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NW Fishletter #332, May 15, 2014

[2] West Coast Sea Snails Show Signs Of Ocean Acidification

Ocean researchers from NOAA Fisheries have published **new findings** documenting shell deterioration of tiny snails up to a half-inch long called pteropods, and say the likely cause is increasing ocean acidification.

Published April 30 in *Proceedings of the Royal Society B*, the scientists said that up to half the samples collected in areas off the West Coast during an August 2011 cruise showed signs of shell damage.

Just what that means for future salmon runs is unclear. Other recent studies have yet to find any overall trends in pteropod abundance, but it's complicated by several factors. Some of the snail species eat each other, and only some salmon species, like pinks and chums, seem to prefer pteropods when they are abundant.

"Our findings are the first evidence that a large fraction of the West Coast pteropod population is being affected by ocean acidification," said lead author Nina Bednarsek, of NOAA's Pacific Marine Environmental Laboratory in Seattle, in a statement. "Dissolving coastal pteropod shells point to the need to study how acidification may be affecting the larger marine ecosystem."

The research was concentrated in the California Current, an area along the West Coast where significant summer upwelling can bring CO_2 and nutrients that trigger plankton production to the surface from the depths, where they have been trapped for decades. With up to 30 percent of human-caused CO_2 emissions being absorbed by the world's oceans, the combination is creating more acidic conditions off the West Coast not expected in high-latitude regions for decades to come.

The paper reports that in pre-industrial times, enough CO_2 was added to surface waters on the Continental Shelf from upwelling alone to create these conditions about 10 percent of the time. But with the added absorption of increased levels of atmospheric CO_2, the researchers estimated that such conditions appear about 30 percent of the time.

The researchers said the pteropods' thin shells are vulnerable to dissolution when exposed to such conditions in only 4-14 days. Where the ocean is less than 200 meters deep, they found 53 percent of all samples showed severe shell dissolution, more than twice the percentage they expected to have been severely affected by upwelling alone in pre-industrial times. By 2050, they said, up to 71

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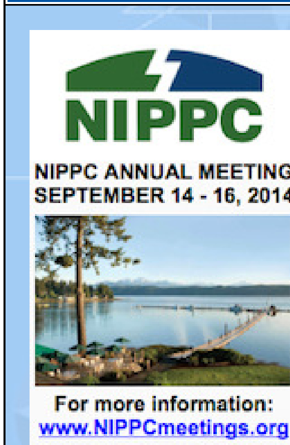
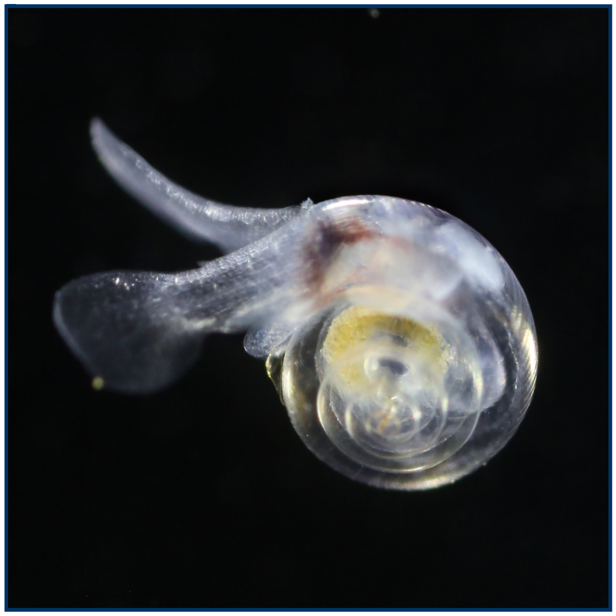


percent of the pteropods could be severely affected in shallow shelf waters.

Newport, Ore.-based NOAA oceanographer Bill Peterson, one of the paper's co-authors, told *NW Fishletter* that he was surprised by the results. But the good news is that most salmon species on the West Coast don't usually eat many pteropods in the first place. Peterson said pink salmon are the exception, while Chinook and coho favor small fishes in their diet, and sockeye generally don't generally go after pteropods either.



A healthy pteropod collected during the U.S. West Coast survey cruise. (Credit: NOAA) (Click to Enlarge)

Over the years, scientists have found most salmon feed on a mixture of fish, squid, krill, amphipods, copepods, pteropods, larval crustaceans, gelatinous zooplankton, tiny worms, sea slugs, and various shrimps. The potential reduction in one part of their diet could be made up by other types of prey.

The paper says the volume of "undersaturated" water in the top 100 meters off the West Coast that can lead to shell dissolution has increased by six times compared to pre-industrial times. Peterson said that corresponds to a pH of around 7.7. While readings above 7 are considered basic, what is important is how the pH changes, since a drop of 0.1 in the logarithmic scale indicates a 30-percent increase in acidity.

The West Coast is not the only place where such conditions have been around for decades.

Two Canadian scientists who examined research from survey cruises in the 1950s, produced a new analysis of the data in 2009 that suggested more acidic conditions were likely common in some of those years in the Gulf of Alaska, comparable with the pH levels found off the West Coast a few years ago. They said that during the winter, atmospheric CO_2 was greater, with upwelling and turbulent wind-driven mixing bringing less saturated, lower pH subsurface water toward the surface.

"So it appears that even in the mid-1950s," they said, "pelagic organisms with aragonitic exoskeletons living in the northern Gulf of Alaska may have already faced the challenges of producing (or maintaining) shells in undersaturated seawater."

Another **paper** (Mackas, 2012) that examined different types of pteropods found that the species highlighted by the NOAA researchers "showed fairly strong declining temporal trends" that could be a response to increasing ocean acidity. But they also said other evidence has suggested that acidification is not yet the main driver of pteropod population changes in the northeast Pacific.

First, they pointed out, the "most severe" present-day and year-round acidification stress occurs in the offshore core of the Alaska Gyre, where the recent abundance trends of two pteropod species were "weakly positive," including *Limacina helicina*, the species studied in the NOAA paper. And in the more near-shore regions where *Limacina* has been declining, the other two main pteropod species have shown "weak-to-significant" upward trends. They said it seemed unlikely that the effects of ocean acidification would be negative on one species, but positive on the other two. They speculated that one species may be eating another when *Limacina* is less available.

But the authors ended on a cautious note. "The conclusion that we have not yet passed a tipping point does not mean that we will not pass a tipping point in the near (or moderately distant) future. One of the best candidates for 'canary' indicators will be the continued maintenance of pteropod time-series in regions where we now know past and recent population histories and baselines." ***-B. R.***

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