Division rates, grazing rates, and accumulation rates from phytoplankton dilution experiments conducted on cruises aboard the R/V Robert Gordon Sproul along the Southern California coast during July and August 2023

Website: https://www.bco-dmo.org/dataset/953007
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2025-02-18

Project
» Postdoctoral Fellowship: OCE-PRF: Smoke on the water: the impacts of wildfire ash deposition on surface ocean biology (Smoke on the water)

Contributors	Affiliation	Role
Baetge, Nicholas	Oregon State University (OSU)	Principal Investigator
Graff, Jason	Oregon State University (OSU)	Scientist
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Abstract
These data include division rates, grazing rates, and accumulation rates from dilution experiments conducted on cruises aboard the R/V Robert Gordon Sproul (SP2319, SP2320) between dates 2023-07-28 and 2023-08-19 along the Southern California coast. Dilution experiments were used to assess phytoplankton growth and microzooplankton grazing rates. Deposition of wildfire ash on the ocean can fertilize microbial production but also has the potential to inhibit microbial growth due to heavy metal toxicity. The data collected from these field experiments can contribute to elevating understanding of wildfire-driven material transfer from the terrestrial system to the ocean and its impact on carbon and energy flow in marine food webs. These data were collected by Dr. Nicholas Baetge, Dr. Jason Graff, Dr. Allen Milligan, Brian Ver Wey, and Parker Hansen of Oregon State University.

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Coverage

Location: Southern California coast
Spatial Extent: **N**:35.21268 **E**:-118.402 **S**:33.54503 **W**:-122.2133
Temporal Extent: 2023-08-02 - 2023-08-18

Methods & Sampling

All surface seawater was collected just prior to local sunrise from a SBE-911+ Conductivity-Temperature-Depth (CTD, Sea-Bird Scientific) Niskin bottle rosette cast and then transferred or directly filtered into acid-cleaned 20-liter (L) carboys with platinum-cured silicone tubing.

Phytoplankton division and accumulation rates and zooplankton grazing rates (1/d) were estimated in 14 experiments, in which changes in group-specific phytoplankton cell abundances were measured using flow cytometry in a dilution series of total and filtered seawater after 24 hours (sampling at 0 hours and 24 hours). Phytoplankton apparent and instantaneous division rates, accumulation rates, and zooplankton grazing rates were quantified following Morison et al. (2019). For each experiment, 0.45-micrometer (µm) filtered seawater was generated directly from Niskin bottles using a polyethersulfone capsule filter (Polycap TC, Whatman) (Morison et al., 2019). Total seawater was diluted with the filtered seawater in 1-liter (L) acid-cleaned polycarbonate bottles to a final concentration of 100%, 75%, 50%, and 25% total seawater (Landry and Hassett, 1982). Each experiment included at least one biological replicate of one randomly selected dilution. Diluted water either remained unamended or was amended with ash leachate prior to being screened with mesh and incubated in a deck-board incubator with continuously flowing seawater. Ash leachates were added to a final amendment of ~4 micromoles carbon per liter (µmol C/L) as dissolved organic carbon (DOC). Incubations were screened to obtain a light level corresponding to the median intensity in the surface mixed layer.

BCO-DMO Processing Description

- Imported original file "PHYTO_DILUTION.csv" into the BCO-DMO system.
- Flagged "NA" as a missing data value; missing data are empty/blank in the final CSV file.
- PI applied rounding to numeric values and provided a new file.
- Saved final data file as "953007_v1_phytoplankton_dilution_experiments.csv".

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Data Files

File	
953007_v1_phytoplankton_dilution_experiments.csv	(Comma Separated Values (.csv), 8.97 KB) MD5:8bec42af512a4f0e6a0b8f1ab7c4ecfd
Primary data file for dataset ID 953007, version 1	

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Related Publications

Baetge, N., Halsey, K.H., Hanan, E.J., Behrenfeld, M.J., Milligan, A.J., Graff, J.R., Hansen, P., Carlson, C.A., Boiteau, R.B., Arrington, E.A., Comstock, J., Halewood, E.R., Harvey, E.L., Nelson, N.B., Opalk, K., Very Wey, B. (in review). Pre-existing in situ conditions shape coastal plankton response to fire-generated ash leachate. Limnology and Oceanography
Results

Landry, M. R., & Hassett, R. P. (1982). Estimating the grazing impact of marine micro-zooplankton. Marine Biology, 67(3), 283–288. doi:10.1007/bf00397668 https://doi.org/10.1007/BF00397668
Methods

Morison, F., Harvey, E., Franzè, G., & Menden-Deuer, S. (2019). Storm-Induced Predator-Prey Decoupling Promotes Springtime Accumulation of North Atlantic Phytoplankton. Frontiers in Marine Science, 6. https://doi.org/10.3389/fmars.2019.00608
Methods

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Parameters

Parameter	Description	Units
stn	station number	unitless
lat	latitude	degrees North
lon	longitude	degrees West
dt	datetime (UTC) in ISO 8601 format	unitless
trt	treatment type: control or amendment with (1) Thomas Fire ash leachate, (2) low temperature (<500 degrees C) ash leachate, or (3) high temperature (>500 degrees C) ash leachate.	unitless
phyto	phytoplankton group enumerated in dilution experiments	unitless
division	mean apparent division rate for each phytoplankton group across replicate bottles	per day (1/d)
sd_division	standard deviation of the mean apparent division rate for each phytoplankton group across replicate bottles	per day (1/d)
grazing	mean grazing rate rate for each phytoplankton group across replicate bottles	per day (1/d)
sd_grazing	standard deviation of the mean grazing rate for each phytoplankton group across replicate bottles	per day (1/d)
accumulation	mean accumulation rate for each phytoplankton group across replicate bottles	per day (1/d)
sd_accumulation	standard deviation of the mean accumulation rate for each phytoplankton group across replicate bottles	per day (1/d)

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Instruments

Dataset-specific Instrument Name	Influx Cell Sorter
Generic Instrument Name	BD Biosciences Influx Cell Sorter
Dataset-specific Description	Three phytoplankton groups - Synechococcus, picoeukaryotes, and nanoeukaryotes - were identified and enumerated by flow cytometry using an Influx Cell Sorter (Becton, Dickinson, and Company).
Generic Instrument Description	The BD Influx cell sorter is a flow cytometry platform with modular architecture and a combination of detection capabilities and hands-on controls. The optical system has up to ten lasers that can be customized with detectors and filters. The BD Influx system can handle a throughput rate of up to 200,000 events per second and features two, four and six way sorting as well as plate sorting. The fluidics system protects cells and addresses contamination. The nozzle assembly is designed to produce high droplet frequencies at relatively low pressures, enabling high-speed sorting while maintaining cell viability and functionality.

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

SP2320

Website	https://www.bco-dmo.org/deployment/953019
Platform	R/V Robert Gordon Sproul
Start Date	2023-08-14
End Date	2023-08-19
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SP2320

SP2319

Website	https://www.bco-dmo.org/deployment/953028
Platform	R/V Robert Gordon Sproul
Start Date	2023-07-28
End Date	2023-08-10
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SP2319

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Project Information

Postdoctoral Fellowship: OCE-PRF: Smoke on the water: the impacts of wildfire ash deposition on surface ocean biology (Smoke on the water)

Coverage: Pacific Ocean

NSF Award Abstract:
Climate-driven warming is projected to increase the frequency, intensity, and size of wildfires that can have severe environmental, human, and economic impacts, particularly along the U.S. West Coast. These wildfires result in dramatic CO2 emissions and deposition of ash carrying nutrients, organic matter, and trace metals onto the coastal and open ocean. Deposition of wildfire ash on the ocean can alter the carbon and energy flow through marine food webs by fertilizing microbial production or inhibiting microbial growth due to heavy metal toxicity. How the character of both the ash (e.g., chemical quality, fertilizing v. toxic) and the starting microbial community composition (e.g., diversity, size distribution) influences the microbial response to ash-derived material is unknown. This project will address this knowledge gap by investigating the physiological responses of marine plankton off the U.S West Coast to different types of ash generated from local wildfires and plant biomass. This work will advance interdisciplinary science, bridging biological oceanography with terrestrial ecology and biogeochemistry, by generating foundational knowledge of wildfire impacts on surface ocean biology and carbon and energy transfer from land to ocean. Results from this project will enable improved forecasts of changes in marine ecosystems in response to wildfires, which is information pertinent to communities and industries that depend on ocean ecosystem resources, including fisheries. The work will also inform national efforts to mitigate and adapt to the impacts of climate change by addressing whether wildfire-stimulated fertilization and carbon fixation in the ocean can offset CO2 emissions from wildfires. This project will broaden participation and education in ocean science by providing immersive research experiences for multiple undergraduate students and opportunities for them to disseminate their work through scientific conferences and publications. Additionally, a day-long content unit related to the project will be developed and implemented in Oregon State University’s annual week-long Microbiology Summer Camp, which provides local high school students with a hands-on learning experience in microbiology.

Specifically, this project consists of mechanistic studies designed to quantitatively describe the physiological responses (e.g., growth, productivity, cellular stoichiometry) of phytoplankton and bacterioplankton to a variety of ash types. The quantity and proportion of nutrients, organic matter, and trace metals leached from ash into seawater likely depends on the quality of the ash, which is influenced by vegetation type and the temperature at which the ash was produced. This study will assess how microbial production and growth are fertilized or inhibited by the composition of ash and will consist of two primary elements. In the first element, ash will be collected from the field and generated in the lab from plant biomass. The ash will then be leached in seawater and chemically characterized for inorganic and organic matter content. In the second element, seawater incubation experiments will be conducted to quantify physiological and diversity-based responses of naturally occurring phytoplankton and bacterial communities to different ash types. Data generated from this project will contribute to improved predictive models of wildfire-driven material transfer from the terrestrial system to the ocean and its impact on carbon and energy flow in marine food webs.

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-2306993

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