Contrasting effects of flow on adult and juvenile ascidian life history stages, including the global invasive *Didemnum vexillum*

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Abstract

Few studies have quantified the relationship between flow and the recruitment, growth and survival of colonial filter feeders. In this study, *Didemnum vexillum* colonies were subjected to four different manipulated flow conditions over the course of three weeks while growth and recruitment were measured.

A direct relationship was seen between inferred increases in flow and adult growth, and an inverse relationship was seen between inferred increases in flow and recruitment .

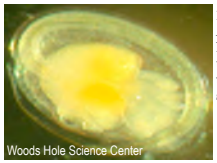


Fig. 1: *D. vex* larva, unhatched tadpole stage

These trends suggest that optimal flow conditions differ for juveniles and adults. The adults' ability to grow over a range of flow conditions adds to its danger as a biological invader. Understanding how adult and juvenile ascidians behave under different flow conditions is important in predicting which marine environments are most vulnerable to invasion. Understanding flow differences may lead to more effective control measures.

Background

Invasive ascidians have been shown to disrupt native organisms, and ecosystems, impact biodiversity[1] and frequently cause economic harm[2]. *D. vex* is regularly found in maritime habitats including ship hulls and marine structures as well as in fishing grounds and shellfish farms, making it a nuisance species of considerable concern[3]. For sessile aquatic animals, water flow is essential to the exchange of food and waste as well as for the transport of new recruits. However, different amounts of flow may affect these essential activities of growth, survival, and reproduction differentially.

Fig. 2: D. vex overgrowing shellfish nets

Materials and Methods

Aerial Map of Pillar Point Harbor, Half Moon Bay CA. (Fig 3): *D. vex* pieces were collected and tied to 15cm. by 15cm. PVC plates that were deployed in Pillar Pt Harbor.

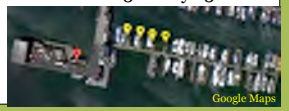


Fig 3: Yellow points mark where *D. vex* was collected and the red point marks site of experiment.

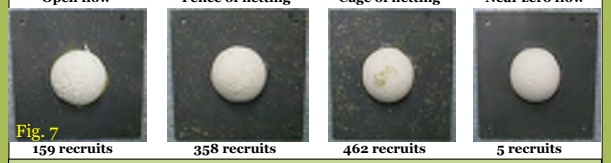
Flow treatments (Fig. 4): *D. vex* plates were randomly assigned to one of four flow treatments: open flow, fence of vinyl hex netting, cage of netting and near zero flow.

Open flow | Fence of hex netting | Cage of netting | Near zero flow

Measuring flow (Fig. 5): Plaster clods were placed under the same four flow conditions to determine relative water flow rates through clod dissolution[4]. Clods were replaced every seven days for three weeks.

Growth rates (Fig 6): PVC plates were photographed every week for four weeks. Image J was used to calculate weekly size specific growth rates based on pixel measurements.

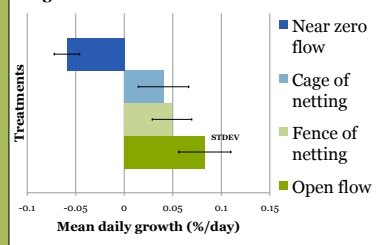
Recruitment rates (Fig 7): Image J was used to record the number of new recruits on the clod plates for three weeks.



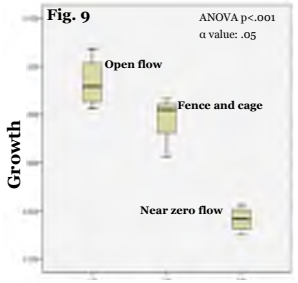
Open flow | Fence of netting | Cage of netting | Near zero flow

159 recruits | 358 recruits | 462 recruits | 5 recruits

Results

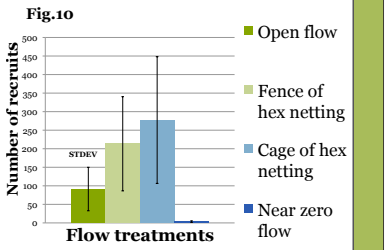


***D. vex* colonial growth rate increases with flow (Fig 8):** *D. vex* placed in the low flow condition experienced a reduction in growth and subsequent death after 14 days. *D. vex* in the other three treatments all experienced growth.



There were significant differences in growth between the treatments when both netting conditions were grouped together (Fig 9): Open flow treatment was significantly different from near zero treatment (ANOVA p<.001). Hex netting treatments showed trend of intermediate growth rates, but not significantly different from other treatments.

An inverse relationship between local restrictions in flow and larval settlement (Fig 10): Recruits seen on plates included a diverse community of native and invasive sessile filter feeders, predominantly ascidians[5].



Discussion/ Further Research

Adult *D. vex* growth rate increased with flow, while recruit number decreased at higher flows. The trend in recruit number suggests that optimal flow conditions differ for juveniles and adults. Increased sample size could test the significance of this observed trend. If this trend holds true, it is of interest that the ideal conditions for adults would differ from ideal conditions for recruits. Further investigation of lower flows could establish limiting conditions for *D. vex* growth, survival, and recruitment.

References

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