

Invasive fish and mussels team up to transfer toxic substances into Great Lakes walleyes

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A round goby. Photo by David Jude.

(PhysOrg.com) -- Two notorious Great Lakes invaders -- the zebra mussel and the round goby -- now play a central role in transferring toxic chemicals called PCBs up the food chain and into Saginaw Bay walleyes, one of that region's most popular sport fish.

The links between [zebra mussels](#), round gobies and contaminated Saginaw Bay walleyes is a disturbing example of unanticipated problems that can occur when non-native species get loose in the [Great Lakes](#), said University of Michigan fishery biologist David Jude, lead author of a paper on the topic published online today in the *Journal of Great Lakes Research*.

"This zebra mussel-to-goby link in Great Lakes contaminated areas is

one of the main conduits of PCB transfer to top aquatic predators such as the walleye, and it plays a substantial role in PCB transfer to birds, mammals and reptiles in the region as well," said Jude, a research scientist at the U-M School of Natural Resources and Environment.

Between 2005 and 2007, Jude's team collected walleyes, round gobies and various other [fish species](#), as well as zebra mussels and zooplankton, in the Tittabawassee River, the Saginaw River and Lake Huron's Saginaw Bay. Then they measured levels of PCBs in all those organisms—the first such study in the Saginaw Bay region.

"Though the levels of PCBs in Saginaw Bay walleyes have declined sharply in recent years, these toxic substances continue to show up at levels high enough to warrant concern," Jude said.

The highest levels were seen in the largest walleyes, which contained an average of 1,900 nanograms of PCBs per gram—just under the 2,000 nanogram [Environmental Protection Agency](#) threshold for mandatory fish-consumption advisories. A nanogram is a billionth of a gram.

Polychlorinated biphenyls, or PCBs, are manmade chemicals that were once used in hundreds of industrial and commercial applications. But the manufacture of PCBs was banned in the United States in 1979, and EPA now classifies the chemicals as probable human carcinogens.

Beginning in the 1940s, factories, chemical manufacturers and municipal wastewater treatment plants discharged PCBs into the Saginaw River; many of the PCBs settled into river-bottom sediments. The contamination led to advisories against human consumption of selected species and sizes of fish from the Saginaw River, as well as many species of fish in the Bay.

In 2000-01, the mouth of the Saginaw River was dredged to remove

accumulated sediments contaminated with PCBs, metals and various hazardous compounds. Since then, the level of PCBs has dropped precipitously in Saginaw Bay walleyes.

In addition to the U-M scientists, Jude's team includes researchers from Grand Valley State University and the University of Saskatchewan. The team compared its results to the findings of a similar study conducted in the same area in 1990, prior to the dredging project.



Walleye illustration. Courtesy Michigan Sea Grant.

Jude's team found that the average concentration of PCBs in Saginaw River walleyes dropped 65 percent between 1990 and 2007, a result that is consistent with previous studies that also showed significant declines. Much of the change can likely be attributed to the dredging project, though changes in the food web and other factors may also have played a role, Jude said.

The walleye is the top predator in the Saginaw Bay ecosystem, and the bay's world-class walleye fishery is a key part of the \$7 billion-a-year Great Lakes fishery.

Twenty years ago, Saginaw Bay walleyes fed mainly on alewives, another non-native fish species. But alewives have been nearly eliminated from Lake Huron, a decline blamed largely on predation by salmon and the

proliferation of invasive zebra and quagga mussels, which have depleted two of the alewives' main food sources.

As alewives declined, the zebra mussel/round goby/walleye link enabled substantial amounts of PCBs to continue moving up the food chain and into Saginaw Bay walleyes.

Walleyes prey on round gobies, which in turn gorge on bottom-dwelling zebra mussels that suck up massive amounts of lake water. Each fingernail-size zebra mussel filters up to a liter of water a day—taking in any toxic substances present in the water. Some of those contaminants are incorporated into the mussels' tissues and shells, and round gobies eat the little mollusks shell and all.

"Zebra mussels can accumulate relatively high concentrations of PCBs, which can then be transferred to round gobies and eventually to walleyes," Jude said.

The Saginaw Bay/Saginaw River region is designated an International Joint Commission Area of Concern, due to contamination of sediments with persistent inorganic and organic pollutants. It is one of 14 Areas of Concern in Michigan.

Authors of the Journal of Great Lakes Research paper are Jude and Stephen Hensler of the University of Michigan, Richard Rediske and Jim O'Keefe of Grand Valley State University, and John Giesy of the University of Saskatchewan.

Provided by University of Michigan

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