Yes, fish have ears -- and they can tell a fish's life story, ESF prof finds

Karin Limburg, a professor at the SUNY College of Environmental Science and Forestry, peers at a screen showing blown-up images of tiny stones in fish ears, which Limburg uses to trace a fish's movements over its life. *(Glenn Coin | gcoin@syracuse.com)*

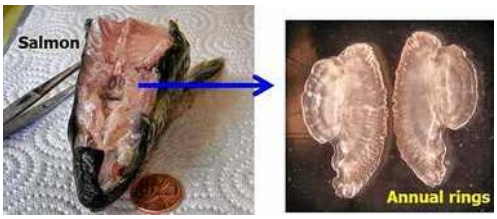
By **Glenn Coin | gcoin@syracuse.com**
Follow on Twitter
on June 01, 2014 at 4:25 AM, updated June 02, 2014 at 5:55 AM

Syracuse, N.Y. -- The severed head of a fish arrived at Karin Limburg's doorstep one Sunday morning in 2003.

It was an offering she couldn't refuse.

That Atlantic salmon was among the first that Limburg

studied in her decade of work on how fish migrate between Onondaga and Oneida lakes, and the adjoining rivers and streams.



View full size

This Atlantic salmon head, delivered to biology professor Karin Limburg, helped establish that a plan to reintroduce the fish into Oneida Lake could be successful. On the right are otoliths, ear stones in the fish that help track the age and migration of a fish.

Karin Limburg | Provided photo

Limburg, **an ecology professor** at SUNY College of Environmental Science and Forestry, has tracked the lives and migrations of fish for more than a decade by X-raying tiny stones in their ears. Limburg traces the life stories of fish by tracking the chemicals that settle in those stones, called otoliths, over a fish's lifetime.

Those life stories those stones tell - Limburg dryly calls them "fish tales" -- are important to science and how to keep fisheries healthy. Otoliths (Latin for "ear rocks"), have annual growth rings like trees and also absorb a variety of trace chemicals that can track the fish's movements over its lifetime. Fish don't have external ears, but they have internal ear parts that pick up vibrations through their bodies.

Biologists often tag and track fish, but that can be hit-or-miss because it relies on the fish being caught again later or tracked using monitoring equipment. Otoliths, on the other hand, provide a lifetime record of where a fish has lived and for how long.

"They come ready-tagged," Limburg said.

By X-ray and chemical analyses, Limburg can tell, for example, how

Al Roker at Oswego State University

See All Photo Galleries
Syracuse and CNY Photo Essays
Videos by The Post-Standard

More News Topics

Sean Kirst: Read his latest columns

Opinion: Editorials, letters & more

CNY Obituaries

Active Discussions

Most Read

Key Heidi Allen witness Jennifer Wescott will talk for $5 million, according to friend

Report: Danzer's Restaurant

View full size

The tiny white object wrapped in tape is an otolith -- a stone in a fish's ear that Karin Limburg, a professor at the SUNY College of Environmental Science and Forestry, uses to trace a fish's movements over its life.

Glenn Coin

long a fish caught in Onondaga Lake has lived there, and where it might have lived before. Fish can move freely between Oneida and Onondaga lakes via the Oneida River, but the "chemical signatures" of the lake are different enough to allow researchers to see where a fish has been.

"If you're going to manage a population of fish, you need to know its life history," Limburg said. "If their habitat is this entire system of lakes and rivers, you need to know that."

Where's the mercury?

Limburg has studied fish from Stockholm to Syracuse. Half Swedish herself, she has returned to Scandinavia many times to survey fish populations in the Baltic Sea. She worked there for more than two years as a marine biologist. She came to ESF in 1999, and co-published a dozen papers on what otoliths tell us about the lives of fish.

She has studied the ears of fish in the Hudson and Mohawk rivers, finding that manmade waterways like the Erie Canal were spurring the movement of some fish into the Great Lakes basin. She has shown how Baltic sea trout use streams for spawning, and has helped federal fisheries managers **develop plans to save** the endangered humpback chub in the Grand Canyon.

In Central New York, she does some of research at ESF

waitresses walk out, citing racism, poor working conditions and bugs

Five myths about Ebola, including the one about it going airborne (Washington Post)

Carmelo Anthony responds to freshman grades at Syracuse being in Jim Boeheim's new book

'The Snappening': Hacked Snapchat users' leaked nude photos may include child porn

and some in an **underground high-energy X-ray lab** beneath Cornell University's athletic fields. She learned about the Cornell lab from a man sitting next to her at a Passover Seder.

She notes that the cramped working quarters of the Cornell High Energy Synchrotron Source, or CHESS, doesn't resemble the airy, gleaming labs of "CSI."

"It feels more like the submarine in 'Das Boat,'" she quipped.

Limburg turned her attention to the otoliths of Onondaga Lake fish in 2003. She assumed that the otoliths would show high levels of mercury; after all, industry had dumped more than 165,000 pounds of mercury had been dumped into the lake, once considered America's dirtiest.

"If you can't find mercury in Onondaga Lake fishes," Limburg asked, "where can you?"

Not in Onondaga Lake fishes, as it turned out. Limburg found virtually no mercury in the ear stones from fish in a lake laden with mercury.

Stumped, Limburg looked for other chemicals that would be high in Onondaga Lake and could thus serve as evidence a fish spent time there. She found them in species ranging from Atlantic salmon to brown trout.

Onondaga Lake, it turned out, had higher levels of selenium than the creeks and rivers that connect it to the Oneida Lake and the barge canal. Therefore, Limburg could deduce, if a fish has a particularly high level of selenium in its annual growth ring it probably lived in Onondaga Lake that year.

Oneida Lake is higher in strontium, so that, too, leaves a chemical trail if a fish spent time in Oneida Lake.

Limburg still doesn't know why she didn't find mercury in the fish ears of a lake polluted by mercury. At first she thought it might be that selenium and mercury compete

to bond to the otolith cells, and the selenium got there first. Or maybe the mercury is taken "upstream," that is, absorbed so well by organs like the liver that it never reaches the ear.

"I really don't know the answer," she said.

Signing in with chemical signatures

The selenium, strontium and other compounds comprise a unique "chemical signature" of the otolith - a distinct set and concentration of elements that can trace a fish's life from creek to lake to ocean.

One of Limburg's doctoral students is studying a species of Atlantic herring that ranges from Maine to Florida, and by examining their otoliths the student can pinpoint the river in which an individual fish spawned. Another student has found that ocean-going fish that have grown the fastest - and thus have the best chance to avoid being lunch for larger fish - grew up in wetlands.

"She's making the pitch that this is supporting evidence that these wetlands are important and we should be restoring them," Limburg said.

And that fish head delivered to Limburg's door more than a decade ago?

It was brought by a member of the Fish Creek Atlantic Salmon Club, **which had hopes of re-introducing** the fish into Oneida Lake. Limburg's analysis of the salmon's otolith showed that it had lived in Fish Creek for two years, lived in Oneida Lake for a year and then returned to the creek.

"It told us that the fish are able to survive to adulthood in Oneida Lake," said Paul Miller, a member of the club and a former Madison County administrator. "When we started our club and started doing what we're doing, there was lot of skepticism on part of many that there was no habitat for Atlantic salmon."

Limburg continues her work on otoliths, but is also pursuing a new idea: Could fish eyes tell the same stories as ears?

Some fish, such as sea lampreys, don't have ears and therefore don't have otoliths, but they do have eyes. Lenses in the eyes of fish might capture chemicals and tell the same stories that ears do, Limburg said.

She told scientists at a recent conference that her research into fish lenses is just beginning.

"I'm looking into that, so to speak," she said.

Contact Glenn Coin: **Email** | **Twitter** | **Google +** | 315-470-3251

Related Stories

Best of syracuse.com

Syracuse football midseason report card	What Works: Little libraries promote community	Former SCSD superintendent stands by Vieira-Suarez