

## Friend or foe? – Larvae of the invasive Pacific oyster (*Magallana gigas*) trade off positive and negative cues in their decision making for settlement

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Many factors contribute to the successful colonization of new substrates by bivalves. One key factor is settlement preference at the final larval stage. Understanding how ecological cues influence larvae settlement is critical to inform habitat restoration projects, aquaculture, and antifouling efforts. This study aims to better understand how larvae weigh positive and negative trade-offs in their decision making for settlement.

Larvae of the Pacific oyster (*Magallana gigas*) are attracted to cues from conspecific adults, which have been shown to originate from shells of dead or living individuals, and waterborne cues released from living individuals. Cues from marine biofilms are also known to cause a (typically) positive effect on oyster larvae settlement. We further know that predator cues can reduce settlement propensity. However, in bivalves, these cues have rarely been studied in combination in controlled laboratory experiments. Here, we investigated the settlement preferences of the Pacific oyster when exposed to conspecific cues, predator cues, and cues associated from marine biofilms. Larvae were exposed to cues separately and in combination. We used a positive cue associated with conspecific shells, a positive cue from water conditioned by live adults, positive cues associated from marine biofilms, and negative (non-consumptive) cues from kairomones of two predators: the European green crab (*Carcinus maenas*) and the common starfish (*Asterias rubens*).

We found that predator cues from *C. maenas* decreased settlement propensity in the presence of a positive waterborne conspecific cue, however predator cues from *A. rubens* do not have the same effect. Our results also suggest that the effects of positive cues (conspecific shell, waterborne conspecific cues, and biofilms), interact in a mainly additive manner. But there was also a weaker interaction effect, whereby the presence of a conspecific cue mitigated the negative effect of the predator cue. This is first study (to the best of our knowledge) that shows decreased settlement from non-consumptive predator cues for larvae of *M. gigas*.

In this experiment, settlement is quantified in two ways, behavior in the water column and final metamorphosis. In parallel to manual assessment of metamorphosis, we used video analysis to track larvae behaviors in the water column. This was achieved using a novel low-cost setup, Raspberry pi HQ cameras and computers, and particle tracking software.

### Keywords

Oyster Larvae; Larvae Settlement; Marine Ecology; Settlement Cues