

DOEI Mullineaux/Beaulieu funded July 2003-Dec 2005

Time-Series Larval Studies in the Deep Sea

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Final project report

Stace Beaulieu 19 May 2006, reviewed by L. Mullineaux

What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

For animals living on the seafloor, a planktonic larval stage is a critical phase of the life cycle. Studies of larval dispersal are important for understanding community development at hydrothermal vents, which are disjunct and ephemeral habitats in the deep sea. We investigated short-term variation in larval supply to hydrothermal vent communities at 2500-m depth on the East Pacific Rise near 9°N. Previous work has shown significant variation in the abundance and species composition of larvae between seasons of the year. We wondered whether these patterns were truly seasonal, or might instead be a result of ‘snap-shot’ sampling of higher frequency variations. We also conducted a technical comparison of two types of larval collection devices: large-volume plankton pumps and time-series sediment traps. Part of our motive for these objectives is development of a sampling design for use at observatories planned for mid-ocean ridges.

What have you discovered or learned that you didn't know before you started this work?

Our research resulted in three main discoveries:

- (1) The variation in number of larvae collected on daily time scales was remarkably high. It exceeded that of all previous larval sampling in this region. This high variation on short time scales means that ‘snap-shot’ sampling is not adequate to assess seasonal- and long-term changes in larval supply. Sustained continuous sampling will be needed.
- (2) Larval abundances in this study were surprisingly high compared to previous pump sampling from 1998-2000. Average gastropod larval abundances were two-fold higher and polychaete larval abundances an order of magnitude higher than previous studies. However, these high abundances were not accompanied by higher diversity of species. We are analyzing aspects of the regional hydrodynamic setting to determine whether currents or eddies might be responsible for retaining or delivering large numbers of larvae during this interval.
- (3) Our technical comparison indicates that the sediment trap collects a much higher ratio of gastropod to polychaete larvae than the plankton pump. In addition, the relative abundance of species differed between the two sampling methods. For instance, *Cyathernia naticoides* was the most abundant gastropod species collected by the trap (~50% of gastropod larvae), but *Lepetodrilus* spp. were most abundant in the simultaneous pump collections (38% of gastropod larvae).

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

Part of our motive for this study is development of a sampling design for use at observatories planned for mid-ocean ridges within the ORION Program. The remarkable range in number of larvae collected on day-week time scales and the differences between sampling devices have implications for a sampling design to assess seasonal- and long-term changes in larval supply

near deep-sea vents. Researchers are starting to use sediment traps for deep-sea larval studies, but without a clear idea of how to relate samples to natural abundances or compare them to more traditional pump or net collections. Our results indicate that the sustained, continuous records provided by sediment traps are essential for accurately characterizing long-term changes in larval supply. However, they also show that the downward flux of larvae quantified by trap collections is, for many species, not directly correlated with the more traditionally measured larval concentrations or horizontal transport rates.

What is the significance of this research for society?

In most types of marine habitat, local populations are connected to each other by migrating individuals, often in a larval stage. Management decisions, such as harvesting limits on local stocks or designing marine reserves, require an understanding of this larval exchange. Our study of vent communities contributes to a general understanding of how larval exchange influences the dynamics and character of local populations and communities.

What were the most unusual or unexpected results and opportunities in this investigation?

We were surprised by the high variation in larval supply on very short time scales (days). We are not sure what processes are driving this variation, but are investigating possible hydrodynamic influences.

What were the greatest challenges and difficulties?

The comparison of sediment trap and pump sampling characteristics required that we position the instruments close to each other within the axial trough of the ridge. We developed a system of lowering each instrument mooring on the ship's hydrowire, navigating it into position using the seafloor transponder net, and releasing it within a few meters of our target location. This technique will be useful in the future because it requires no subsequent repositioning by submersible or ROV, and can be conducted during night hours.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

We investigated larval supply to hydrothermal vents at 2500-m depth on the East Pacific Rise at 9°N in Nov. 2004 on R/V *Atlantis* Cruise AT11-20. We conducted our comparison of sediment trap and plankton pump collections near East Wall Vent. In addition to fulfilling the project objectives, we deployed a second sediment trap at Choo Choo Vent (1.5km to the south) as part of Diane Poehls's graduate thesis research.

What were the key tools or instruments you used to conduct this research?

Sediment traps
Plankton pumps
Aanderaa current meters
Acoustic releases
Long-baseline navigation network

Is this research part of a larger project or program?

The region of the East Pacific Rise near 9°N has been selected as a site for integrated studies by the NSF-sponsored Ridge2000 program. This DOEI project was part of our lab's long-term efforts to investigate larval transport and population connectivity at this and other deep-sea vent sites. The project is also part of an effort to design sampling strategies for seafloor observatories that will be installed at mid-ocean ridges as part of the NSF ORION program.

What are your next steps?

We plan to use this study as a springboard into an NSF-funded study of dispersal processes at mid-ocean ridges, as part of the Ridge2000 program. Our next cruise will be going to the East Pacific Rise in Oct. 2006.

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

WEBPAGE: http://www.who.edu/science/B/people/sbeaulieu/cruise_AT11-20/

ABSTRACTS:

ASLO/AGU Ocean Sciences Meeting, Honolulu, Feb. 2006: “Short-Term Variability in Larval Supply to Hydrothermal Vents: a Comparison of Sediment Traps and Plankton Pumps.”

Abstract published in *Eos, Transactions, American Geophysical Union*, 87(36), Ocean Sci. Meet. Suppl., Abstract OS15F-08. Also presented at **11th Deep-Sea Biology Symposium**, Southampton, U.K., July 2006. POSTER ATTACHED AS PDF.

ASLO/AGU Ocean Sciences Meeting, Honolulu, Feb. 2006: “Effects of a Mesoscale Eddy on Larval Dispersal at Hydrothermal Vents.” Abstract published in *Eos, Transactions, American Geophysical Union*, 87(36), Ocean Sci. Meet. Suppl., Abstract OS43I-02.

Please provide some biographical information:

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In 1998, I packed everything I owned into the back of my purple truck and drove across the country, from SIO in San Diego, to WHOI in Woods Hole for a postdoctoral scholarship. After 5 years in AOPE, I joined the Biology Department as a Research Specialist in 2003. I pretty much knew that I wanted to study deep-sea biology since I was about 7 years old and saw photos of hydrothermal vents in National Geographic. At about that time, growing up in Florida, my best friend's father used to take us snorkeling while he scuba'd for lobsters, and every so often we would breathe from his scuba regulator underwater. Back in high school, I was quoted as saying that I didn't know whether to become a marine biologist or an ocean engineer. Luckily, research in deep-sea biology enables me to combine skills from both fields. In addition to research at WHOI, I enjoy teaching the JP courses in biological oceanography and marine invertebrates. Outside of WHOI, I am most active in the Falmouth Track Club and with the Town of Falmouth Bikeway Committee. I met my husband, Steve Faluotico (AOPE), because we went for a run before boarding Atlantis for a cruise to the EPR in 2000.