Copper making salmon prone to predators

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WSU researcher Jenifer McIntyre has found that minute amounts of copper from brake linings and mining operations can affect salmon to where they are easily eaten by predators. Credit: Washington State University photo

Minute amounts of copper from brake linings and mining operations can affect salmon to where they are easily eaten by predators, says a Washington State University researcher. Jenifer McIntyre found the metal affects salmon's sense of smell so much that they won't detect a compound that ordinarily alerts them to be still and wary.

"A copper-exposed fish is not getting the information it needs to make good decisions," says McIntyre, a postdoctoral research associate in WSU's Puyallup Research and Extension Center. Her research, conducted for a University of Washington doctorate with colleagues at UW and the National Oceanic and Atmospheric Administration, appears in the latest issue of the journal Ecological Applications.

Earlier research showed that copper impacts a salmon's sense of smell. Other research showed that when a salmon's sense of smell is affected, its behavior changes.

McIntyre put the two together, exposing juvenile coho salmon to varying amounts of copper and placing them in tanks with cutthroat trout, a common predator. The results were striking.

Salmon are attuned to smell a substance called Schreckstoff. German for "scary stuff," it is released when a fish is physically damaged, alerting nearby fish to the predator's presence.

In her experiments, conducted in a four-foot-diameter tank, fish that weren't exposed to copper would freeze in the presence of Schreckstoff, making it harder for motion-sensitive predators to detect them. On average, half a minute would go by before they were attacked.

But salmon in water with just five parts of copper per billion failed to detect the Schreckstoff and kept swimming. They were attacked in about five seconds.

"It's very simply and obviously because predators can see them more easily," says McIntyre. "They're not in lockdown mode."

The unwary exposed fish were also more likely to be killed in the attack, being captured 30 percent of the time on the first strike. Unexposed fish managed to escape the first strike nearly nine times out of ten, most likely because they were already wary and poised to take evasive action.

McIntyre also noticed that the behavior of predators was the same whether or not they had been exposed to copper.

Copper finds its way into streams and marine waters from a variety of sources, including motor vehicle brake linings, pesticides, building materials and protective boat coatings. Actual amounts will vary from undetectable in rural or forested areas to elevated in urban areas, especially when runoff from a storm washes roads of accumulated brake dust and other contaminants.

With testimony from McIntyre's NOAA colleagues and others, the Washington State legislature in 2010 started phasing out copper brake pads and linings over the next 15 to 20 years. According to the state Department of Ecology, brake pads are the source of up to half the copper in the state's urban waterways.

McIntyre used concentrations of between 5 and 20 parts per billion but has sampled highway runoff with 60 times as much copper. Copper's effect is mediated by organic matter, which can make the metal unavailable to living things.

"My scenarios are potentially more like a hard-rock copper mining situation than storm water runoff, which typically carries dissolved organic matter along with the copper and other contaminants," McIntyre says.

Alaska's proposed Pebble Mine, for example, would produce tens of billions of pounds of copper near Bristol Bay, the largest sockeye salmon fishery in the world.

Provided by Washington State University