Construction of a double grid turbulence tank for larval behavior studies

A Report to the:
Rinehart Coastal Research Fund (Project #3203100)
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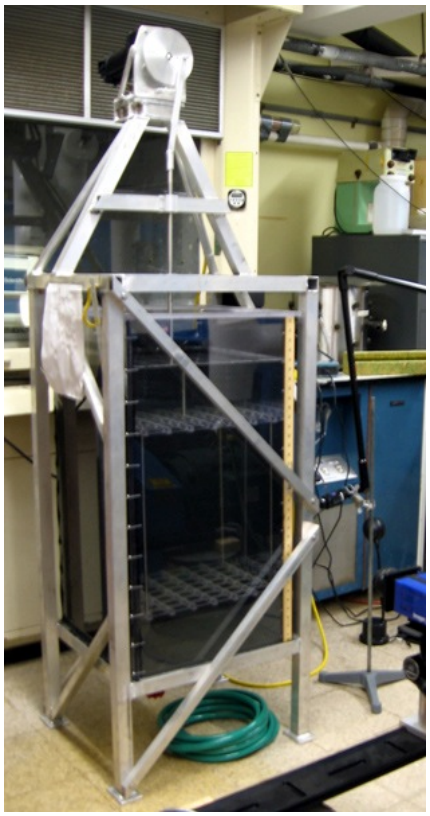
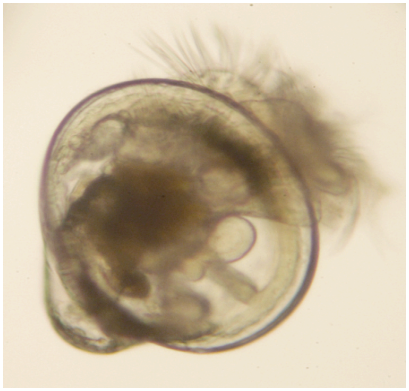
We used Rinehart Coastal Research funds to construct a double-grid turbulence tank (Fig. 1) in order to study behavioral responses of marine organisms to flow. The tank is an improvement over earlier versions because it produces turbulence without the vertical gradients and other asymmetries that are introduced by a single-grid system. We use it in conjunction with a particle imaging system (PIV: Particle Image Velocimetry) that allows us to track the movements of the organisms, and measure the intensity and characteristics of the flow.



Double-grid turbulence tank

Turbulence is an important part of the environment of planktonic marine organisms. It influences how often an individual contacts food particles, and how often it contacts predators. For the larval stage of bottom-living marine organisms (clams or snails, for instance) it may also serve as a valuable cue that a good benthic habitat is nearby.

We know from our prior studies that larvae of the mud snail drop rapidly to the seafloor when they experience high levels of turbulence. We will be using this new tank to explore how larvae of mollusc species (including the eastern oyster, shown here) detect turbulence and whether they respond to it in a way that increase their chances of successful settlement and survival to adulthood.



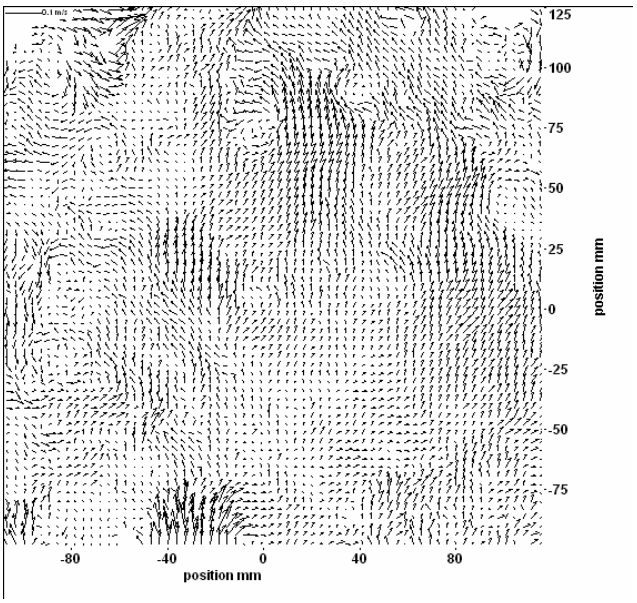
Larva of eastern oyster (0.3 mm)

The PIV system uses a high-power laser to illuminate small scattering particles in the tank.

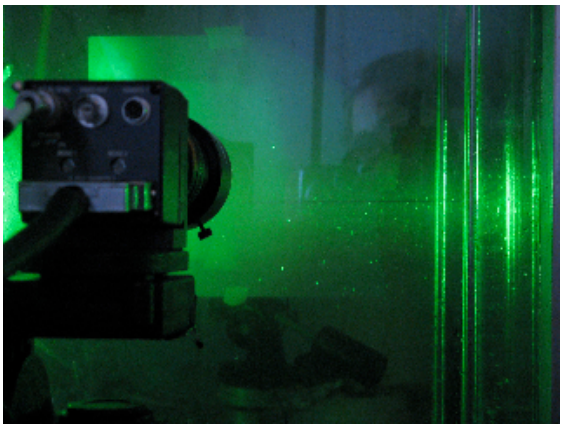
The movement of these particles is recorded on video, and pictures of the turbulent flow are produced by comparing two consecutive video frames. The pictures give a visual indication of the scales and intensity of turbulence, and the velocity vectors are used to calculate various quantitative descriptors.

The paths of larvae are also being recorded at the same time as turbulence measurements. Larvae are distinguished from the scattering particles by size, and are easily detected by eye as white specs in the laser light sheet. Video records are analyzed to track larval motions and determine how larvae behave when they encounter specific features of turbulence.

Larval responses to turbulence are particularly important in coastal habitats subject to perturbations, both natural and human induced. If these behaviors influence settlement patterns and success, then changes in turbulence from natural (storms, sea level change) or anthropogenic (erosion, coastal armoring or structures) sources may influence the viability of regional populations. Knowledge of these influences is important for informed decision making about shellfish management and ecosystem conservation.



PIV image of turbulence in tank



Oyster larvae (white dots) in laser light sheet