Oysters as a model organism for settlement of reef-building organisms in response to complex sensory landscapes of chemical, tactile, and sound cues

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Colonization of substrates by planktonic larvae is a complex process. As larvae conclude their pelagic period, they rely on environmental cues to assess the quality of a habitat for permanent settlement. For many species, settlement cues have multiple origins and can affect larvae at different spatial scales. A better understanding of larvae responses to these cues can not only advance fundamental knowledge regarding larval settlement strategies but also provide critical information for informing habitat restoration projects, aquaculture practices, and antifouling efforts.

Through a series of controlled lab-based experiments, we investigate known or predicted settlement cues of Pacific oyster (*Magallana gigas*). We optimized research-scale larviculture of this species and, as ready to spawn adults are commercially available, highlight its suitability as a model organism for larvae settlement research.

In the first series of experiments, we focus on how larvae change optimization strategies under scenarios of multiple and conflicting cues (e.g. from conspecifics or predators). Based on our findings, we propose that larvae rank settlement cues and respond to conflicting cues based on this ranking, prioritizing highly ranked positive cues over negative cues from predators. Building upon these experimental observations, we develop a conceptual framework that is further refined by a mechanistic model.

In a second experiment, we explore how marine soundscapes influence larval settlement. We analyze sounds associated with oyster reefs, as well as anthropogenic noises from marine vessel traffic. Our findings indicate an increased settlement response to healthy reef noises. We propose the significance of acoustic diversity for larval settlement, emphasizing not only the decibel increase but also the acoustic characteristics of the different sounds.

In a third experiment, we investigate how changes in surface microtopography and subsequent alterations to the biofilm community can influence patterns of larvae settlement.

We conclude that while much can be learned about larvae settlement from sophisticated experimental designs, there is still a lack of conceptual frameworks that can explain the observed patterns. These concepts urgently are needed to generate novel hypotheses that can advance the research field.

Keywords
Oyster Larvae, Larvae Settlement, Invertebrate Ecology, Settlement Cues