Dissection data for metazoan parasites and other symbionts from vent-endemic host species collected from the 9°50’N deep-sea hydrothermal vent field.

Website: https://www.bco-dmo.org/dataset/879118
Data Type: Other Field Results
Version: 2
Version Date: 2023-05-11

Project
» Trajectories in functional diversity after disturbance at vents on the East Pacific Rise (EPR Functional Diversity)
» RUI: Collaborative: The Predictive Nature of Microbial Biofilms for Cuing Larval Settlement at Deep-Sea Hydrothermal Vents (Vent Settlement Cues)

Contributors	Affiliation	Role
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Abstract
A dataset of metazoan parasite species and counts from dissections of hydrothermal vent fauna from the 9°50’N vent field on the East Pacific Rise (EPR). Specimens were primarily collected on two research cruises, AT42-21 in 2019 and RR2102 in 2021. This dataset also includes dissection data from several preserved fish specimens collected on cruises AT15-15 in 2007 (provided by Kate Buckman and Timothy Shank) and AT37-12 in 2017 (provided by Carolyn Tepolt). Vent fauna were collected using traps, slurps, and the manipulator of HOV Alvin and ROV Jason. We provide dissection data from 2,215 potential host individuals of 51 species from the 9°50’N EPR vent field. These included 10 crustacean, 2 fish, 14 mollusk, and 25 polychaete species. Dissections revealed 12 adult metazoan parasite morphogroups and nine larval morphogroups in five major marine parasite taxa. These were two adult acanthocephalans, one adult copepod, one adult nematode, one larval nematode, one adult rhizocephalan, seven adult trematodes, six trematode metacercariae, and one trematode sporocyst. Dissections also revealed non-parasitic symbionts: several copepod species that may be commensals or micropredators, nemertean egg predators, and the commensal scaleworm Branchipolynoe symmitilida. Photographs of parasites and hosts are provided as zip files.

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Coverage

Spatial Extent: **Lat**:9.83 **Lon**:-104.3
Temporal Extent: 2007-02-02 - 2021-04-17

Dataset Description

These data are being published in Dykman et al. (2023).

Methods & Sampling

Animals were collected from deep-sea hydrothermal vent sites at the East Pacific Rise 9°50'N vent field (EPR 9N) during two cruises, one in December of 2019 (AT42-21) using DSV *Alvin* and one in March of 2021 (RR2102) using ROV *Jason*. Hosts were sampled from a range of thermal zones and substrate types, including basalt and active sulfide chimneys. This sampling design ensured our study covered a broad representative diversity of potential hosts in the active vent field and increased the chance of encountering parasite species that are patchily distributed in host populations. For the vent fishes, we include dissection data from preserved specimens collected during two prior cruises: two whole frozen *Thermarces cerberus* collected in April, 2017 (AT37-12); and preserved gut contents of 22 *Thermichthys hollisi* collected in February, 2007 (AT15-15) (Buckman 2009).

Large tubeworms and mussels were collected into sealed, insulated "bioboxes" using the manipulator of the HOV or ROV. Mobile hosts such as fish, crabs, and squat lobsters were collected using suction samplers or box-style crayfish traps baited with tubeworm and mussel tissue and left overnight on the seafloor. Small fauna, including crustaceans, mollusks, and polychaetes were gathered opportunistically from geological samples or directly targeted with suction sampling or faunal grabs.

Data Processing Description

Potential hosts were dissected fresh aboard the ship or frozen at -80°C immediately upon arrival at the surface. Each potential host was thoroughly examined following standard methods for detecting metazoan parasites (Kuris et al. 2008, Morton et al. 2021, McLaughlin 2018).

Before dissection, hosts were identified to species using reference guides (Desbruyères et al. 2006). When species ID was uncertain, hosts were given a morphogroup ID or grouped at a higher taxonomic level (i.e., Family or Genus). In some cases, host identification was based on COI barcoding using universal metazoan primers (Folmer et al. 1994).

Host length was measured along the maximum dimension using standard protocol for each taxon: gastropods were measured from the base of the column to the apex; crabs were measured at the maximum carapace width; and shrimp were measured by carapace length along the midline, including the rostrum. Standard length and total length were recorded for fish. Additional host information, such as weight, sex, gut contents, and condition, were recorded when possible.

The exterior of each specimen and the wash from its storage bag or compartment were carefully inspected for ectoparasites. Internal parasites were detected visually by pressing host tissues between two glass plates, shining transmitted light from beneath and carefully scanning the entire slide in a grid pattern under a dissecting scope at 10-50x magnification. For large animals, each organ was examined individually to record the site of infection. Small animals were squashed and examined whole.

All symbionts detected by our methods (including metazoan parasites, commensals, protozoan parasites, and microbial pathologies) were assigned a species or morphogroup name and counted. When a species or morphogroup was first encountered or found in a new host species, several individuals were measured, photographed, and preserved for further morphological and molecular description.

Photos were taken using an eyepiece camera or a camera attached to a microscope photo tube and C-mount. Parasites were measured with a micrometer installed in the microscope eyepiece. Parasite specimens were preserved in 80% ethanol for morphological description and 95% ethanol for genetic analysis. Specialist taxonomists were consulted to ensure morphogroups were distinct to the species level. Parasite morphogroups were classified to the lowest possible taxonomic level based on morphological description and/or 18S and 28S barcoding (Bray et al. 2014). Barcoding was used as the primary method for classification of juvenile and cyst stages.

This dataset includes true parasites (macroparasites, castrators, and trophically-transmitted parasites) as well as other symbionts such as commensals and egg predators.

BCO-DMO Processing Notes:
* Added data file in Data File section to comply with data base requirements
* Dataset version 1 primary data file (version data 2022-08-24) replaced with version 2 (2023-05-11). The change is due to "Two parasite morphospecies names were updated based on new genetic information."
* File "PARASITES_VENT_DISSECTION.xlsx" (submitted to bcodmo on 2023-05-10) loaded as a data table into the BCO-DMO data system. Values "NO" "NR" and "NA" were identified as missing data values but preserved as strings within the data table instead of becoming blank (null) values to indicate no data. No modifications were made to the column names or values.

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Data Files

File	
parasites_vent_dissection.csv	(Comma Separated Values (.csv), 1,022.89 KB) MD5:d8b78e0d06764656bbeab56bd9024512
Primary data file for dataset 879118 version 2. Dissection data for metazoan parasites and other symbionts from vent-endemic host species collected from the 9°50'N deep-sea hydrothermal vent field.	

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Supplemental Files

File	
EPR_Host_Pictures filename: EPR_Hosts.zip	(ZIP Archive (ZIP), 8.69 GB) MD5:a83442e753c2dd977e6681dca250770b
Zip file contains host pictures that can be related to the dataset using the picture name in the "HOST_PHOTOS" column.	
EPR_Parasite_Pictures filename: EPR_Parasites.zip	(ZIP Archive (ZIP), 14.27 GB) MD5:c0fa313e1dd296b097fbb9e9225f1384
Zip file contains parasite pictures that can be related to the dataset using the picture name in the "PARASITE_PHOTOS" column.	

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Related Publications

Bray, R. A., Waeschenbach, A., Dyal, P., Littlewood, D. T. J., & Morand, S. (2014). New digeneans (Opecoelidae) from hydrothermal vent fishes in the south eastern Pacific Ocean, including one new genus and five new species. Zootaxa, 3768(1), 73-87. https://doi.org/10.11646/zootaxa.3768.1.5
Methods

Buckman, K. L. (2009). Biotic and abiotic interactions of deep-sea hydrothermal vent-endemic fish on the East Pacific Rise. Tech. rep., Massachusetts Institute of Technology, Cambridge. https://apps.dtic.mil/sti/citations/ADA505050
Methods

Desbruyeres, D., Segonzac, M., Bright, M., & Decapoda, A. (2006). Handbook of deepsea hydrothermal vent fauna. In Denisia. https://isbnsearch.org/isbn/13978-3-85474-154-1
Methods

Dykman, L. N., Tepolt, C. K., Kuris, A. M., Solow, A. R., & Mullineaux, L. S. (2023). Parasite diversity at isolated, disturbed hydrothermal vents. Proceedings of the Royal Society B: Biological Sciences, 290(2000). https://doi.org/10.1098/rspb.2023.0877
Results

Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. Mol Mar Biol Biotechnol. 1994 Oct;3(5):294-9. PMID: 7881515.
Methods

Kuris, A. M., Hechinger, R. F., Shaw, J. C., Whitney, K. L., Aguirre-Macedo, L., Boch, C. A., Dobson, A. P., Dunham, E. J., Fredensborg, B. L., Huspeni, T. C., Lorda, J., Mababa, L., Mancini, F. T., Mora, A. B., Pickering, M., Talhouk, N. L., Torchin, M. E., & Lafferty, K. D. (2008). Ecosystem energetic implications of parasite and free-living biomass in three estuaries. Nature, 454(7203), 515-518. https://doi.org/10.1038/nature06970
Methods

Lafferty, K. D., & Kuris, A. M. (2002). Trophic strategies, animal diversity and body size. Trends in Ecology & Evolution, 17(11), 507–513. https://doi.org/10.1016/S0169-5347(02)02615-0
Methods

Lafferty, K. D., DeLeo, G., Briggs, C. J., Dobson, A. P., Gross, T., & Kuris, A. M. (2015). A general consumer-resource population model. Science, 349(6250), 854-857. https://doi.org/10.1126/science.aaa6224
Methods

McLaughlin, J. P. (2018). The food web for the sand flats at Palmyra Atoll. UC Santa Barbara. ProQuest ID: McLaughlin_ucsb_0035D_14095. Merritt ID: ark:/13030/m54z06th. Retrieved from https://escholarship.org/uc/item/45p5j103
Related Research

Morton, D. N., Antonino, C. Y., Broughton, F. J., Dykman, L. N., Kuris, A. M., & Lafferty, K. D. (2021). A food web including parasites for kelp forests of the Santa Barbara Channel, California. Scientific Data, 8(1). https://doi.org/10.1038/s41597-

021-00880-4
References

Wu, J. N., Parnell-Turner, R., Fornari, D. J., Kurras, G., Berrios-Rivera, N., Barreyre, T., & McDermott, J. M. (2022). Extent and volume of lava flows erupted at 9 50′ N, East Pacific Rise in 2005–2006 from autonomous underwater vehicle surveys. Geochemistry, Geophysics, Geosystems, 23(3). DOI:10.1029/2021GC010213
Methods

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Related Datasets

IsRelatedTo

Dykman, L. (2023) **Records and metadata for deep-sea hydrothermal vent parasite, egg predator, and micropredator species reported in published literature.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-08-25 doi:10.26008/1912/bco-dmo.879266.1 [view at BCO-DMO]

IsReferencedBy

Dykman, L. (2023) **Parasite taxonomic and life cycle information from literature.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2023-05-11 doi:10.26008/1912/bco-dmo.879253.2 [view at BCO-DMO]
Relationship Description: Source of the species in "life cycle" dataset.

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Parameters

Parameter	Description	Units
HOST_ID	A unique identifier for the host individual usually including four letters from the host scientific or higher taxon name and two to three numbers indicating the individual. For host individuals identified to species, the four letters at the beginning of the host ID are the first two letters of the genus and the first two letters of the species.	unitless
HOST_SPECIES	The accepted genus and species name if the host is identified to species or a morphogroup identifier if it is not. Morphogroup names usually include the lowest taxonomic level and a letter to indicate a distinct morphological type. “Sp.” indicates the morphogroup is a single morphologically distinct group, and “spp.” indicates multiple species were likely grouped under the morphogroup name.	unitless
HOST_SPECIES_AphiaID	Numerical identifier from World Register of Marine Species at the lowest known taxonomic level that matches the host scientific or morphogroup name.	unitless
HOST_SPECIES_LSID	Machine-readable Life Science Identifier (LSID) containing the AphiaID from World Register of Marine Species at the lowest known taxonomic level that matches the host scientific or morphogroup name. This corresponds to Darwin Core term http://rs.tdwg.org/dwc/terms/scientificNameID.	unitless
HOST_GROUP_COMMON_NAME	The common name used to refer to the host taxonomic group in Dykman et al. (2023). Includes Crustacean, Fish, Mollusk, and Polychaete.	unitless

COLLECTOR	Name of the person who collected the sample. When samples were collected from an HOV, the collector is usually the primary science observer on the dive. For ROV dives, the collector is the person who retrieved, processed, and stored the sample aboard ship. Missing data identifier NR (not recorded).	unitless
DIVE_NUMBER	The *HOV Alvin* or *ROV Jason* dive number. Missing data identifier NA (not applicable) or NR (not recorded).	unitless
COLLECTION_EVENT	Free text providing additional information on the collection event (i.e., slurp, grab, trap), deployed collection device (i.e., trap or colonization surface), or storage container on HOV Alvin or ROV *Jason* (i.e., forward biobox). These values may correspond with collection events recorded in dive logs (i.e., SeaLog). Missing data identifier NR (not recorded).	unitless
COLLECTION_DATE	The date the specimen was collected in format “YYYY-MM-DD”. Sample dates correspond to the timestamp recorded for the sample collected at the seafloor, not the date the HOV or ROV arrived on deck. Missing data identifier NR (not recorded).	unitless
COLLECTION_SITE	Name for the vent site where the specimen was collected consistent with Wu et al. (2022). If there was ambiguity in the records of collection site, all potential sites are provided separated by the pipe (|) symbol. Missing data identifier NR (not recorded).	unitless
COLLECTION_TIMESTAMP_UTC	Timestamp in UTC for the sample collection as recorded in SeaLog. The timestamp includes the date and time in UTC to the nearest second as a concatenated string in the format “YYYY-MM-DD” + “UTC” + “HH:MM:SS”. If there was ambiguity in the records of collection time, all potential timestamps are provided separated by the pipe (|) symbol. Missing data identifier NR (not recorded).	time
COLLECTION_LATITUDE	Renav latitude in decimal degrees recorded by HOV *Alvin* or ROV *Jason* at the time when the sample collection event was logged. If there was ambiguity in the records of collection location, all potential latitudes are provided separated by the pipe (|) symbol. Missing data identifier NR (not recorded).	decimal degrees
COLLECTION_LONGITUDE	Renav longitude in decimal degrees recorded by HOV *Alvin* or ROV *Jason* at the time when the sample collection was logged. If there was ambiguity in the records of collection location, all potential longitudes are provided separated by the pipe (|) symbol. Missing data identifier NR (not recorded).	decimal degrees
COLLECTION_DEPTH_M	The depth recorded by the depth meter on HOV *Alvin* or ROV *Jason* taken from renav data at the time when the sample collection was recorded. Depth is reported to the nearest meter. If there was ambiguity in the records of collection depth, all potential depths are provided separated by the pipe (|) symbol. Missing data identifier NR (not recorded).	meters (m)
PRESERVATION	How the host specimen was preserved before dissection, or “fresh” if the host was dissected immediately without preservation. “Fresh/Frozen” means some of the host tissue was processed fresh and the rest was frozen and processed later. Missing data identifier NR (not recorded).	unitless

DISSECTION_DATE	The date the host specimen was dissected in format “YYYY-MM-DD”. Missing data identifier NR (not recorded).	date
DISSECTOR	The name(s) of the person or people who processed the host specimen. Missing data identifier NR (not recorded).	unitless
HOST_LENGTH_TOTAL_MM	The length of the host or the closest estimate (i.e., ~10) measured along the longest axis in units of millimeters following accepted methods for each taxon. For squat lobsters and shrimp, from the tip of the rostrum to the back of the carapace (carapace length); for crabs, at the widest point of the carapace (carapace width); for snails, from the apex to the tip of the siphonal canal or aperture (height); and for fish, from the tip of the nose to the end of the tail (total length). Missing data identifier NR (not recorded).	millimeters (mm)
HOST_LENGTH_STANDARD_MM	Standard length was recorded for fish. This was measured from the tip of the snout to the posterior end of the final vertebral column, following the accepted definition (https://www.marinespecies.org/introduced/wiki/TraitsStandardLength). Missing data identifier NA (not applicable) or NR (not recorded).	millimeters (mm)
HOST_WIDTH_MM	The width of the host measured at the widest point. Missing data identifier NR (not recorded).	millimeters (mm)
HOST_WEIGHT_WET_G	The total wet weight of the host including the shell. Missing data identifier NR (not recorded).	grams (gr)
HOST_SEX	The sex of the host determined by observations of eggs or sperm. Specimens were labeled “Male” or “Female” if the sex assignment was confident and “Male?” or “Female?” if the sex assignment was less confident. “Indeterminant” indicates the sex could not be determined. “Immature” indicates the specimen was too young for sexual characteristics to be developed. Missing data identifier NR (not recorded).	unitless
HOST_PHOTOS	A list of unique identifiers for photographs of the host specimen, or “NO” if no photos were taken. Missing data identifier NA (not applicable).	unitless
HOST_GUT_CONTENT	Free text notes on the host gut contents. Missing data identifier NA (not applicable) or NR (not recorded).	unitless
HOST_NOTES	Free text notes on additional observations on the host including ecological and morphological details, changes to the data, sample storage, and measurements of additional dimensions. Missing data identifier NR (not recorded).	unitless
HOST_TISSUE	The tissue or anatomical location on or in the host where the parasite was found. “Wash” indicates the parasite was found detached in the collection container or storage bag with the host. NA is used if no parasites were found on the host. Missing data identifier NA (not applicable) or NR (not recorded).	unitless

PARASITE_MORPHOGROUP_NAME	A morphogroup ID assigned to the parasite or other symbiont based on morphological features. Morphogroup IDs usually include four characters to indicate the taxonomic group and two numerals to indicate distinct morphological types. Missing data identifier NA (not applicable).	unitless
PARASITE_COUNT	An integer count or estimate (i.e., 10-100, ~500) of parasites or other symbionts encountered in dissections. Users should be aware that counts within a host specimen are split into unique rows if they were found in different tissues, had different preservation methods, or include unique length and width measurements. Users should aggregate counts by host ID or as suits their questions. Missing data identifier NR (not recorded).	count
PARASITE_SPECIES_NAME	An official binomial species name for the parasite or other symbiont if species-level identification was possible, or a concatenation of the lowest possible taxonomic level name and the parasite morphogroup name. Missing data identifier NA (not applicable).	unitless
PARASITE_SPECIES_NAME_AphiaID	Numerical identifier from World Register of Marine Species that matches the lowest known taxonomic level of the parasite or other symbiont species name. Missing data identifier NA (not applicable).	unitless
PARASITE_SPECIES_NAME_LSID	Machine-readable Life Science Identifier (LSID) containing the AphiaID from World Register of Marine Species that matches the lowest known taxonomic level of the parasite or other symbiont species name. This corresponds to Darwin Core term http://rs.tdwg.org/dwc/terms/scientificNameID. NA (not applicable).	unitless
BASIS_FOR_TAXONOMIC_ASSIGNMENT	Whether the species or lowest possible taxonomic level identification of the parasite or other symbiont was based on morphological features, genetic identification by 18S or 28S barcoding, or both. Missing data identifier NA (not applicable).	unitless
PARASITE_CONSUMER_STRATEGY	A consumer strategy for the parasite or other symbiont at its current life stage based on definitions in Lafferty & Kuris (2002) and Lafferty et al. (2015). Here, a parasite is defined as a consumer that feeds intimately on one host per life stage. True parasites are included in the consumer strategies “Castrator,” “Macroparasite,” and “Trophically_Transmitted_Macroparasite.” Data users interested in parasites should filter for these consumer strategies. A “Castrator” is a parasite that blocks host reproduction. A “Macroparasite” is a parasite with intensity-dependent pathology. A “Trophically_Transmitted_Macroparasite” is a parasite that is transmitted to the next host via predation. Other consumer strategies that are not parasitic include “Commensal,” “Egg Predator,” and “Micropredator.” A “Commensal” organism lives in close association with a host while not harming the host. An “Egg predator” feeds from brooded eggs on the host rather than directly on host tissue. A “Micropredator” is a predator that does not kill its prey. Missing data identifier NA (not applicable).	unitless

PARASITE_GROUP_COMMON_NAME	The common name used to refer to the parasite or other symbiont taxonomic group in Dykman et al. (2023). Metazoan parasite group common names include Acanthocephala, Copepoda, Nematoda, Rhizocephala, and Trematoda. Commensal and egg predator group names include Polychaeta and Nemertea. Microbial or unknown pathologies are given informal descriptive names (i.e., cyst unk, filamentous bacteria, melanized tissue). Missing data identifier NA (not applicable).	unitless
PARASITE_LIFE_STAGE	The life stage of the parasite or other symbiont. “adult” indicates the specimen is in the adult sexually reproductive stage and has mature, developed reproductive organs; “adult, immature” indicates it is in its adult stage but is immature and has not yet developed reproductive organs; “larva” is the non-reproductive nematode life stage found in intermediate hosts; “metacercaria” is the encysting trematode life stage found in the second intermediate host; “sporocyst” is the asexual cloning trematode life stage found in the first intermediate host. Missing data identifier NA (not applicable).	unitless
PARASITE_LIFE_CYCLE	Whether the parasite uses one host (direct), or whether it must pass through two or more hosts (indirect) to complete its life cycle. Life cycle assignments were based on direct observations when possible. Otherwise, the life cycle assignment was based on the most closely-related species for which a life cycle description was available, especially when life cycle traits were known to be constrained at a high taxonomic level. For detailed rationale for life cycle assignments, see Dykman, L. (2022) **Parasite taxonomic and life cycle information from literature.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-08-25 http://lod.bco-dmo.org/id/dataset/879253. Missing data identifier NA (not applicable).	unitless
PARASITE_PHOTOS	List of file names for photographs of the parasite specimen. “NO” indicates a parasite was found but no photos were taken. Missing data identifier NO (no photos were taken) or NA (not applicable).	unitless
PARASITE_SAMPLES	Free text indicating whether a specimen was preserved and what preservation method was used (e.g., 95% ethanol, 10% formalin). Sometimes the number of specimens preserved in a container is noted in parentheses. “NO” indicates a parasite was found but a sample was not collected. Missing data identifier NO (no photos were taken) or NA (not applicable).	unitless
PATHOLOGY	Whether the parasite was causing noticeable pathology to the host such as damaged, atrophied, or discolored tissue. “YES” indicates tissue damage was recorded, “MAYBE” indicates slight or undetermined tissue damage was observed or the parasite had potential to cause damage due to its size or numbers in the tissue, “NO” indicates no tissue damage was noticed. Missing data identifier NA (not applicable) or NR (not recorded).	unitless
PARASITE_LENGTH_MICRON	The length of the parasite or the closest estimate (i.e., ~1000) measured along the longest dimension in units of micrometers. Missing data identifier NA (not applicable) or NR (not recorded).	micrometers
PARASITE_WIDTH_MICRON	The width of the parasite or the closest estimate (i.e., ~1000) measured at the widest point in units of micrometers. Missing data identifier NA (not applicable) or NR (not recorded).	micrometers

PARASITE_NOTES	Additional free-text notes on the parasite including ecological and morphological details, any changes to the data, sample storage, and additional measurements. Missing data identifier NA (not applicable) or NR (not recorded).	unitless

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Instruments

Dataset-specific Instrument Name	HOV Alvin
Generic Instrument Name	HOV Alvin
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	ROV Jason
Generic Instrument Name	ROV Jason
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/

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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

AT15-15

Website	https://www.bco-dmo.org/deployment/883152
Platform	R/V Atlantis
Start Date	2007-01-10
End Date	2007-02-05

AT37-12

Website	https://www.bco-dmo.org/deployment/734074
Platform	R/V Atlantis
Report	http://datadocs.bco-dmo.org/docs/Vent_O2_NO3_Roles/data_docs/AT37-12_Cruise_Report.pdf
Start Date	2017-04-24
End Date	2017-05-15

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Project Information

Trajectories in functional diversity after disturbance at vents on the East Pacific Rise (EPR Functional Diversity)

Coverage: East Pacific Rise

NSF Award Abstract:
Hydrothermal vents support oases of life in the deep sea and are inhabited by unusual organisms that use chemical energy instead of photosynthesis as the basis of their food web. However, because the vents occur in geologically active areas of the seafloor, entire communities can be eradicated by catastrophic natural disturbances such as eruptions. The main objectives of this project are to quantify how quickly these communities recover from catastrophic disturbance and to determine what processes influence their resilience. The project focuses on both the structure (species diversity) and function (trait diversity) of the communities. The investigators will examine vents on an active segment of the East Pacific Rise where eruptive disturbance occurs on decadal time scales. These activities will create an unprecedented long-term (>14-year) quantitative time-series of colonist species composition and function. The application of trait-based analysis to the question of biological succession at vents has the potential to change the way we think about resilience in other patchy, transient and regionally-connected ecosystems. By considering how traits change over time, the researchers can untangle which species-level characteristics most influence abundance and distribution. The project objectives have broad significance with the growing potential for human-caused disturbances at deep-sea vents through deep-sea mining. Additional impacts include strengthening participation of under-represented minorities in marine science and contributing to international database development for functional traits of deep-sea vent species.

The unique, chemosynthesis-fueled fauna inhabiting deep-sea hydrothermal vents are subject to tectonic and eruptive disturbance that can eradicate entire communities. The main objectives of this project are to quantify how quickly these

communities recover from catastrophic disturbance and to determine what processes influence their resilience. The focus is on vents on an active segment of the East Pacific Rise where eruptive disturbance occurs on decadal time scales. Field data on colonization and larval supply are used to characterize not only species succession but also the trajectory of functional diversity after a recent (2006) eruption. A new, promising approach to the colonization studies comes from incorporating trait-based analysis of functional diversity. Functional trait analysis is increasingly recognized in terrestrial and freshwater systems as a tool to holistically answer ecological questions, but trait analysis has not been often applied to marine systems. By considering how traits of incoming colonists change over time, the investigators can untangle which species-level factors most influence abundance and distribution. This project will create an unprecedented long-term (>14-year) quantitative time-series of colonist species composition and function. It includes multiple vent sites to encompass the full diversity of habitat conditions, and assesses both local processes and regional connectivity through larval supply. Field observations at individual sites contribute to broader questions when placed in the context of metacommunity theory. In this theoretical framework, field data such as this can be used to answer such questions as how the eradication of the vent community at a particular site affects the persistence of the metacommunity overall, and which vent sites contribute most to regional biodiversity.

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.

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Funding

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