

The Mullineaux Lab: Research

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Dispersal and Colonization of Hydrothermal Vent Species



Members of the Mullineaux lab and the R/V *Atlantis* deck crew recovering a plankton pump in November 2007 (Susan Mills)

Deep-sea hydrothermal vents are patchy and transient, so the species living there (which typically have low mobility as adults) rely on larval dispersal to maintain regional populations and colonize newly opened vent habitat. We are studying the mechanisms of dispersal in order to find out how far larvae can disperse, how quickly they colonize new sites, and what oceanographic and topographic features act as dispersal barriers. This information allows us to predict (and then test) how species' life histories and behaviors interact with oceanographic and geological settings to affect biodiversity and biogeography of vent communities. At present, we are involved in a multidisciplinary field study of larval dispersal at vents along the East Pacific Rise, the [LADDER](#) project, funded by the National Science Foundation and associated with the RIDGE 2000 program. We also collaborate with theoretical ecologists to investigate metapopulation dynamics of vent species through [modeling](#). Several members of the lab are conducting associated projects on vent systems, including the publication of an [online guide to the identification of hydrothermal vent larvae](#).

Larval connectivity in western Pacific vents

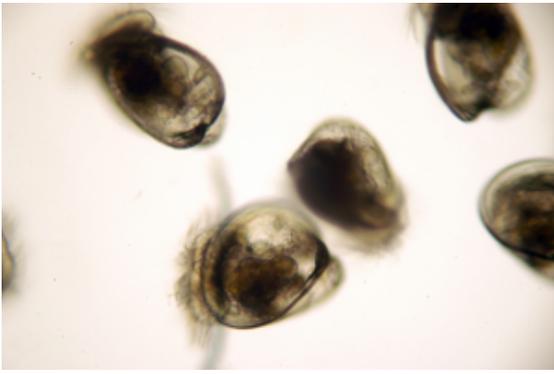


Stace Beaulieu with one of our collaborators, Hiromi Watanabe (JAMSTEC, Japan), getting ready for a dive in the submersible Shinkai 6500. (Susan Mills)

The Mullineaux lab group recently initiated studies of larval dispersal at hydrothermal vents in the western Pacific. Funded by an [NSF RAPID grant](#) led by Stace Beaulieu, we collected larvae near vents in the southern Mariana Trough on a Japanese cruise in 2010 ([cruise blog](#)). The main objective was to study the diversity, abundance, and local dispersal of larvae in this region, but we also recorded high-resolution video of live larvae to investigate their swimming speeds and behavior. Our work in both the western and eastern Pacific vent studies involves collaboration with deep-sea biologists from numerous nations including France, England, Austria and Japan.

Larval Behavior in Flow

Larvae of benthic invertebrates behave actively in ways that can alter their transport in oceanic currents and contribute to their settlement into suitable habitat on the seafloor. We are studying these behaviors in the laboratory, using facilities such as a racetrack flume to examine larval responses to boundary-layer flow



Oyster larvae (size approx. 0.26 mm) are one target species for behavioral experiments
(Susan Mills)

and a grid-stirred tank to look at behaviors in the water column. Larval swimming and benthic exploration are recorded on video and compared directly to dynamic features of the flow. Recently we have been exploring the use of Particle Image Velocimetry (PIV) during larval observations in order to link the behaviors to specific aspects of the turbulent flow structure. These studies are funded by the National Science Foundation and the [Coastal Ocean Institute](#) in collaboration with Karl Helfrich.

Larval Dispersal in Coastal Bivalve Populations

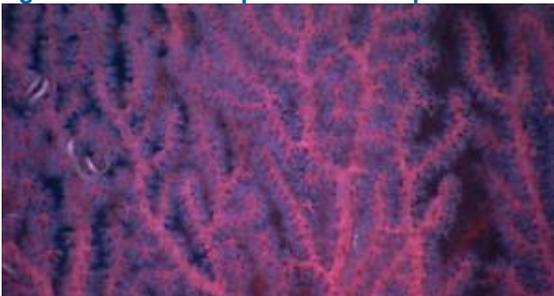


Collecting clams at low tide in the Neponset River Mudflat near Boston, MA

Larvae of the soft-shell clam *Mya arenaria* spend several weeks in the plankton, giving them the potential to disperse tens or even hundreds of kilometers away from their natal populations. We are studying larval exchange among coastal populations of *Mya* in order to understand how it is influenced by coastal hydrodynamic processes and how population dynamics at one site might affect recruitment and dynamics at another. Direct tracking of larvae is difficult, so we are using naturally occurring elements as dispersal tags. This approach is promising because elements such as Pb, Mg, Sr and Ba vary in concentration along the New England coastline, and create a location-specific elemental signature in the water of many bays. This signature gets incorporated into the shells of larval bivalves as they develop. Individuals retain this shell after they settle, and laser ablation ICPMS can be used to analyze its

elemental composition. That analysis tells us whether a clam recruited back into its natal population or into a remote one. This study has direct applications to shellfish management because we can identify source and sink populations, and predict the effects of one population on another in a given hydrodynamic setting. Our efforts are part of a broader [mutidisciplinary project funded by the National Science Foundation](#).

Age Structure of Deep-Sea Coral Populations



[Enlarge image](#)

Paragorgia sp. polyps on Manning Seamount

Many deep seamounts, such as those in the New England Seamount chain in the North Atlantic, support extensive coral populations. These coral colonies, which may live to be hundreds of years old, provide habitat for a variety of species, including invertebrates and fishes. Because the corals are so old and the sources for recolonization are so distant, it is believed that these communities are very vulnerable to disturbance, such as deep-water trawling by fishermen seeking to exploit seamount fisheries. We plan to use radioisotope dating of existing colonies, together with colonization studies and surveys of existing populations, in order to determine the age structure of these coral populations and

estimate the possible impacts of anthropogenic disturbance. These studies are funded by the [NOAA Ocean Exploration program](#) and the [Ocean Life Institute](#).

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