Counts of faunal colonists found on experimental settlement surfaces deployed at Tica Vent in East Pacific Rise on R/V Atlantis cruise AT42-21 and R/V Roger Revelle cruise RR2102 from Dec 2019 to Apr 2021

Website: https://www.bco-dmo.org/dataset/949181
Data Type: experimental
Version: 1
Version Date: 2025-01-23

Project
» RUI: Collaborative: The Predictive Nature of Microbial Biofilms for Cuing Larval Settlement at Deep-Sea Hydrothermal Vents (Vent Settlement Cues)

Contributors	Affiliation	Role
Arellano, Shawn M.	Western Washington University (WWU)	Co-Principal Investigator
Mullineaux, Lauren	Woods Hole Oceanographic Institution (WHOI)	Co-Principal Investigator
Vetriani, Costantino	Rutgers University (Rutgers IMCS)	Co-Principal Investigator
Ladd, Tanika	Western Washington University (WWU)	Scientist
Mills, Susan	Woods Hole Oceanographic Institution (WHOI)	Scientist
Selci, Matteo	Rutgers University (Rutgers IMCS)	Scientist
Cannon, Olivia	Rutgers University (Rutgers IMCS)	Student
Inaba, Aila	Rutgers University (Rutgers IMCS)	Student
Plowman, Caitlin Q.	University of Oregon	Student
Schlegel, Ian	Rutgers University (Rutgers IMCS)	Student
Davis, Dexter	Western Washington University (WWU)	Technician
Mickle, Audrey	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
These data include counts of faunal colonists found on experimental settlement surfaces (termed “sandwiches” – comprised of 6 stacked polycarbonate plates separated by spacers) deployed at Tica Vent in the 9°50’ N region of the East Pacific Rise and details of the colonization experiment deployments and recoveries (e.g., dive numbers, deployment and recovery times, temperature measurements, etc.). Some sandwiches were originally deployed on cruise AT42-21 (R/V Atlantis, December 2019) and additional sandwiches were deployed and all were recovered on cruise RR2102 (R/V Roger Revelle, March-April 2021). Deployment and recovery of sandwiches utilized deep submergence vehicles HOV Alvin and ROV Jason. Sandwiches were deployed in three biogenic zones (Alvinella-dominated, Riftia-dominated, and mussel-dominated) and had either an established microbial biofilm or no biofilm upon the start of the colonization experiment. It was hypothesized that established microbial biofilms may be indicators of suitable habitat for faunal colonists, specifically larvae, in hydrothermal vent environments characterized by high spatial and temporal variability in abiotic conditions. These short-term (~2 week) colonization experiments thus tested whether the age of the microbial biofilm influenced faunal communities that colonized surfaces across a gradient of habitat conditions. These data were collected as part of a collaborative project involving the personnel associated with the labs of Dr. Shawn Arellano (Western Washington University), Dr. Lauren Mullineaux (Woods Hole Oceanographic Institution), and Dr. Costantino Vetriani (Rutgers University). This dataset is published in Ladd et al., 2024 (DOI: 10.1016/j.dsr.2024.104314).

Table of Contents

- Coverage
- Dataset Description
    - Methods & Sampling

- BCO-DMO Processing Description
- Data Files
- Supplemental Files
- Related Publications
- Parameters
- Instruments
- Deployments
- Project Information
- Funding

Coverage

Location: Tica Vent (9°50.3987 N, 104°17.4970 W) in the 9°50' N region of the East Pacific Rise
Spatial Extent: **N**:9.84008 **E**:-104.29162 **S**:9.84004 **W**:-104.29168
Temporal Extent: 2019-12-29 - 2021-04-01

Methods & Sampling

Study site and experiment details

A short-term in-situ colonization experiment was conducted at Tica Vent (9°50.3987 N, 104°17.4970 W) in the 9°50' N region of the EPR. Colonization surfaces, comprised of 6 stacked polycarbonate plates separated by spacers and termed "sandwiches" (described by Mullineaux et al., 2010 and Dykman et al., 2021), were deployed by the deep submergence vehicles HOV Alvin and ROV Jason over two cruises; one aboard the R/V Atlantis in December 2019 and the other on the R/V Roger Revelle in March-April 2021.

During the first deployment in December 2019, 12 sandwiches were covered in 200 µm nylon mesh bags termed "purses" to prevent animal colonization while allowing for microbial biofilm development. The purses were custom designed with handles and completely enclosed around the sandwich with hook and loop fasteners so that they could be removed in-situ by vehicle manipulators (L. Lavigne, Anacortes, WA). Four replicate "pursed sandwiches" were placed within each of three biogenic zones (*Alvinella*-dominated, *Riftia*-dominated, and mussel-dominated) that span a gradient of temperature and chemical conditions. The colonization experiment was initiated when the ROV Jason revisited the pursed sandwiches approximately 15 months later. Several pursed sandwiches (3 from the Alvinellid zone and 2 from the *Riftia* zone) were lost due to overgrowth by animal communities, resulting in the discovery of 7 of the initial 12 pursed sandwiches. For the 7 pursed sandwiches that were discovered, purses were removed, and the established biofilm sandwiches were placed back in the location they had been found. Fresh sandwiches (no previously developed biofilm) were deployed next to each of the 7 established biofilm sandwiches to act as paired controls. The sandwiches were left on the seafloor for approximately 15 days to allow for animal colonization. After which, they were recovered into separate sealed collection compartments on the ROV Jason.

Although most sandwiches were brought to the surface before preservation, one established biofilm sandwich from each zone (including the only established biofilm sandwich in the Alvinellid zone) was recovered into individual cylinders specifically designed for immediate preservation of samples in-situ (Analytical Instrument Systems, Ringoes, NJ) that were filled with an RNA stabilization solution (25 mM sodium citrate, 10 mM EDTA, 70 g ammonium sulfate per 100 mL solution, adjusted to pH 7.0 with sulfuric acid); preservation in the RNA stabilization buffer makes these samples available for other work not reported here. A temperature probe held at the base of each sandwich for approximately 1-2 minutes was used to record the temperature maximum at deployments and recoveries of all sandwiches.

Shipboard preservation and processing of sandwiches

Upon vehicle recovery, containers holding sandwiches were transported to a cold room (4 °C). Attached weights and polypropylene handles were removed and the zipties holding each sandwich together were cut to remove the top sandwich plate. Any animals visible on the top plate were gently removed and placed into a separate container filled with RNA preservative. The top plate was then placed into a plastic bag with enough RNA preservative to cover the entire plate and frozen at -80 °C until further processing for 16S rRNA gene sequencing (not included in the dataset here). The remaining parts of the sandwich were placed into separate plastic bags, submerged in RNA preservative, and stored at 4 °C until further processing for animal colonization. To collect any fauna that had fallen off the sandwiches, seawater or RNA preservative in the sandwich collection compartments was poured and rinsed over a 63 µm mesh sieve, then stored in RNA preservative at 4 °C until further processing.

Characterizing animal colonist communities

At Western Washington University's Shannon Point Marine Center (SPMC) faunal colonists from each sandwich were observed and counted under a stereo microscope (Olympus) at 4x magnification. Both sides of each sandwich plate were carefully inspected under a microscope and attached organisms were removed and counted. Additionally, any organisms in the RNA stabilization solution in the containers holding the sandwich plates and sieved sandwich compartment contents were sorted and counted. Individual colonists were grouped into morphotypes based on visual features while any damaged organisms that could not be assigned to a morphotype group were grouped into a broad unknown taxonomic group (e.g., unknown polychaete, unknown gastropod, etc.). Representative organisms from morphotype groups were imaged on either a stereo microscope (Leica; magnification range 0.8-10x) or a compound microscope (Leica; 20x magnification) for possible further taxonomic identification and to create a morphotype guide (See supplemental files: RR2102_morphotype_guide.pdf).

BCO-DMO Processing Description

- Imported "RR2102_colonist_counts.csv" into BCO-DMO system
- Converted deployment, purse recovery, and recovery dates into ISO 8601 format: YYYY-MM-DD HH:MM
- Renamed fields to conform with BCO-DMO naming conventions
- Saved the file as "949181_v1_colonization_exp_tica_vent.csv"

Scientific names in the supplemental files were checked using World Register of Marine Species (WoRMS) Taxon Match. All scientific names in the data are valid and accepted names as of 2025-02-07.

Both "RR2102_morphotype_guide.pdf" and "Morphcode_info.csv" have been attached as supplemental files. The file "RR2102_morphotype_guide.pdf" provides a visual guide of the morphotypes and the "Morphcode_info.csv" file provides the textual information in a structured table.

[table of contents | back to top]

Data Files

File
949181_v1_colonization_exp_tica_vent.csv (Comma Separated Values (.csv), 4.49 KB) MD5:76eb7c55b21f4814500c76dc9ff98f84 Primary data file for dataset ID 949181, version 1

[table of contents | back to top]

Supplemental Files

File	
accepted_names_AphiaIDs_949181.csv Taxon identifiers (AphiaID and LSID) for scientific names listed in the Morophotype Code Information. Generated using the World Register of Species taxa match tool performed 2025-02-07.	(Comma Separated Values (.csv), 2.88 KB) MD5:09ba7dca5c0264aeb64b87fe3b4fd021
Morphotype Code Information filename: Morphcode_info.csv Details of morphotype codes used in the Colonist Count Data file	(Comma Separated Values (.csv), 3.67 KB) MD5:ecdcce64bcb9f513380f4262d08a9509
Morphotype Guide filename: RR2102_morphotype_guide.pdf Guide showing images of fauna and an associated code that is used in the Colonist Count Data file	(Portable Document Format (.pdf), 4.18 MB) MD5:620adb6cacd38e445f07d80e2828516f

[table of contents | back to top]

Related Publications

Dykman, L. N., Beaulieu, S. E., Mills, S. W., Solow, A. R., & Mullineaux, L. S. (2021). Functional traits provide new insight into recovery and succession at deep-sea hydrothermal vents. Ecology, 102(8). Portico. https://doi.org/10.1002/ecy.3418
Methods

Ladd, T. M., Selci, M., Davis, D. J., Cannon, O., Plowman, C. Q., Schlegel, I., Inaba, A., Mills, S. W., Vetriani, C., Mullineaux, L. S., & Arellano, S. M. (2024). Faunal colonists, including mussel settlers, respond to microbial biofilms at deep-sea hydrothermal vents. Deep Sea Research Part I: Oceanographic Research Papers, 208, 104314. https://doi.org/10.1016/j.dsr.2024.104314
Results

Mullineaux, L. S., Adams, D. K., Mills, S. W., & Beaulieu, S. E. (2010). Larvae from afar colonize deep-sea hydrothermal vents after a catastrophic eruption. Proceedings of the National Academy of Sciences, 107(17), 7829–7834. https://doi.org/10.1073/pnas.0913187107
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
ID	Unique ID code for each sandwich	unitless
Sample_type	Experiment condition of "pursed sandwich" or "sandwich"; if the sandwich was ever covered with mesh = "pursed"	unitless
Lat	Latitude of sandwich deployment, south is negative	decimal degrees
Lon	Longitude of sandwich deployment, west is negative	decimal degrees
Site_name	Name of experimental site	unitless
Zone	Biogenic zone in which a sandwich was deployed	unitless

Cruise_deployed	Cruise ID when sandwich was initially deployed	unitless
Dive_deployed	Alvin or Jason dive number for sandwich deployment	unitless
ISO_DateTime_UTC_deployed	Datetime (UTC) sandwich was initially deployed in ISO format	unitless
Exp_start_temp	Temperature (degrees Celsius) under the sandwich at experiment start	degrees Celsius
Pursed	"Y" or "N", if the sandwich was ever covered with mesh = "Y"	unitless
Cruise_purse_removal	Cruise ID when sandwich mesh (purse) was removed	unitless
Dive_purse_removal	Alvin or Jason dive number for sandwich mesh (purse) removal	unitless
ISO_DateTime_UTC_purse_removal	Datetime (UTC) sandwich mesh (purse) was removed in ISO format	unitless
Cruise_recovered	Cruise ID when sandwich was recovered	unitless
Dive_recovered	Alvin or Jason dive number for sandwich recovery	unitless
ISO_DateTime_UTC_recovered	Datetime (UTC) sandwich was recovered in ISO format	unitless
Recovery_temp	Temperature (degrees Celsius) under the sandwich at experiment end (recovery)	degrees Celsius
Nearby	Unique ID code for pursed sandwiches that were the target pairs for fresh sandwiches	unitless
Biofilm_dev_time	Length of time in days that pursed sandwiches were pursed	days
Larval_set_time	Length of time in days that fauna could colonize the sandwich	days
ID_pairs	unique ID for each sandwich pair	unitless
AMP1	Counts for each colonist morphotype from each sandwich: Amphipod Type 1	unitless

ISO1	Counts for each colonist morphotype from each sandwich: Isopod Type 1	unitless
BIV1	Counts for each colonist morphotype from each sandwich: Bivalve Veliger Type 1	unitless
COP1	Counts for each colonist morphotype from each sandwich: Copepod Type 1	unitless
COP2	Counts for each colonist morphotype from each sandwich: Copepod Type 2	unitless
COP3	Counts for each colonist morphotype from each sandwich: Copepod Type 3	unitless
COP4	Counts for each colonist morphotype from each sandwich: Copepod Type 4	unitless
FOR1	Counts for each colonist morphotype from each sandwich: Foraminifera	unitless
GAS1	Counts for each colonist morphotype from each sandwich: Gastropod - conical spiral	unitless
GAS2	Counts for each colonist morphotype from each sandwich: Gastropod - semicircle	unitless
GAS3	Counts for each colonist morphotype from each sandwich: Gastropod - angular spiral	unitless
GAS4	Counts for each colonist morphotype from each sandwich: Gastropod - macaroni	unitless
GAS5	Counts for each colonist morphotype from each sandwich: Gastropod - white spiral	unitless
GASU	Counts for each colonist morphotype from each sandwich: Gastropod - unknown	unitless
GAV1	Counts for each colonist morphotype from each sandwich: Gastropod Veliger Type 1	unitless

GAV2	Counts for each colonist morphotype from each sandwich: Gastropod Veliger Type 2	unitless
GAV3	Counts for each colonist morphotype from each sandwich: Gastropod Veliger Type 3	unitless
GAVU	Counts for each colonist morphotype from each sandwich: Gastropod Veliger - unknown	unitless
GAS6	Counts for each colonist morphotype from each sandwich: Limpet type 1	unitless
GAS7	Counts for each colonist morphotype from each sandwich: Limpet type 2	unitless
GAS8	Counts for each colonist morphotype from each sandwich: Limpet type 3	unitless
GAS9	Counts for each colonist morphotype from each sandwich: Limpet type 4	unitless
GAS10	Counts for each colonist morphotype from each sandwich: Limpet type 5	unitless
MIT1	Counts for each colonist morphotype from each sandwich: Marine mite	unitless
MUS1	Counts for each colonist morphotype from each sandwich: Juvenile Mussel	unitless
CNP1	Counts for each colonist morphotype from each sandwich: Nauplius - Copepod various	unitless
NEC1	Counts for each colonist morphotype from each sandwich: Nectochaete Type 1	unitless
POL17	Counts for each colonist morphotype from each sandwich: Polychaete Type 17	unitless
NEC2	Counts for each colonist morphotype from each sandwich: Nectochaete Type 2	unitless

NEC3	Counts for each colonist morphotype from each sandwich: Nectochaete Type 3	unitless
POL18	Counts for each colonist morphotype from each sandwich: Polychaete Type 18	unitless
NEC4	Counts for each colonist morphotype from each sandwich: Nectochaete Type 4	unitless
POL19	Counts for each colonist morphotype from each sandwich: Polychaete Type 19	unitless
NEC5	Counts for each colonist morphotype from each sandwich: Nectochaete Type 5	unitless
NEC6	Counts for each colonist morphotype from each sandwich: Nectochaete Type 6	unitless
NEC7	Counts for each colonist morphotype from each sandwich: Nectochaete Type 7	unitless
NEC8	Counts for each colonist morphotype from each sandwich: Nectochaete Type 8	unitless
POL21	Counts for each colonist morphotype from each sandwich: Polychaete Type 21	unitless
POL22	Counts for each colonist morphotype from each sandwich: Polychaete Type 22	unitless
POL27	Counts for each colonist morphotype from each sandwich: Polychaete Type 27	unitless
NEM1	Counts for each colonist morphotype from each sandwich: Nematode	unitless
NECU	Counts for each colonist morphotype from each sandwich: Nectochaete - unknown	unitless
OPH1	Counts for each colonist morphotype from each sandwich: Ophiuroid	unitless
OST1	Counts for each colonist morphotype from each sandwich: Ostracod	unitless

POL1	Counts for each colonist morphotype from each sandwich: Polychaete Type 1	unitless
POL2	Counts for each colonist morphotype from each sandwich: Polychaete Type 2	unitless
POL3	Counts for each colonist morphotype from each sandwich: Polychaete Type 3	unitless
POL4	Counts for each colonist morphotype from each sandwich: Polychaete Type 4	unitless
POL5	Counts for each colonist morphotype from each sandwich: Polychaete Type 5	unitless
POL6	Counts for each colonist morphotype from each sandwich: Polychaete Type 6	unitless
POL7	Counts for each colonist morphotype from each sandwich: Polychaete Type 7	unitless
POL8	Counts for each colonist morphotype from each sandwich: Polychaete Type 8	unitless
POL9	Counts for each colonist morphotype from each sandwich: Polychaete Type 9	unitless
POL11	Counts for each colonist morphotype from each sandwich: Polychaete Type 11	unitless
POL12	Counts for each colonist morphotype from each sandwich: Polychaete Type 12	unitless
POL15	Counts for each colonist morphotype from each sandwich: Polychaete Type 15	unitless
POL16	Counts for each colonist morphotype from each sandwich: Polychaete Type 16	unitless
POLU	Counts for each colonist morphotype from each sandwich: Polychaete - unknown	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Heat Flow Probes
Generic Instrument Name	Alvin Heatflow Probe 0.66m
Dataset-specific Description	Heat Flow Probes (temperature sensors): used to measure maximum temperatures below sandwiches on both HOV Alvin and ROV Jason during the colonization experiment, measurable temperature range is 0 to 40 °C, with 0.2
Generic Instrument Description	The Heatflow probe is a temperature measuring device on the submersible Alvin. It is a 0.6 m titanium tube containing a linear heater and 5 thermistors. The Heatflow probe is designed to measure temperature gradients when inserted into soft sediments.

Dataset-specific Instrument Name	HOV Alvin, Heat Flow Probes (temperature sensors)
Generic Instrument Name	HOV Alvin
Dataset-specific Description	Deployment and recovery of sandwiches utilized deep submergence vehicles HOV Alvin and ROV Jason. Heat Flow Probes (temperature sensors): used to measure maximum temperatures below sandwiches on both HOV Alvin and ROV Jason during the colonization experiment, measurable temperature range is 0 to 40 °C, with 0.2 degree accuracy and .001 degree resolution. Additionally, a temperature pulse can be generated and monitored to observe temperature decay in sediments. Data from the heat flow probe is normally displayed on the observer’s internal video overlays and is additionally recorded in the submersible’s computer data files.
Generic Instrument Description	Human Occupied Vehicle (HOV) Alvin is part of the National Deep Submergence Facility (NDSF). Alvin enables in-situ data collection and observation by two scientists to depths reaching 6,500 meters, during dives lasting up to ten hours. Commissioned in 1964 as one of the world’s first deep-ocean submersibles, Alvin has remained state-of-the-art as a result of numerous overhauls and upgrades made over its lifetime. The most recent upgrades, begun in 2011 and completed in 2021, saw the installation of a new, larger personnel sphere with a more ergonomic interior; improved visibility and overlapping fields of view; longer bottoms times; new lighting and high-definition imaging systems; improved sensors, data acquisition and download speed. It also doubled the science basket payload, and improved the command-and-control system allowing greater speed, range and maneuverability. With seven reversible thrusters, it can hover in the water, maneuver over rugged topography, or rest on the sea floor. It can collect data throughout the water column, produce a variety of maps and perform photographic surveys. Alvin also has two robotic arms that can manipulate instruments, obtain samples, and its basket can be reconfigured daily based on the needs of the upcoming dive. Alvin's depth rating of 6,500m gives researchers in-person access to 99% of the ocean floor. Alvin is a proven and reliable platform capable of diving for up to 30 days in a row before requiring a single scheduled maintenance day. Recent collaborations with autonomous vehicles such as Sentry have proven extremely beneficial, allowing PIs to visit promising sites to collect samples and data in person within hours of their being discovered, and UNOLs driven technological advances have improved the ability for scientific outreach and collaboration via telepresence Alvin is named for Allyn Vine, a WHOI engineer and geophysicist who helped pioneer deep submergence research and technology. (from https://www.whoi.edu/what-we-do/explore/underwater-vehicles/hov-alvin/, accessed 2022-09-09)

Dataset-specific Instrument Name	In-situ RNA preservation samplers
Generic Instrument Name	In-situ RNA preservation sampler (Analytical Instrument Systems)
Dataset-specific Description	In-situ RNA preservation samplers: cylinders filled with RNA preservative specifically designed for use with vehicle manipulators (Analytical Instrument Systems, Ringoes, NJ)
Generic Instrument Description	The in-situ RNA preservation sampler is a cylindrical instrument, developed by Analytical Instrument Systems (Ringoes, NJ), that is filled with RNA stabilization solution and specifically designed for use with vehicle manipulators to preserve biofilm samples in situ. The sampler was first described in Ladd et al., 2024 (doi: 10.1016/j.dsr.2024.104314).

Dataset-specific Instrument Name	Olympus SZ stereo microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Olympus SZ stereo microscope: used to count and identify fauna associated with sandwiches
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Leica M125 stereo microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Leica M125 stereo microscope: used to image fauna (magnification range 0.8-10x)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Leica DM5500 B compound microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Leica DM5500 B compound microscope: used to image fauna (magnification range 5-40x)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	ROV Jason, Heat Flow Probes (temperature sensors)
Generic Instrument Name	ROV Jason
Dataset-specific Description	Deployment and recovery of sandwiches utilized deep submergence vehicles HOV Alvin and ROV Jason. Heat Flow Probes (temperature sensors): used to measure maximum temperatures below sandwiches on both HOV Alvin and ROV Jason during the colonization experiment, measurable temperature range is 0 to 40 °C, with 0.2 degree accuracy and .001 degree resolution. Additionally, a temperature pulse can be generated and monitored to observe temperature decay in sediments. Data from the heat flow probe is normally displayed on the observer's internal video overlays and is additionally recorded in the submersible's computer data files.
Generic Instrument Description	The Remotely Operated Vehicle (ROV) Jason is operated by the Deep Submergence Laboratory (DSL) at Woods Hole Oceanographic Institution (WHOI). WHOI engineers and scientists designed and built the ROV Jason to give scientists access to the seafloor that didn't require them leaving the deck of the ship. Jason is a two-body ROV system. A 10-kilometer (6-mile) fiber-optic cable delivers electrical power and commands from the ship through Medea and down to Jason, which then returns data and live video imagery. Medea serves as a shock absorber, buffering Jason from the movements of the ship, while providing lighting and a bird's eye view of the ROV during seafloor operations. During each dive (deployment of the ROV), Jason pilots and scientists work from a control room on the ship to monitor Jason's instruments and video while maneuvering the vehicle and optionally performing a variety of sampling activities. Jason is equipped with sonar imagers, water samplers, video and still cameras, and lighting gear. Jason's manipulator arms collect samples of rock, sediment, or marine life and place them in the vehicle's basket or on "elevator" platforms that float heavier loads to the surface. More information is available from the operator site at URL. https://ndsf.whoi.edu/jason/

[table of contents | back to top]

Deployments

AT42-21

Website	https://www.bco-dmo.org/deployment/879912
Platform	R/V Atlantis
Start Date	2019-12-17
End Date	2020-01-07

RR2102

Website	https://www.bco-dmo.org/deployment/879915
Platform	R/V Roger Revelle
Start Date	2021-03-24
End Date	2021-04-25

[table of contents | back to top]

Project Information

RUI: Collaborative: The Predictive Nature of Microbial Biofilms for Cuing Larval Settlement at Deep-Sea Hydrothermal Vents (Vent Settlement Cues)

Coverage: East Pacific Rise, 9 North hydrothermal vents

NSF Award Abstract:
Over four decades of research have shown that tiny free-swimming offspring of the unique inhabitants of hydrothermal vents can disperse effectively between their specialized habitats. Yet, we know almost nothing about how these larval animals complete the journey by locating and settling down in suitable locations. This question remains one of the key unresolved puzzles in the ecology of the deep sea and is becoming increasingly important to solve as hydrothermal vents are becoming threatened by human impacts. The investigators suggest that the films of bacteria that first form at vents are good signposts for settlement of larvae because they indicate that the hydrothermal vents are suitable for life. This project uses a combined program of field experiments, cutting-edge molecular biology techniques, and shipboard experiments with hydrothermal-vent larvae and cultured bacterial films. The project also connects undergraduate research interns at a primarily undergraduate institution (Western Washington University) with undergraduate research interns at two research institutions (Rutgers and Woods Hole Oceanographic Institution) while working on the project at sea together. Finally, the team is producing a science-in-action documentary filled with ocean science and exploration intended for television distribution and museum screenings. The investigators are using footage of the deep-sea vents, shipboard and diving operations, and laboratory work to create a documentary that highlights the foundation of scientific research—hypothesis-driven research, the application of the scientific method, and the importance of critical thinking—all in the framework of the study of an exciting, but threatened, ecosystem.

Hydrothermal vents are particularly tractable systems in which to study questions about the roles of biofilms in larval settlement because biofilms at vents are relatively low-complexity; vent animals are strictly dependent on vent microbes, often through symbiotic partnerships acquired after settlement; and environmental variations are present within the range of a common larval pool. Moreover, decades of research on settlement in model organisms give us good insight into biofilm cues; there is solid foundational understanding about colonization patterns at vents; we now have excellent tools to collect, identify, and culture vent larvae and microbes; and modern environmental "-omics" techniques are a good tool to characterize biological cues produced by biofilms. The project provides an unprecedented, quantitative look into the role of microbial biofilms in structuring larval settlement at hydrothermal vents, achieved only through the close collaboration of microbial and larval ecologists. The combined field program of short-term settlement experiments, microbial "-omics" work, and subsequent shipboard settlement experiments allows the investigative team to use field experiments to statistically model the factors that best predict larval settlement in the field, then test those predictions with shipboard experiments that decouple covarying conditions. This extensive characterization of putative larval settlement cues and their relationship to colonization success in heterogeneous vent habitat niches will contribute to a broader understanding of colonization success across diverse marine ecosystems. Understanding the role that the initial settlement of larvae plays in the recovery and resilience of hydrothermal-vent ecosystems is critical to developing informed management plans for deep-sea mining.

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-1948580
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947735
NSF Division of Ocean Sciences (NSF OCE)	OCE-1948623

[table of contents | back to top]