Estimated frequency of lytic viral infection from samples collected in the Eastern Tropical North Pacific oxygen minimum zone region (ETNP OMZ) on R/V New Horizon cruise NH1315 during June 2013

Website: https://www.bco-dmo.org/dataset/822914
Data Type: Cruise Results
Version: 1
Version Date: 2020-09-01

Project
» Ecology and biogeochemical impacts of viruses in marine oxygen minimum zones (OMZ Viruses)

Contributors	Affiliation	Role
Brum, Jennifer R.	University of Arizona (UA)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Estimated frequency of lytic viral infection from samples collected in the Eastern Tropical North Pacific oxygen minimum zone region (ETNP OMZ) on R/V New Horizon cruise NH1315 from 13-28 June 2013. Samples were deposited onto TEM grids, stained, and examined using a transmission electron microscope. Micrographs of cells were collected and characterized as infected or uninfected.

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Coverage

Spatial Extent: **N**:18.92 **E**:-104.89 **S**:18.92 **W**:-108.799
Temporal Extent: 2013-06-19 - 2013-06-22

Dataset Description

Estimated frequency of lytic viral infection from samples collected in the Eastern Tropical North Pacific oxygen minimum zone region (ETNP OMZ) on R/V New Horizon cruise NH1315 from 13-28 June 2013. Samples were deposited onto TEM grids, stained, and examined using a transmission electron microscope. Micrographs of cells were collected and characterized as infected or uninfected.

Methods & Sampling

Detailed protocols, including suggestions from the scientific community, are published on the lab website at https://u.osu.edu/viruslab/protocols/ and maintained on protocols.io at https://www.protocols.io/workspaces/sullivan-lab.

Samples were collected from the Eastern Tropical North Pacific oxygen minimum zone region (ETNP OMZ) during the OMZ Microbial Biogeochemistry Expedition cruise (R/V NewHorizon,13-28 June 2013). Seawater was collected from 16 depths spanning the mixed layer, oxycline, OMZ core, and below the OMZ. Collections were made using Niskin bottles on a rosette. Samples were preserved with EM-grade glutaraldehyde (2% final concentration), flash-frozen in liquid nitrogen and stored between -72 °C and -80 °C until analysis.

Samples were centrifuged for 1 h at 55 000 g using an ultracentrifuge (LM-80, Beckman, Brea, CA, USA) onto TEM grids (200 mesh copper grids with carbon- stabilized formvar support; Ted Pella, Redding, CA, USA). Grids were then stained with uranyl acetate and analyzed as previously described (Brum et al., 2005) to determine the frequency of visibly infected cells using a transmission electron microscope (CM12, Philips, Eindhoven, The Netherlands). The frequency of infected cells was then calculated from the frequency of visibly infected cells (Binder, 1999).

Data Processing Description

BCO-DMO Processing:
- added station latitude and longitude;
- added date (from related dataset https://www.bco-dmo.org/dataset/629125);
- replaced spaces with underscores in parameter names.

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Data Files

File
fic.csv (Comma Separated Values (.csv), 1.24 KB) MD5:57fe2765adad7a2c7bd430c5c118f1d1 Primary data file for dataset ID 822914

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Related Publications

Binder, B. (1999). Reconsidering the relationship between virally induced bacterial mortality and frequency of infected cells. Aquatic Microbial Ecology, 18, 207–215. doi:10.3354/ame018207
Methods

Brum, J. (2015). Adsorbing Viruses on TEM Grids v1. Protocols.io. doi:10.17504/protocols.io.dar2d5
Methods

Brum, J. (2015). Concentrating Viruses with an Amicon or Nanosep Centrifugal Ultrafiltration Device v1. Protocols.io. doi:10.17504/protocols.io.c54y8v
Methods

Brum, J. (2015). FVIC (Frequency of Visibly Infected Cells) Protocol v1. Protocols.io. doi:10.17504/protocols.io.dbp2mm
Methods

Brum, J. (2015). Positive and Negative Staining of Viruses on TEM Grids v1. Protocols.io. doi:10.17504/protocols.io.day2fv
Methods

Brum, J., Steward, G., Jiang, S., & Jellison, R. (2005). Spatial and temporal variability of prokaryotes, viruses, and viral infections of prokaryotes in an alkaline, hypersaline lake. Aquatic Microbial Ecology, 41, 247–260. doi:10.3354/ame041247
Methods

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Parameters

Parameter	Description	Units
Number_of_Infected_Cells	Number of infected cells seen	unitless
Number_of_Cells_Analyzed	Number of cells analyzed	unitless
FVIC_percent	Calculated frequency of visibly infected cells	unitless
Lower_90_CI_FVIC	Lower bound of 90% confidence interval for FVIC	unitless
Upper_90_CI_FVIC	Upper bound of 90% confidence interval for FVIC	unitless
FIC	Calculated frequency of infected cells	unitless
Lower_90_CI_FIC	Lower bound of 90% confidence interval for FIC	unitless
Upper_90_CI_FIC	Upper bound of 90% confidence interval for FIC	unitless
Station	Station where sample was collected	unitless
Depth	Depth of sample	meters
Latitude	Station latitude	degrees North
Longitude	Station longitude	degrees East
Date	Date; format: YYYY-MM-DD	unitless

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Instruments

Dataset-specific Instrument Name	Macrofire Monochrome CCD camera
Generic Instrument Name	Camera
Dataset-specific Description	Macrofire Monochrome CCD camera (Optronics, Goleta, CA, USA)
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Air-driven ultracentrifuge (Beckman)
Generic Instrument Name	Centrifuge
Dataset-specific Description	Air-driven ultracentrifuge (Airfuge CLS, Beckman Coulter, Brea, CA, USA)
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

Dataset-specific Instrument Name	Philips CM12 transmission electron microscope (TEM)
Generic Instrument Name	Electron Microscope
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of electrons behaving as waves.

Dataset-specific Instrument Name	Niskin bottles
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

NH1315

Website	https://www.bco-dmo.org/deployment/628427
Platform	R/V New Horizon
Start Date	2013-06-13
End Date	2013-06-28
Description	Oxygen Minimum Zone Microbial Biogeochemistry Expedition (OMZoMBiE) Proposed Sampling Stations Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Ecology and biogeochemical impacts of viruses in marine oxygen minimum zones (OMZ Viruses)

NSF Award Abstract:
Marine oxygen minimum zones (OMZs) are regions of the world's oceans that have low or no oxygen. Often referred to as "dead zones" because of their lack of larger organisms, OMZs actually support specific microbial communities adapted to survive in these low-oxygen regions. These microbes perform metabolic processes that produce greenhouse gases such as methane, and significantly alter global nitrogen budgets. In turn, viruses can alter every aspect of microbial communities by causing mortality and altering microbial functions; yet we know little regarding how viruses affect OMZ ecosystems, which is limiting our ability to predict future changes to the Earth system as these OMZs expand over time. This proposed research seeks to fill this knowledge gap by examining the types of viruses that are present in OMZs, as well as how they alter microbial communities and their impact on global processes. In the broader perspective, this proposed work will provide extensive datasets for 7 marine OMZ regions that can be interrogated through publically-available analysis tools, thus enabling environmental science for both research and educational purposes including real-world research experience in undergraduate classes to strengthen scientific education. One postdoc, two graduate students, and undergraduate students will be trained and mentored during this project. Furthermore, the work will facilitate international collaboration with leading microbial oceanographers from across the world.

This project will use recent advances in quantitative environmental viral analysis to rapidly enhance our knowledge of OMZ viral communities through examination of 100s of samples from 7 globally-distributed marine OMZ regions with varying levels of oxygen depletion. The specific aims of the project are to (i) gain a basic understanding of viral abundances, viral-induced microbial mortality, and viral community structure, as well as the environmental conditions that drive differences in these parameters, and (ii) assess the effects of viruses on nutrient and gas cycling in OMZs. These aims will be accomplished through analyzing viral

metagenomes to assess how viral communities differ among the 7 diverse OMZ regions, and how they diverge from communities in oxygenated waters. Further, the viral metagenomes will be coupled with microbial metagenomes to assess virus-host dynamics and the effects of viral-induced mortality on microorganisms performing key metabolic functions. Finally, the abundance and expression of viral-encoded metabolic genes will be used to perform gene-based biogeochemical modeling to determine the extent of viral influences in OMZ biogeochemical cycling.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658040

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