Determining distribution of larval Pacific geoduck clams in Quartermaster Harbor using a novel tracking approach

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Introduction and Goals

The Pacific geoduck clam is both commercially important and highly managed in the Puget Sound. Wild commercial harvest of geoduck in 2010 was worth over $30 million (Washington Department of Fish and Wildlife 2011).

To effectively manage shellfish populations we must:

• Understand and quantify their larval dispersal and connectivity (Potter & Kline 1991; Orensanz et al. 2006).
• Be able to map and predict the movements of individuals throughout an area (reviewed in Levin 2006, Cowen & Sponaugle 2009).

There is a large amount of information about geoduck larval biology in the laboratory, but little is known about the distribution, behavior, or in situ dispersal (Strass et al. 2009).

Goals of this project:

• Determine the temporal and spatial distribution of geoduck larvae throughout most of their reproductive season
• Compare this distribution to water conditions to determine whether any physical parameters are associated with geoduck larval relative abundance

Sampling Site and Design

Quartermaster Harbor (QMH) was selected as our site due to the high probability of capturing geoduck larvae there, the retentive nature of the hydrology, and the existence of a large source population of adult geoducks.

We established three replicate buoys at three stations in QMH: Inner, Middle, and Outer. Traps were deployed at three depths: surface (approximately 1 m down), 4 m (where the thermocline was expected to be), and bottom (within 1 m of the sea floor) (Figure 1).

Larval tube traps (similar to those described by Yund et al. (1991)) made from clear shipping tubes with a dense festive (CMOS) at the bottom were constructed to capture larvae passively. Two traps were attached to a PVC frame. In order to monitor relative water flux at each trap, a calcium sulfide “puck” (following Gaines & Barnes 1993) was attached to each frame.

Sample Processing

Traps were retrieved as new ones were being deployed, and then taken back to the lab for filtering and preservation. The contents of each tube were run through a series of filters and then rinsed until all viable DMSO was removed. The sample was then preserved using modified salt ethanol solution.

Samples were then sent to USBC to determine how many geoduck larvae were in each. FISH-C5 was performed according to the methods of Henzler et al. (2010). To verify the biodegradable larvae sorted from the samples were geoduck, DNA was extracted individually from a subset of sorted larvae using the protocol of Gloor et al. (1995).

Results

We captured and identified over 2000 geoduck larvae throughout the sampling period.

The Inner and Middle stations had higher relative larval abundances than the Outer station (F1,26=11.345, p=0.003). The bottom traps caught significantly fewer larvae than those at the surface and at 4 m (F1,26=6.651, p=0.004) (Figure 3).

Only stratification indices showed a significant association with relative abundance of larvae.

There was no significant association of relative larval abundance with temperature, salinity, fluorescence, or dissolved oxygen (Figure 4).

Discussion

Although adult geoducks are found in the outer and middle sections of QMH, more larvae were found in the inner and Middle stations than at the mouth of the harbor. This implies that at least some of the larvae are retained in this part of the harbor throughout their planktonic larval duration.

Project Success:

• FISH-C5 allowed geoducks to be rapidly identified and sorted from samples (Henzler et al. 2010).
• Our passive trap design allowed for time-integrated samples of the water column, and functioned well in the estuarine environment.
• We have a better idea of the temporal and spatial distribution of geoduck larvae
• We have determined that it is unlikely physical oceanographic properties other than stratification index have any effect on geoduck larval abundance

Implications

Washington State has a significant concern about the effects of geoduck farming on wild populations, and more needs to be understood about their larval ecology in situ.

There is a range of conservation and management issues that depend on understanding species-specific pre-recruitment processes. These include:

• management of invasive species
• emerging diseases
• genetic diversity
• harvest closures
• marine reserves and restoration sites
• the effects of climate change

Our sampling approach and empirically-determined larval distribution data can be used to combat some of these issues.

References


Acknowledgements


Funding provided by UW Tidelands Fund for Research and UW Royalty Research Fund.