, these images were not analyzed. Zero values indicate that category of organism was not detected in the ~250 mL imaged volume.

BCO-DMO Processing Description

* Converted date to ISO format (yyyymmdd -> yyyy-mm-dd)
* Converted time to ISO format (hhmmss -> hh:mm:ss)
* Created an ISO_DateTime_UTC column from the original, separate date and time columns (the original two date and time columns have been removed from the data file
* Special characters within the parameter names of the data file have been removed and replaced with underscores ("_"); for example, column "Particles_0.25mm_0.45mm" has been changed to "Particles_0_25mm_0_45mm"

[table of contents | back to top]

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

[table of contents | back to top]

Related Datasets

IsRelatedTo

Ohman, M. D., Gastauer, S., Ellen, J. S. (2025) **CTD Data for BioSWOT-Med Zooglider deployment in the Northwestern Mediterranean Sea, March-May 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-05 http://lod.bco-dmo.org/id/dataset/971065 [view at BCO-DMO]
*Relationship Description: The temperature, salinity, density, and pressure recorded by *Zooglider* during ascent.*

Ohman, M. D., Gastauer, S., Ellen, J. S. (2025) **Zonar data for BioSWOT-Med Zooglider deployment in the Northwestern Mediterranean Sea, March-May 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-22 http://lod.bco-dmo.org/id/dataset/983031 [view at BCO-DMO]
*Relationship Description: Volume backscatter at two acoustic frequencies (1000 and 200 kHz), and the dB-differenced values between them, recorded by *Zooglider* during ascent.*

Ohman, M. D., Gastauer, S., Ellen, J. S. (2025) **Zooglider dive record from the BIOSWOT-Med cruise in the Northwestern Mediterranean Sea, March-May 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-05-19 http://lod.bco-dmo.org/id/dataset/962204 [view at BCO-DMO]
Relationship Description: Includes the beginning and ending latitudes/longitudes and times of the overall mission, the estimated mid-point latitudes/longitudes of the ascent phase when Zoocam and Zonar data were recorded (i.e., 75% of the distance between the location of the beginning and end of each dive), and the maximum pressure reached for each dive.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Dive_number	Sequence of Zooglider dives	unitless
latitude_mid_ascent_75	Latitude of mid-point of dive during ascent, north is positive	decimal degrees
longitude_mid_ascent_75	Longitude of mid-point of dive during ascent, east is positive	decimal degrees

ISO_DateTime_UTC	Datetime of sampling (UTC time zone, ISO format)	unitless
Pressure	Pressure below the sea surface	decibars
Particles_0_25mm_0_45mm	Concentration of particles between 0.25-0.45 mm Equivalent Circular Diameter	Number/liter
Acantharia	Concentration of Acantharians	Number/Liter
Appendicularians_w_House	Concentration of Appendicularians with a visible House	Number/Liter
Appendicularians_without_House	Concentration of Appendicularians without a visible House	Number/Liter
Ceratium	Concentration of the dinoflagellae Ceratium	Number/Liter
Chaetognaths	Concentration of Chaetognaths	Number/Liter
Cladocerans	Concentration of Cladocerans	Number/Liter
Collodaria	Concentration of Collodaria	Number/Liter
Comets	Concentration of unknown particles with comet-like shape	Number/Liter
Copepods_Oithona	Concentration of Oithona copepods	Number/Liter
Copepods_Others	Concentration of Copepods other than Oithona	Number/Liter
Ctenophores	Concentration of Ctenophores	Number/Liter
Diatoms_high_concentrations	Frames containing diatoms at very high concentrations	Number/Liter
Doliolids_Salps	Concentration of Doliolids plus Salps	Number/Liter
Ephyrae	Concentration of Scyphozoan ephyrae	Number/Liter

Euphausiids	Concentration of Euphausiids and possibly some Decapods	Number/Liter
Fluffs	Concentration of unknow paticles with fluff-like geometry	Number/Liter
Foraminifera	Concentration of Foraminifera	Number/Liter
Hydromedusae	Concentration of Hydromedusae	Number/Liter
Nauplii_and_Calyptopis	Concentration of Nauplii plus Calyptopis stages	Number/Liter
Ostracods	Concentration of Ostracods	Number/Liter
Phaeodarians	Concentration of Phaeodarians	Number/Liter
Polychaetes	Concentration of Polychaetes	Number/Liter
Pteropods	Concentration of Pteropods (excluding cymbuliid pteropods), and possibly some Atlantid heteropods	Number/Liter
Pteropods_Cymbuliids	Concentration of Cymbuliid Pteropods	Number/Liter
Siphonophores	Concentration of Siphonophores	Number/Liter
Non_Identified_Particles_ECD_GT_0_451mm	Concentration of particles larger than 0.451 mm Equivalent Circular Diameter that were not identified	Number/image frame
Total_Particles_ECD_GT_0_451mm	Concentration of total particles larger than 0.451 mm Equivalent Circular Diameter	Number/image frame

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Zoocam shadowgraph optical imaging system
Generic Instrument Name	Underwater Camera
Dataset-specific Description	Custom Zoocam shadowgraph optical imaging system with telecentric lens, as described in Ohman et al. (2019
Generic Instrument Description	All types of photographic equipment that may be deployed underwater including stills, video, film and digital systems.

Dataset-specific Instrument Name	
Generic Instrument Name	Zooglider
Dataset-specific 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.
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.

[table of contents | back to top]

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.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]