



The Effect of Ultrasonic Vibration on Mussel Larvae Settlement

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Background

In the marine environment, mussel fouling is a persistent and costly problem, especially in hard-to-reach places. A good example is box coolers on ocean going vessels, which are essential for engine cooling. Fouling on these systems can significantly impair their function, potentially necessitating interim docking. This results in high costs and operational delays. Therefore, it is crucial to prevent fouling as much as possible.

Objective

The goal of this study is to evaluate whether ultrasonic vibration can be effectively used to prevent mussel fouling in hard-to-reach places, such as box coolers on ocean going vessels. Specifically, it investigates the extent to which ultrasonic vibration can reduce the settlement and growth of mussels.

Introduction

Mussels reproduce during specific periods, depending on location and species. During this time, many larvae float in the water looking for a place to attach and form colonies using byssal threads.

Antifouling aims to make surfaces unattractive for settlement. Many common methods are harmful to the marine environment, and few eco-friendly alternatives exist. Ultrasonic vibration is a potential alternative. By vibrating the surface, fouling can be inhibited in two ways:

By directly preventing larval attachment

By preventing biofilm formation (bacteria and algae), which emit chemical signals that attract larvae (Hadfield, 2011).

By interrupting these settlement signals, ultrasonic vibration can make surfaces unattractive to mussels over time, without releasing harmful substances into the environment.

Method

The experiment was conducted in two tanks, each with four plates. In one tank, ultrasonic transducers² were mounted on all plates; the other tank served as a control with no ultrasound. In each tank, two plates were hung 2.5 weeks in advance and continuously aerated with an algae mix to stimulate biofilm formation and serve as a food source for mussel larvae during the experiment.

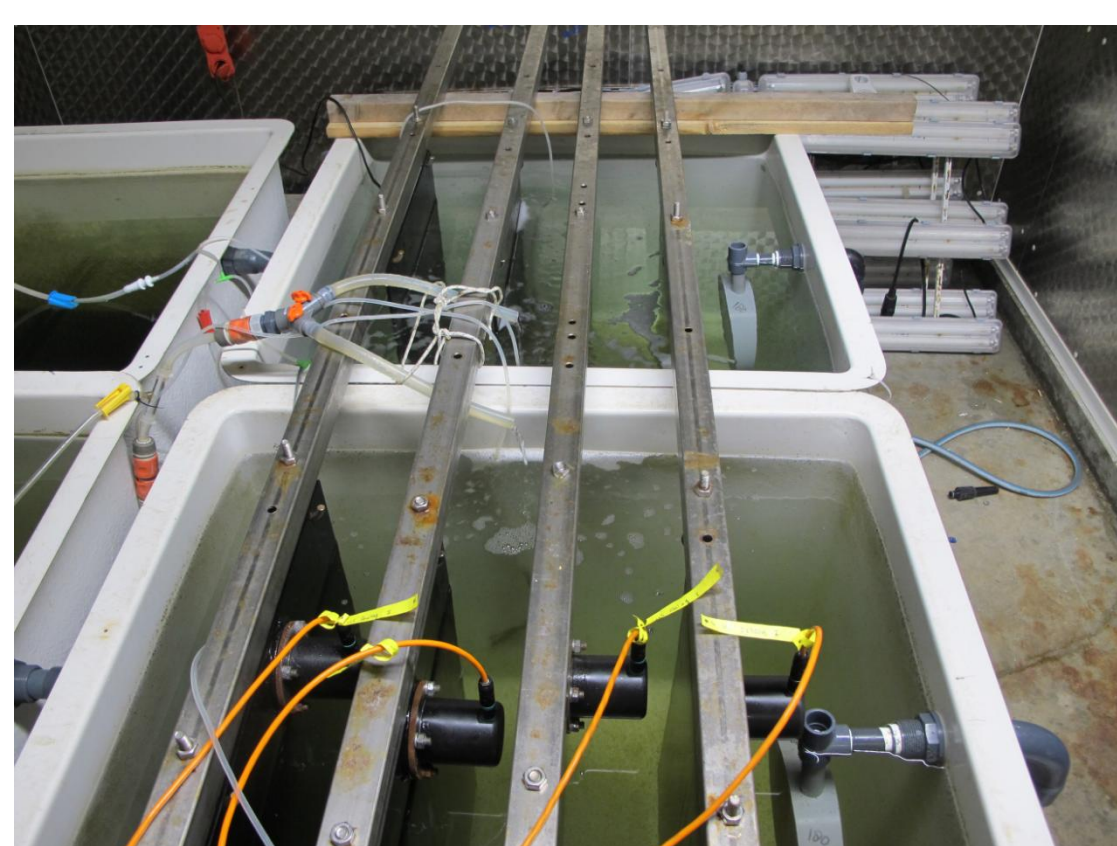
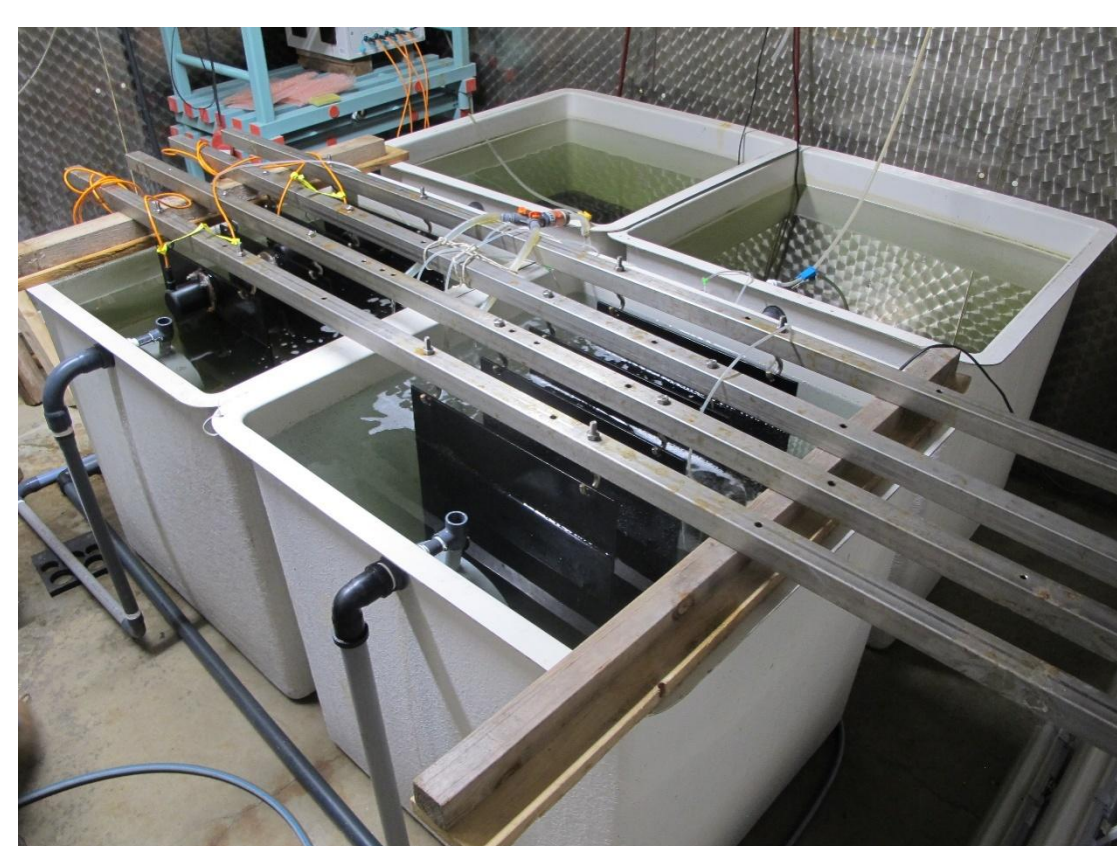


Figure 1 – Experimental setup

The remaining two plates were only suspended when a high concentration of mussel larvae was introduced. After the settlement period, the plates were removed, and the number of young mussels per plate was counted. The experiment was repeated over time to obtain replicates, as setting up multiple simultaneous tanks was too costly.

Results

Biofilm proved to be crucial for mussel settlement: without biofilm, larval settlement was minimal, while with biofilm it was extremely high. Ultrasonic vibration effectively prevented biofilm formation, which strongly reduced the mass settlement of mussel larvae. Without biofilm, ultrasonic vibration also resulted in less spat, but this effect was much smaller than the biofilm-related effect.

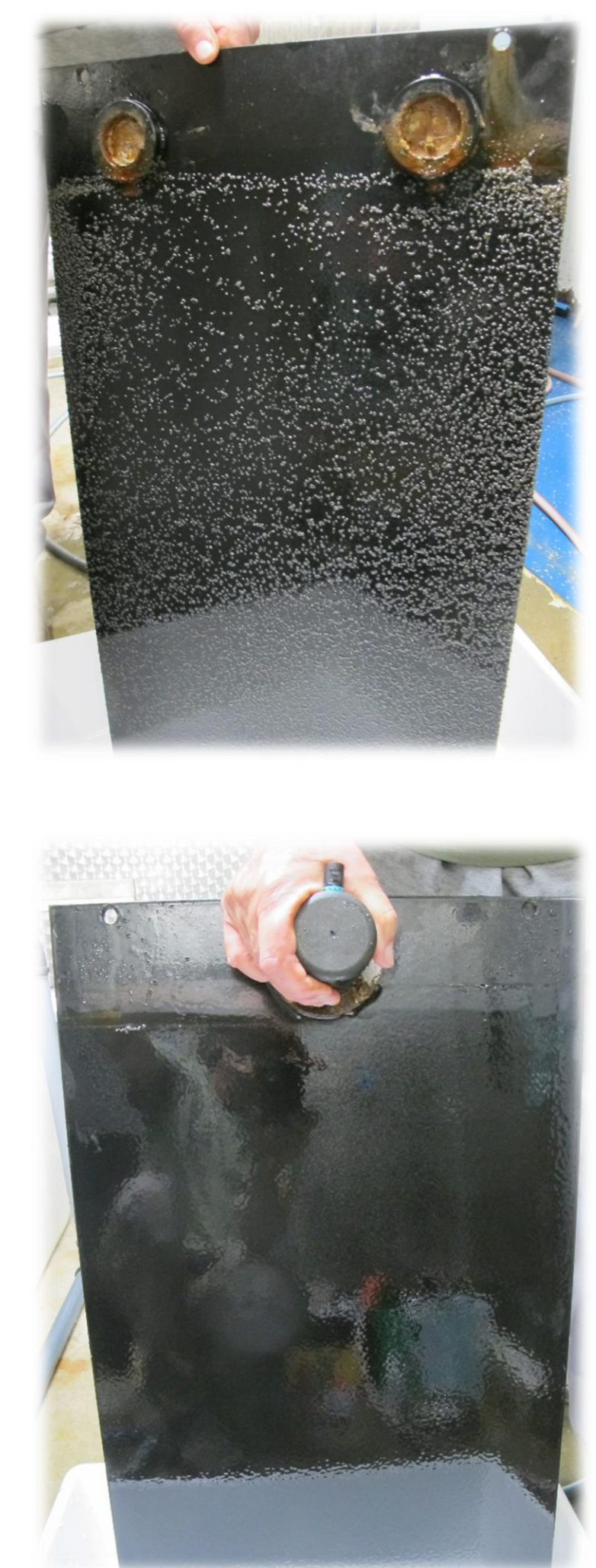
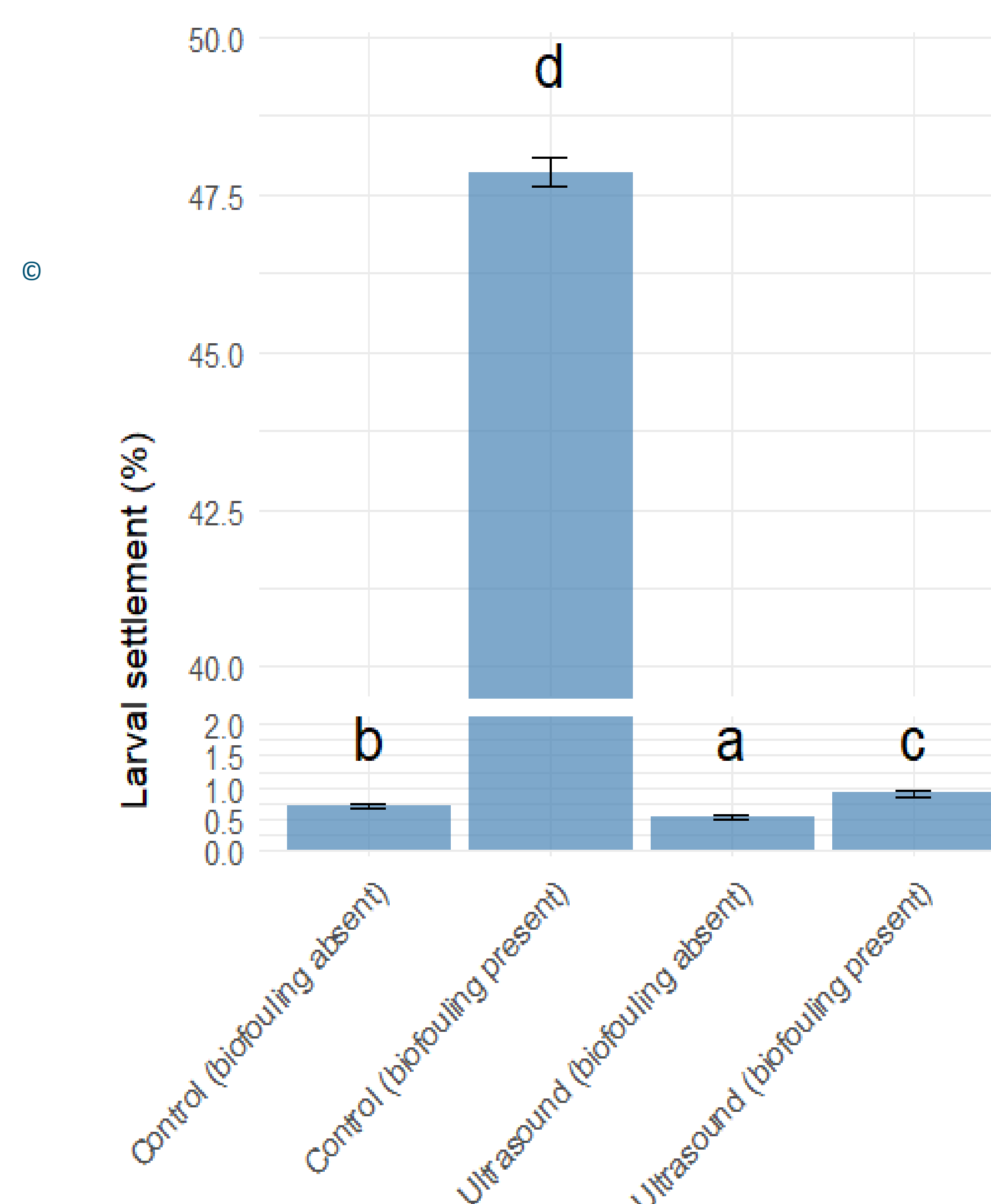


Figure 2 - Percentage of mussel larvae on plates per treatment. The letters indicate significant differences. The right panel shows the control treatment with fouling (top) and the ultrasonic treatment with fouling (bottom).

Conclusions

- Ultrasonic vibration of the substrate prevents biofilm formation, significantly reducing mussel larvae settlement.
- Biofilm strongly stimulates larval settlement; without biofilm, settlement is minimal.
- Ultrasonic vibration also reduces larval settlement in the absence of biofilm, but this effect is weaker.

Literature

Hadfield, M. G. (2011). Biofilms and Marine Invertebrate Larvae: What Bacteria Produce That Larvae Use to Choose Settlement Sites. *Annual review of marine science*, 3(Volume 3, 2011), 453-470

