Summary of AUV Sentry dives conducted on R/V Endeavor cruise EN658 from Narragansett, Rhode Island to Gulfport, Mississippi in October and November 2020

Website: https://www.bco-dmo.org/dataset/893961
Data Type: Cruise Results
Version: 1
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Project
» Collaborative Research: dispersal depth and the transport of deep-sea, methane-seep larvae around a biogeographic barrier (SALT)

Contributors	Affiliation	Role
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Abstract
This dataset is a summary of AUV Sentry dives conducted on R/V Endeavor cruise EN658 (Narragansett, Rhode Island to Gulfport, Mississippi) in October and November 2020. This cruise was the second in a series of four in the project titled "Collaborative Research: dispersal depth and the transport of deep-sea, methane-seep larvae around a biogeographic barrier", also called "SALT" for short. Also included in this dataset is a series of vertical plankton net tows conducted on the EN658 cruise to supplement the Sentry dives.

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Coverage

Spatial Extent: **N**:38.0546 **E**:-73.812477 **S**:23.981813 **W**:-91.507558

Methods & Sampling

AUV Sentry dives were made with SyPRID attached. Dives were conducted during R/V Endeavor cruise EN658, from Narragansett, Rhode Island to Gulfport, Mississippi, in October and November 2020. A series of 200-meter vertical plankton net tows were also conducted to supplement the Sentry dives.

Data Processing Description

BCO-DMO Processing:
- removed 'NA' as missing data value (appears as blank/empty in final csv);
- renamed fields to comply with BCO-DMO naming conventions.

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Parameters

Parameter	Description	Units
Site	Site name	unitless
Sample_IDs	Sample identifier; shows the cruise number, the site initials (except for Baltimore Canyon), the Sentry Dive number with Port or Stbd sampler initial or the plankton net casting depth. If multiple net casts were made at a site these are indicated by "B" or "C".	unitless
Sentry_Dive_Number	Sentry dive number	unitless
Zooka	?	unitless
Height_off_bottom	Height off bottom	meters (m)
Hours_of_pumping	Duration of pumping	hours and/or minutes
Volume_sampled	Volume sampled	liters (L)
Notes	Notes or comments	unitless
Total_number_of_larvae	Total number of larvae collected	individuals
Total_number_of_Morphotypes	Total number of morphotypes present	unitless
larvae_per_liter	Number of larvae per liter	larvae per liter
number_of_new_morphotypes	Number of new morphotypes ?	unitless
Start_Lat	Latitude at start of Sentry deployment	degrees North
Start_Lon	Longitude at start of Sentry deployment	degrees East
End_Lat	Latitude at end of Sentry deployment	degrees North
End_Lon	Longitude at end of Sentry deployment	degrees East
Start_Time	Time at start of Sentry deployment; in local time zone unless noted as "UTC" in the "Note_Time_UTC" column	unitless
End_Time	Time at end of Sentry deployment; in local time zone unless noted as "UTC" in the "Note_Time_UTC" column	unitless
Note_Time_UTC	Notes if time was recorded in UTC	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	AUV Sentry
Dataset-specific Description	AUV Sentry with SyPRID attached.
Generic Instrument Description	The autonomous underwater vehicle (AUV) Sentry is a fully autonomous underwater vehicle capable of exploring the ocean down to 6,000 meters (19,685 feet) depth. Sentry builds on the success of its predecessor the ABE, with improved speed, range, and maneuverability. Sentry's hydrodynamic shape also allows faster ascents and descents. Sentry carries a superior science sensor suite and an increased science payload enabling it to be used for both mid-water and near-seabed oceanographic investigations. Sentry produces bathymetric, sidescan, subbottom, and magnetic maps of the seafloor and is capable of taking digital bottom photographs in a variety of deep-sea terrains such as mid-ocean ridges, deep-sea vents, and cold seeps at ocean margins. Sentry is uniquely able to operate in extreme terrain, including volcano caldera and scarps. Sentry's navigation system uses a doppler velocity log and inertial navigation system, aided by acoustic navigation systems (USBL or LBL). The USBL system also provides acoustic communications, which can be used to obtain the vehicle state and sensor status as well as to retask the vehicle while on the bottom. In addition its standard sensors, Sentry has carried a variety of science-supplied sensors, including the Nakamura redox potential probe, ACFR 3-D imaging system, and the Tethys in-situ mass spectrometer. Sentry can be used to locate and quantify hydrothermal fluxes. Sentry is also capable of a much wider range of oceanographic applications due to its superior sensing suite, increased speed and endurance, improved navigation, and acoustic communications. Sentry can be used as a stand alone vehicle or in tandem with Alvin or an ROV to increase the efficiency of deep-submergence investigations. More information is available from the operator site at URL: http://www.whoi.edu/main/sentry

Dataset-specific Instrument Name	SyPRID
Generic Instrument Name	Sentry Precision Robotic Impeller Driven Sampler
Generic Instrument Description	The SyPRID (Sentry Precision Robotic Impeller Driven) sampler is an innovative deep-rated (6000 m) plankton sampler that partners with the Sentry Autonomous Underwater Vehicle (AUV) to obtain paired, large-volume plankton samples at specified depths and survey lines to within 1.5 m of the seabed and with simultaneous collection of sensor data. SyPRID uses a perforated Ultra-High-Molecular-Weight (UHMW) plastic tube to support a fine mesh net within an outer carbon composite tube (tube-within-a-tube design), with an axial flow pump located aft of the capture filter. The pump facilitates flow through the system and minimizes the bow wave at the mouth opening. The cod end, a hollow truncated cone, is also made of UHMW plastic and is designed to 'soften' the landing of zooplankton on the capture surface. SyPRID attaches as a saddle-pack to the Sentry vehicle. Sentry itself is configured with a flight control system that enables autonomous survey paths to altitudes as low as 1.5 m. In its inaugural deployment at the Blake Ridge Seep (2160 m) on the US Atlantic Margin, SyPRID was operated for 6 h at an altitude of 5 m. It recovered plankton samples from that stratum in excellent condition and with greater larval numbers than recovered in a typical 'near-bottom' MOCNESS sample from comparable habitats and depths. The prototype SyPRID and its next generations will enable studies of plankton or other particulate distributions associated with patchy habitats, localized physico-chemical strata (e.g., above and below the thermocline), or discrete water masses at an unprecedented spatial resolution for a large volume system [1]. More information is available by contacting: Carl Kaiser Program Manager Applied Ocean Physics & Engineering NDSF AUV Operations Manager Office Phone: +1 508 289 3269 ckaiser@whoi.edu [1] Billings, A., Kaiser, C., Young, C. M., Hiebert, L. S., Cole, E., Wagner, J. K. S., & Van Dover, C. L. (2017). SyPRID sampler: A large-volume, high-resolution, autonomous, deep-ocean precision plankton sampling system. In Deep Sea Research Part II: Topical Studies in Oceanography (Vol. 137, pp. 297–306). Elsevier BV. https://doi.org/10.1016/j.dsr2.2016.05.007

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Deployments

EN658

Website	https://www.bco-dmo.org/deployment/893849
Platform	R/V Endeavor
Start Date	2020-10-22
End Date	2020-11-07
Description	See more information at R2R: https://www.rvdata.us/search/cruise/EN658 During this cruise, we had four dives with AUV Sentry to use the SyPRID plankton sampler. We also took 14 plankton samples from 0-200 m depth using a standard plankton net.

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Project Information

Collaborative Research: dispersal depth and the transport of deep-sea, methane-seep larvae around a biogeographic barrier (SALT)

Website: https://wp.wwu.edu/arellanolab/category/salt/

Coverage: Methane seeps on the shelf and slope of Louisiana, Mississippi, Florida, North Carolina, Virginia and Maryland

NSF Award Abstract:
Ever since hydrothermal vents and methane seeps were first discovered in the deep ocean more than 40 years ago, scientists have wondered how these isolated communities, fully dependent on underwater "islands" of toxic chemicals, are first colonized by organisms, and how the populations of these specialized animals are exchanged and maintained. These fundamental processes depend on the transport of babies (larvae) by the ocean currents, yet because the larvae are microscopic and diluted in the vastness of the ocean, it is very difficult to determine where and how they drift. This project uses an autonomous underwater vehicle to collect larvae from precise regions of the water column. Larval traps on the bottom and chemical analyses of larval shells will also be used to determine the depths where larvae swim. These findings will provide realistic estimates for mathematical models that show how biology interacts with ocean currents to predict which methane seeps will be colonized by larvae originating at different depths. A detailed knowledge of larval dispersal is needed for conservation and management of the deep sea. Without such information, we cannot know the best placement of marine protected areas, nor can we facilitate the reestablishment of communities impacted by deep-sea mining, drilling, or other human activities. This project will provide hands-on at-sea training for college students to learn the rapidly vanishing skills needed for studies of larvae and embryos in their natural habitats. Learning opportunities will also be available to individuals of all ages through new, interactive exhibits on deep-sea biology and larval ecology produced for small museums and aquaria on the coasts of Oregon, Washington and North Carolina.

Reliable estimates of connectivity among metapopulations are increasingly important in marine conservation biology, ecology and phylogeography, yet biological parameters for biophysical models in the deep sea remain largely unavailable. The movements of deep-sea vent and seep larvae among islands of habitat suitable for chemosynthesis have been inferred from current patterns using numerical modeling, but virtually all such models have used untested assumptions about biological parameters that should have large impacts on the predictions. This project seeks to fill in the missing biological parameters while developing better models for predicting the dispersal patterns of methane seep animals living in the Gulf of Mexico and on the Western Atlantic Margin. Despite the existence of similar seeps at similar depths on two sides of the Florida peninsula, the Western Atlantic seeps support only a subset of the species found in the Gulf of Mexico. It is hypothesized that the ability of larvae to disperse through the relatively shallow waters of the Florida Straits depends on an interaction between the adult spawning depth and the dispersal depth of the larvae. Dispersal depth, in turn, will be influenced by larval flotation rates, swimming behaviors, feeding requirements, and ontogenetic migration patterns during the planktonic period. The recently developed SyPRID sampler deployed on AUV Sentry will be used to collect larvae from precise depth strata in the water column, including layers very near the ocean floor. Larval traps deployed on the bottom at three depths in each region will be used in conjunction with the plankton collections to determine what proportion of larvae are demersal. Comparisons of stable oxygen isotopes between larval and juvenile mollusk shells will provide information on the temperatures (and therefore depths) that larvae develop, and geochemical analyses of larval and juvenile shells will determine whether larval cohorts mix among depth strata. Ocean circulation and particle transport modeling incorporating realistic biological parameters will be used to predict the movements of larvae around the Florida Peninsula for various spawning depths and seasons.

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
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