When fish farms are built along the coast, where does the waste go?

February 15 2009, By Dan Stober

If you are a fish eater, it's likely that the salmon you had for dinner was not caught in the wild, but was instead grown in a mesh cage submerged in the open water of oceans or bays. Fish farming, a relatively inexpensive way to provide cheap protein to a growing world population, now supplies, by some estimates, 30 percent of the fish consumed by humans.

Two hundred and twenty species of finfish and shellfish are now grown in farms.

Intuitively, it seems a good idea—the more fish grown in pens, the fewer need be taken from wild stocks in the sea. But marine aquaculture can have some nasty side effects, especially when the pens are set near sensitive coastal environments. All those fish penned up together consume massive amounts of commercial feed, some of which drifts off uneaten in the currents. And the crowded fish, naturally, defecate and urinate by the tens of thousands, creating yet another unpleasant waste stream.

The wastes can carry disease, causing damage directly. Or the phosphate and nitrates in the mix may feed an algae bloom that sucks the oxygen from the water, leaving it uninhabitable, a phenomenon long associated with fertilizer runoff.

It has been widely assumed that the effluent from pens would be benignly diluted by the sea if the pens were kept a reasonable distance

from shore, said Jeffrey Koseff, a professor of civil and environmental engineering and co-director of Stanford's Woods Institute for the Environment. But early results from a new Stanford computer simulation based on sophisticated fluid dynamics show that the icky stuff from the pens will travel farther, and in higher concentrations, than had been generally assumed, Koseff said.

"What we've basically debunked is the old adage that 'The solution to pollution is dilution,' " he said. "It's a lot more complicated."

The computer modeling (with new Stanford software that goes by the acronym SUNTANS) was conducted by Oliver Fringer, an assistant professor of civil and environmental engineering. He created a virtual coastal marine area resembling California's Monterey Bay.

Previous software, he said, has not been up to the task of accurately predicting where the unhealthy effluent from fish pens will end up, and should probably not be used by state or federal regulators when they approve locations for fish farms.

Existing software is typically derived from models that attempt to describe the drift of effluent from sewage outfall pipes, even though the substances and situations are different from fish farms. (Sewage outflow, for example, is often warmer than the ocean water.)

The fine details of modeling the flow of dissolved fish poop from a submerged cage are not as simple as they may seem. The design of the cage itself can affect the outcome. How much of the current flows through the cage, and how much goes around? Does the moving water swirl into eddies at the edges of the pen? Even the effects of the rotation of the earth on the waste plume comes into play.

The fish farmer would prefer that currents flush out his pens frequently,

but as those currents take out the garbage they might unfortunately deliver it to a mangrove ecosystem or a public beach. On the other hand, insufficient flow through the pen can create a "dead zone" on the ocean floor as the fecal matter and uneaten food pile up beneath the fish.

Fringer is designing his software so that it can be used to asses any site—Puget Sound, perhaps—where sufficient digital mapping of the area already exists. SUNTANS comes just in time, said Stanford oceans expert Rosamond Naylor, as federal and local officials begin spelling the details of new health and environmental regulations for fish pens.

Also participating in the research was former postdoctoral researcher Subhas Karan Venayagamoorthy, now at Colorado State University.

Source: Stanford University