Is the Pacific Ocean's chemistry killing sea life?

June 21 2009, By Craig Welch

The collapse began rather unspectacularly. In 2005, when most of the millions of Pacific oysters in this tree-lined estuary failed to reproduce, Washington's shellfish growers largely shrugged it off.

In a region that provides one-sixth of the nation's oysters -- the epicenter of the West Coast's $111 million oyster industry -- everyone knows nature can be fickle.

But then the failure was repeated in 2006, 2007 and 2008. It spread to an Oregon hatchery that supplies baby oysters to shellfish nurseries from Puget Sound to Los Angeles. Eighty percent of that hatchery's oyster larvae died, too.

Now, as the oyster industry heads into the fifth summer of its most unnerving crisis in decades, scientists are pondering a disturbing theory. They suspect water that rises from deep in the Pacific Ocean -- icy seawater that surges into Willapa Bay and gets pumped into seaside hatcheries -- may be corrosive enough to kill baby oysters.

If true, that could mean shifts in ocean chemistry associated with carbon-dioxide emissions from fossil fuels may be impairing sea life faster and more dramatically than expected.

And it would vault a key Washington industry to the center of international debate over how to respond to marine changes expected to ripple through and undermine ocean food webs.

Scientists seeking to explain what's plaguing these coastal oysters say the link to more corrosive water is strong but anecdotal. It could be just one of several factors.

But the possibility leaves some shellfish farmers uneasy about more than just their future business.

Indications that ocean acidification may already play a role in the decline of oysters are a "sign of things being out of balance, and that scares the living daylights out of me," said third-generation oysterman Brian Sheldon.

Ruffling his 8-year-old son Jebediah's head, he added, "For this guy."

Pacific oysters aren't native to Willapa Bay, but shellfish growers have farmed them here since the 1920s. It's about the only place left on the West Coast where growers look to the wild to get their oysters.

Normally, oysters spawn in the water, producing larvae that swim and eventually attach to a hard surface _ typically other oyster shells. This creates oyster seed, called a "set." These succulent mollusks are then moved by hand throughout the bay and take two to five years to fatten up.

But somewhere between the larval stage and settling on a shell, these embryonic oysters are dying. And since only a few young have survived since 2005, "we're running out of oysters in the bay," said Bill Dewey, spokesman for Taylor Shellfish Farms. "Growers are scrounging for whatever they can find."

Standing ankle-deep in sea-water on a south Willapa sandbar earlier this month, Sheldon, owner of Northern Oyster Co., watched his workers gather shellfish at low tide from one of the few places that still had

some: a state "oyster reserve," a sort of shellfish bank growers can lease and draw upon to subsidize their own crops.

For the first time since his grandfather started the company in 1934, Sheldon plans this year to spend thousands buying oyster seed -- larvae attached to shells -- from hatcheries, rather than counting solely on wild reproduction. He expects he'll make only half as much as he would in a normal year.

"It perplexes me that we are still, as a country, and really, globally, denying that there is something going on," he said. "I don't have the background in the natural sciences to tell you it's one thing or the other. I can just say that over the last 10 years it's clear to me ... something's changing. There's no doubt in my mind."

Researchers at first blamed an explosion of Vibrio tubiashii, an ocean-borne, larvae-killing bacteria. When researchers sampled the marine waters that get sucked directly into the hatcheries from the sea, they found bacteria counts nearly 100 times above normal. Even after installing extensive microbe-killing ultraviolet water-treatment systems, larvae died.

Then they noticed the water's pH -- the scale measuring acidity and alkalinity -- sometimes dropped below normal, becoming more acidic.

Seawater typically is slightly alkaline, but when oceans absorb carbon dioxide from the atmosphere -- as they have by the hundreds of billions of tons since the Industrial Revolution -- they become more corrosive.

Climate modelers predicted greenhouse gases would make marine waters more acidic by century's end. They expected to notice it first in deep water, some of which hasn't circulated to the surface in 1,500 years and has therefore accumulated more atmospheric carbon dioxide. And deep

waters already run higher in carbon dioxide because dying plants, animals and fish sink and decay.

But two years ago, oceanographers Richard Feely and Chris Sabine, both with the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory in Seattle, found more acidified waters already reaching the surface.

The north winds that blow off Washington's coast push marine surface waters off shore. Those waters are replaced by the icy-cold, more corrosive seawater welling up from hundreds of meters below.

Throughout 2008, researchers at Oregon's Whiskey Creek Shellfish Hatchery noticed a trend: Their die-offs tended to come after north winds pushed those very same deep waters into the pipes that feed the hatchery.

"There seems to be a strong correlation," Feely said.

In a sense, that's exactly what scientists expected -- just not so soon.

Corrosive waters can dissolve clam shells, eat away at corals and kill fish eggs. Already, scientists have taken pteropods, tiny marine snails that swim in the open ocean, from the Gulf of Alaska and exposed them to slightly acidified marine water in a laboratory. Their protective shells immediately dissolved.

Those creatures make up 60 percent of the food for Alaska's juvenile pink salmon. Similar creatures support many of the major fish species in Alaska's North Pacific, which in turn supports the billion-dollar Seattle-based industry that provides half the nation's catch of fish.

"The fish we depend on -- salmon and pollock and herring -- when

they're in the first year of their life, they all depend on shellfish for survival," Feely said. "Early models suggest a 10 percent loss in pteropods can cause a 20 percent loss in weight of a fish."

Just last month, Smithsonian scientists published a paper suggesting that in the next century more acidified oceans will threaten the world's shellfish. Oyster larvae, they pointed out, are particularly susceptible. Their early shells are made from an easily eroded form of calcium carbonate.

Researchers believe that might be part of what's already happening on the Northwest coast. If oyster larvae are swimming in marine waters -- whether pumped from the sea into a hatchery or in the bay -- as deep, acidified water is pushed toward shore, "that could be a problem," said Simon Alin, a NOAA scientist who works with Sabine and Feely.

In addition, Vibrio tubiashii thrives in this more corrosive environment. "It becomes the dominant pathogen," Feely said.

Still, it's too soon to say for certain if these issues are localized or part of a broader phenomenon. The hatchery is not far from a low-oxygen dead zone off the Oregon coast. There also isn't sophisticated enough equipment in place to get precise pH readings.

But it all suggests significant ocean changes are coming fast, if they're not here already.

"We're not saying we're killing all life in the ocean," Sabine said. "There will be winners and losers. But this is not something that's off in the future. This is not something for our children's children. It's happening now."

Already the oyster industry is seeing job losses and other effects. In the

last year, Taylor spent $500,000 just trying to get oysters to attach to shells in a secondary hatchery, said Willapa Division Manager Eric Hall.

The industry has asked Congress for help replumbing hatcheries and developing monitoring systems to track upwelling events and the quality of incoming seawater. Without intervention, its economic contribution to the region could drop another 30 percent just this year, said Robin Downey, director of the Pacific Coast Shellfish Growers Association.

So far in 2009, hatcheries have been able to improve production because of fewer upwelling events. Combined with new piping and technology, oyster production could stabilize before consumers notice a change.

But without major changes in the marine environment, small operators who count entirely on nature, like Sheldon, will likely continue to struggle. "I hope you have your fingers crossed for us," he said.

He wants desperately to pass his business to his son, so he plans to keep on hunting for oysters.

But now he'll do so with one eye trained on the coast's north winds.

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