Ocean acidification impacts olfactory functions of salmon

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By The Cordova Times
Washington Sea Grant studies how acidity of ocean affects ability of cohos to find their way home

Researchers at the University of Washington are observing in laboratory studies that ocean acidification affects a fundamental sensory function of coho salmon, which may impact their ability to feed, avoid danger and find their way home.

While the acidification of ocean waters caused by an increase in carbon dioxide is known to stress shellfish trying to pull calcium carbonate out of seawater to form shells, a lesser known impact of growing ocean acidification is how the changing chemistry of ocean waters is messing with the brains of salmon, says Meg Chadsey, an ocean acidification specialist with Washington Sea Grant.

The Pacific Northwest shellfish industry became aware of the threat of ocean acidification in the early 2000s, when growers began to realize that acidified water was killing hatchery-spawned oysters. Now studies by Chase Williams and others with Washington Sea Grant are looking at how the behavior of coho salmon is affected by increased levels of carbon dioxide, including their ability find their way home and avoid danger.

Their research was the subject of a panel discussion on Nov. 17 during the 2017 Pacific Marine Expo in Seattle.

Salmon can smell a compound that comes from torn salmon skin and if such skin is dipped into a laboratory tank where they are swimming, the fish will swim away, Chadsey said. In

research underway, Williams has been rearing juvenile coho salmon in laboratory tanks, and adding extra carbon dioxide into the water in the tank. At different levels of carbon dioxide he has run the cohos through mazes to see if they would notice and turn away from the salmon skin compound.

The salmon mazes are shaped like a letter “Y” and the salmon were put at the bottom of the “Y” while at the left side of the maze at the top the salmon skin compound would be dripped in, with none of the compound dripped into the right side of the “Y”.

When more carbon dioxide is added into the water, the salmon seemed to lose their ability to smell or respond appropriately to the predator, Chadsey said. As the concentrations of carbon dioxide increased, the fish didn’t seem able to sense the predator or to respond appropriately, she said.

Chadsey, Williams and others, led by Evan Gallagher of the UW Department of Occupational and Health Sciences, have already published some of their research work on the effects of ocean acidification on salmon and sablefish neurobehavioral function.

In one report published by Washington Sea Grant researchers noted that studies elsewhere showed that anticipated marine carbon dioxide concentrations can alter vital smell-mediated behaviors in fish, even repelling fish from prey and drawing them to predators.

No such studies, however, had examined fish in Washington state, where dissolved carbon dioxide already has reached elevated levels and waterborne chemicals cause neurobehavioral impairment in juvenile salmon. So the researchers engaged in a project to expose coho salmon and sablefish, also known as black cod, to actual and anticipated levels of carbon dioxide and to odorant signals for food, predators and schooling.

Williams and Gallagher also published in a 2016 edition of the

Society of Toxicology their research results on cadmium exposure differentially altering odorant-driven behaviors of olfactory receptors in juvenile coho salmon.

They noted that salmon exposed to waterborne metals can experience olfactory impairment leading to disrupted chemosensation, the ability to perceive chemicals in the environment that are odorants or tastants.

They investigated the effects of cadmium on salmon olfactory function by modeling an exposure scenario where juvenile salmon transiently migrate through a polluted waterway.

Cadmium is a poisonous metal that is among common pollutants in urban and agricultural waterways. Cadmium can be electroplated to other materials to protect them from corrosion, and is also used in rechargeable nickel-cadmium batteries.

In this study coho salmon were exposed to environmentally relevant concentrations of waterborne cadmium for 16 days, followed by a 16-day depuration associated with outmigration. Researchers noted that olfaction is a critical sensory system in fish species, and that for salmon the olfactory system serves a central role in their life cycle. The salmon rely on their olfactory system to detect chemosensory cues in locating prey, avoiding predators and in migration.

This olfactory system is also a potential target for waterborne pollutants, and researchers observed that close contact of the olfactory sensory epithelium with the surrounding water slows for interaction with dissolved pollutants which can lead to a loss of olfactory function.

This pollutant-based disruption of olfactory driven neurobehavioral function is a factor implicated in the declining Pacific salmon populations, many of which are threatened or endangered, they said.

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