Bacterial abundance collected from project "DaVINCi" incubations in the Gulf of Naples, Italy from April to May 2022

Website: https://www.bco-dmo.org/dataset/970493
Data Type: Other Field Results, experimental
Version: 1
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Project
» Shunt or shuttle? Nutrient-driven biogeochemical consequences of diatom host-virus interactions (Shunt or Shuttle)

Contributors	Affiliation	Role
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Abstract
Bacterial abundance was measured on glutaraldehyde-fixed seawater samples collected from nutrient amendment experiments conducted on surface water collected at the Long-Term Ecological Monitoring Station, MareChiara, in the Gulf of Naples, Italy, between April 20 and May 19, 2022. Bacteria were counted using Sybr Green I staining and flow cytometry in whole seawater (free and particle-associated bacteria) and 3-micron filtered seawater (free bacteria). These incubations were part of a field study on "Diatom Virus Infection of Natural Communities" (DaVINCi) and were aimed at understanding the role of silicon limitation in driving diatom viral infection and the subsequent impact of that interaction on microbial growth and hydrolytic enzyme activity.

Table of Contents

Coverage

Location: Station MareChiara, Gulf of Naples, Italy
Spatial Extent: **Lat**:40.81667 **Lon**:14.25
Temporal Extent: 2022-04-30 - 2022-05-19

Methods & Sampling

Samples were collected at Station MareChiara (40°49'N, 14°15'E), Gulf of Naples, Italy. Whole seawater (whole) or seawater filtered through a 3-micrometer (um) polycarbonate filter (<3 um) is transferred to a cryovial containing a final concentration of glutarldehyde of 0.5%. The sample is stored at 4 degrees Celsius (C) for 30 minutes, then flash frozen in liquid nitrogen and stored at -80 degrees C. Upon analysis, samples were thawed, and a final concentration of 10 micrograms per milliliter (ug/ml) of Tween-80 was added. Samples were

sonicated at 50 watts (W) in a water bath for 1 minute. Samples were added to 1X TE buffer (0.01 molar (M) Tris, pH 8.0, 5 micromolar (uM) EDTA) with Sybr Gold (1:20,000 dilution) and heated at 80 degrees C for 10 minutes in the dark. Samples were cooled to room temperature for ~5 minutes before analyzing on an Accuri C6 Plus flow cytometer. Bacteria were gated based on SybrGold fluorescence and side scatter.

Data Processing Description

Events in gate were corrected for the sample volume and dilutions to obtain bacteria abundance in cells per milliliter (cells/mL).

BCO-DMO Processing Description

- Imported original file "Incubations_BacteriaAbundance.csv" into the BCO-DMO system.
- Converted Date column to YYYY-MM-DD format.
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved the final file as "970493_v1_bacterial_abundance.csv".

[table of contents | back to top]

Related Publications

Bidle, K. D., & Azam, F. (2001). Bacterial control of silicon regeneration from diatom detritus: Significance of bacterial ectohydrolases and species identity. Limnology and Oceanography, 46(7), 1606–1623. Portico. https://doi.org/10.4319/lo.2001.46.7.1606
Methods

Kranzler, C. F., Busono, D. A., Walsh, G. J., Carrillo, A. C., Bidle, K. D., & Thamatrakoln, K. (2025). Taxonomically distinct diatom viruses differentially impact microbial processing of organic matter. Science Advances, 11(18). https://doi.org/10.1126/sciadv.adq5439
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	Date the sample was collected	unitless
Incubation	Incubation number identifier	unitless
Incubationn_Timepoint	Timepoint during the incubation the sample was collected	day
Bag	Bag number	unitless
Treatment	Nutrient status consisting of either ambient (unamended), replete (amended with 30 uM N, 1.87 uM P, and 30 uM Si), or Si-limited (amended with 30 uM N, 1.87 uM P, 10 uM Si)	unitless
Replicate_Bag	Replicate bag number	unitless
Size_fraction	Whole (unfiltered) or <3 um (3 um filtered) seawater	unitless
Bacterial_abundance	Bacteria abundance	cells per milliliter (cells/ml)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Accuri C6+ (BD Biosciences)
Generic Instrument Name	BD Biosciences Accuri C6 Plus flow cytometer
Generic Instrument Description	A flow cytometer designed to detect fluorochromes (including FITC, PE, APC), polymer dyes, and fluorescent proteins (including GFP, YFP, mCherry). The instrument is equipped with a blue and red laser, two light scatter detectors, and four fluorescence detectors with user-interchangeable filters. A non-pressurised peristaltic pump system drives the fluidics. The system monitors the sample volume pulled per run and can calculate absolute counts or sample concentration per microliter (uL). In the standard configuration (3-blue/1-red), three detectors read fluorescence emissions from fluorochromes excited by the blue laser, while a fourth detector reads emissions from fluorochromes excited by the red laser. The optional Selectable Laser Module allows the system to operate in 2-blue/2-red and 4-blue configurations. The minimum detectable particle size and sample volume are 0.5 micrometers (um) and 0.5 uL respectively. The maximum number of events is 1 million with an acquisition rate of up to 10,000 events/second.

[table of contents | back to top]

Project Information

Shunt or shuttle? Nutrient-driven biogeochemical consequences of diatom host-virus interactions (Shunt or Shuttle)

Coverage: Gulf of Naples, Italy approx. 40 degrees N, 14 degrees E

NSF abstract:

Diatoms are a type of microscopic marine algae that form the base of the ocean food web and generate about 20% of the oxygen on the planet. Admired since the Victorian age, these organisms are often referred to as the ‘glass houses of the sea’ because of the intricate architecture of their cell walls made of silicon dioxide, or glass. When these organisms die, the cellular-associated carbon and other elements can be either recycled and reused by other phytoplankton or, because glass is heavier than seawater, lost by sinking out of the surface ocean. Thus, the contribution diatoms make to carbon cycling is dictated by the balance between the factors that facilitate recycling and those that stimulate export. As the most abundant entity in the ocean, viruses have, for decades, been characterized as efficient recyclers, acting as ‘shunts’ by preventing the transfer of energy up the food chain through host mortality and lysis. However, it has been suggested that viruses may also act as ‘shuttles’ to the deep ocean, stimulating cellular processes that facilitate sinking. This project is testing this emerging hypothesis and determining how different nutrient regimes influence the fate of diatoms through impacts on viral infection dynamics and death. This is particularly timely given major national and international initiatives currently seeking to quantify how ecosystem interactions regulate carbon export in the ocean. Results of this project have the potential to challenge the canonical role of diatom viruses in carbon cycling and transform the understanding of host-virus interactions in the ocean. This project provides critical funding support for a soft-money, underrepresented, female oceanographer, as well a graduate student and undergraduates. Proposed fieldwork leverages a Rutgers and European Union-funded project, fostering ongoing collaborations with researchers at the Stazione Zoologica Anton Dohrn in Naples, Italy. To facilitate ocean literacy, the PIs are working with the Rutgers’ Education and Outreach team to conduct a series of Teen Cafes focused on carbon cycling, phytoplankton, and viruses utilizing the ‘Tools of Science’ (ToS), a series of educational videos and lesson plans designed to introduce middle, high school, and undergraduate students in underrepresented and underserved communities to core scientific practices.

Diatoms contribute almost 40% of marine primary productivity, dominating the biological pump and disproportionately contributing to carbon export due to the ballasted nature of a silica-based cell wall. The contribution of diatoms to carbon sequestration is dictated by the balance between upper ocean remineralization and sinking, yet we still cannot explain widespread spatio-temporal variability in diatom-mediated export. As the most abundant predatory entities in the ocean, viruses play a critical role in shaping microbial ecosystems and driving global biogeochemical cycles. The premise of this proposal is that nutrient regimes drive the biogeochemical consequences of diatom host-virus interactions. For decades, the role of viruses as ‘shunts’, redirecting particulate matter away from higher trophic levels and into the dissolved fraction through host lysis, has dominated microbial ecology and marine virology. However, the idea that viruses may also act as ‘shuttles’, facilitating carbon export by stimulating aggregation and/or ballast production, is now emerging as a potential mechanism for carbon flux. This project is conducting laboratory-based studies on diverse diatom host-virus systems and manipulative studies on natural diatom communities to compare the impact of viral infection on processes that facilitate sinking – mineral ballast production and particle aggregation – to those that stimulate remineralization – bacterial-mediated hydrolysis and subsequent remineralization of diatom particulate organic matter and silica. Taken together, this work is characterizing the relative balance between these diametrically opposing outcomes within the ecophysiological context of nutrient regime (specifically, silicon and iron limitation), ultimately elucidating the impact of viral infection on the fate of diatom organic matter in the ocean.

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-2049386

[table of contents | back to top]