LENFEST OCEAN PROGRAM

SUMMARY

DILUTION CANNOT BE ASSUMED THE SOLUTION FOR AQUACULTURE POLLUTION

Venayagamoorthy, S.K., H. Ku, O.B. Fringer, A. Chiu, R.L. Naylor and J.R. Koseff. 2011. Numerical modeling of aquaculture dissolved waste transport in a coastal embayment. *Environmental Fluid Mechanics.*

A recent scientific study published in the journal *Environmental Fluid Mechanics* shows that the location of coastal and offshore aquaculture pens can dramatically influence the extent to which dissolved fish farm waste disperses from its source and reaches coastlines. This study is the first detailed look at how real world factors influence the flow of wastewater from fish farms and provides a further basis for understanding the impact of aquaculture fish-pens on coastal water quality.

Marine aquaculture, or fish farming, is viewed as a means to supplement declining wild fisheries and to help meet the rising global demand for seafood; however it can cause environmental degradation. For example, water quality can be significantly impacted because farmed fish excrete much of the nutrients contained in their feed, including nitrogen and phosphorous. In excess, these nutrients, can trigger eutrophication and depleted oxygen levels. Nutrients discharges are a particular concern when fish are grown in open net pens because nutrient-laden feces, undigested feed, and other fish wastes flow freely into the surrounding environment, some settling to the bottom and other waste products dissolving into the water column. The concentrations of dissolved waste from net pens are often assumed to decline continuously in all directions as the discharge moves further from the pens, diluting the environmental impacts as the distance from the pens increases.

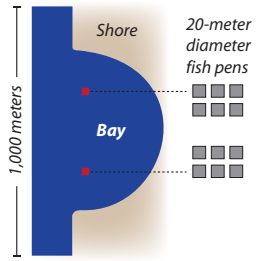
Dr. Venayagamoorthy and colleagues, supported by the Lenfest Ocean Program, explored the influence of local currents and flow conditions on the concentration and dispersal of dissolved wastes from marine aquaculture net pens. In order to test the assumption that waste products are consistently diluted as distance from the net pens increases, the scientists developed an idealized computational model and performed simulations of dissolved pollutant plumes in variable coastal and offshore marine environments. The simulations included representations of the local physical environment (i.e., the shape and depth of the embayment containing the pens), flow conditions (i.e., tides and wind-induced currents), and the physical locale of the pens relative to the coasts and freshwater discharges.

The scientists showed that specific flow conditions around the aquaculture pens, such as tidal flow, the earth's rotation, local river discharges and the drag introduced by the pens, can lead to pockets of concentrated pollution traveling considerable distances from the source, potentially affecting coastal waters and the coastlines far from the aquaculture pens themselves.

The results of this study show that producers, regulators and other stakeholders cannot simply assume that fish waste discharge will be diluted consistently as it moves away from the net pens, or that dilution is necessarily the solution for aquaculture wastes. Instead, they need to consider how factors such as tides, river outflows, shape of embayments and other factors will influence the concentration and spread of dissolved wastewater plumes. Thus, the effluent model created in this exercise can be a useful tool for predicting a site's ability to meet water quality standards before aquaculture facilities are built.

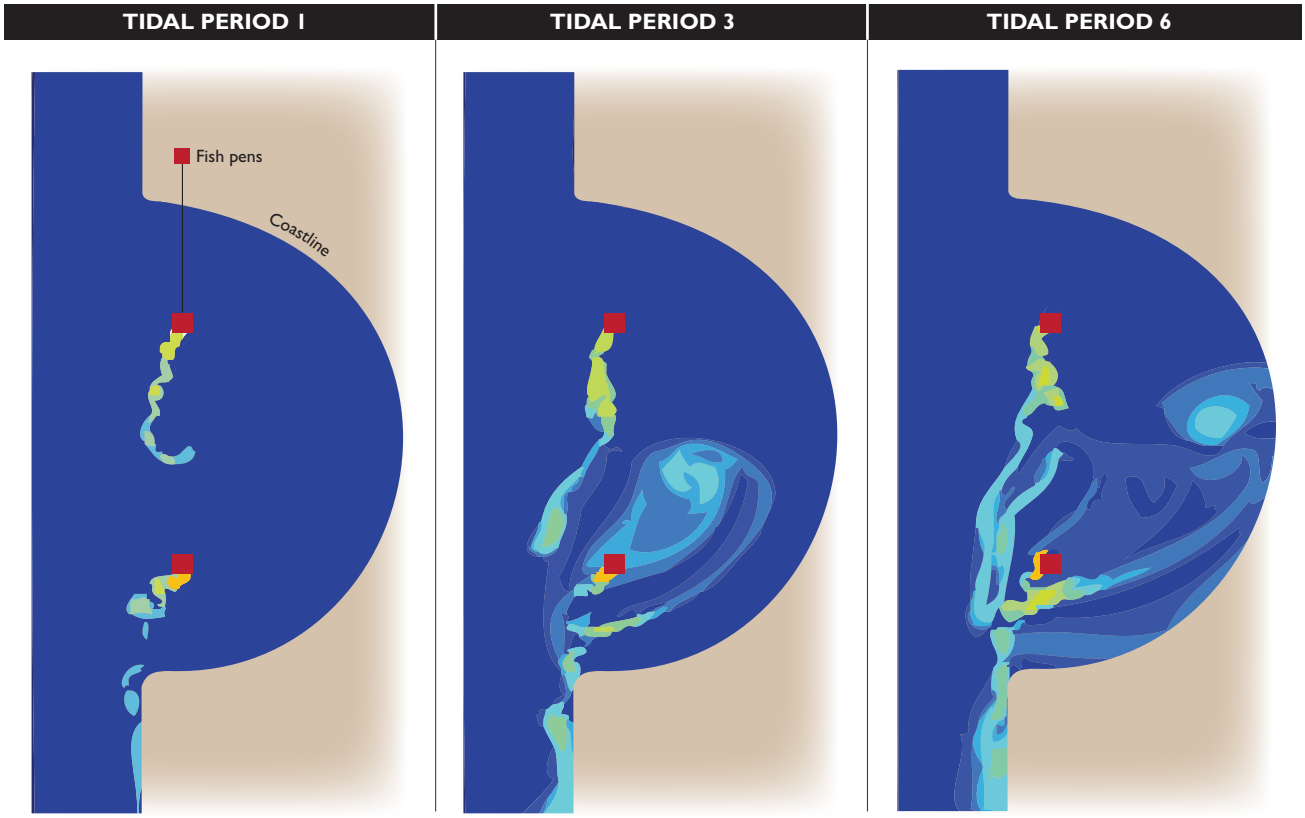
Modelling waste flow from fish farm pens

In this simulation of a pollution plume, plumes originate from two fish pens located in the center of the bay. The model depicts where the pollution would flow over six tidal periods, and we show the first, third and final period. The plume initially moves southward due to the strong current, but also spreads eastward into the bay. The movement also continues south along the coast out of the frame.



BIRD'S EYE VIEW TIME SEQUENCE

Concentration field (higher concentrations of pollutants are represented by warm colors, and more dilute concentrations by cool colors)



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Lenfest Ocean Program: Protecting Ocean Life Through Marine Science

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