In fight against invasive carp, scientists explore new frontier: Track the babies

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Carp from Vltava river, Czech Republic. Credit: public domain

For decades, four invasive species of carp have been devouring plants, gorging on plankton and endangering an interconnected community of fish, plants and mollusks beneath the murky brown water of the Missouri River.

At the same time, conservationists and officials across the country have been fighting to control carp-wrought damage: conscripting scientists,

installing barriers, contracting with commercial fishing companies, and even, later this year, starting a campaign to get more restaurants to serve the fish.

Now scientists at the U.S. Geological Survey and the University of Missouri have identified a potential breakthrough: They are studying the complex way carp eggs move in rivers, in hopes they can kill them while still young.

"We've been developing better ways to remove large numbers of adult carp," said Duane Chapman, supervisory fish biologist with the USGS. "But you need to think about the other end as well."

Carp eggs drift for miles, and, as they drift, the fish develop. If researchers can figure out where they land, and if those locations are suitable for the growth of young carp, then they can target sites and intercept the eggs.

Water moves in three dimensions—downstream, side-to-side and up-and-down. But river models so far have been relatively simple, generally based on one or two dimensions, researchers say. Now, however, they have access to more powerful computers, have spent hundreds of hours gathering new water flow data, and have found some help—an expert who specializes in fluid physics. All of that means scientists now hope to use three-dimensional water flow data to chart the paths of the eggs.

There are four species of invasive carp in Missouri rivers—bighead carp, black carp, grass carp and silver carp. All are important foods in China, cultivated there for more than 1,000 years.

U.S. fish farmers largely imported them in the 1960s and early 1970s to keep fish farms and other ponds clean. But farmers failed to secure the fish properly, scientists have said, and the carp jumped ship, making

their way into the Missouri and Mississippi rivers, and spreading rapidly throughout the Midwest.

The population boomed in Missouri in the early 2000s, said Chapman, the USGS biologist.

Adult grass carp consume aquatic plants, which serve as food and habitat for native fish. Bighead and silver carp feed on plankton, shouldering aside native fish that rely on the same food source.

Silver carp are sometimes called "jumping carp," renowned for flying up to 10 feet in the air when startled, sometimes injuring boaters.

Black carp are just getting a foothold in the Missouri River. But they eat mollusks, such as mussels, and mussels are already critically endangered in Missouri, in part due to their sensitivity to pollution. More than 40% of Missouri's 69 mussels are of conservation concern.

The impact is stunning: The U.S. Fish & Wildlife Service estimates that invasive carp can almost entirely wipe out native fish in some sections of particularly hard-hit rivers.

"They really impact sport fish like walleye and crappie," Chapman said.

Conservationists have had some success removing carp in lakes. For instance, in 2018 at Creve Coeur Lake, government agencies adapted a Chinese technique called "the unified method"—systematically herding fish with sound and electricity, then catching them in large nets—to remove about 47,000 carp, or 119 tons.

Removal in rivers is more difficult.

In 2006, organizers in Bath, Illinois, had a creative idea—an annual

"Redneck Fishing Tournament," during which competitors attempt to collect as many silver carp as they can. The catch? No fishing poles are allowed—jumping carp have to land in boats, or be snagged from the air by participants as they fly by.

In some states commercial anglers harvest carp, largely for pet food and fertilizer. Later this year the state of Illinois plans to roll out a media campaign called "The Perfect Catch," renaming carp in an attempt to boost the fish's popularity as human food—similar to how a seafood merchant 45 years ago relabeled Patagonian toothfish as "Chilean sea bass" to increase its market appeal.

But the carp are still spreading.

"They are continuing to invade new places," said Robert Jacobson, supervisory research hydrologist with the USGS. "There are many states that are now very concerned that they will be next."

In Columbia, scientists have been working for almost two decades to stop the spread.

The USGS Columbia Environmental Research Center is a complex of buildings and ponds behind a chain-link fence. But one lab hosts most of the work with carp. It is "biosecure"—equipped with a specialized wastewater treatment system that has mechanical and ultraviolet filters to prevent even the tiniest egg from escaping, alive, down a drain.

Inside the lab are tubs of carp, of all sizes, connected by a maze of pipes circulating water through the containers.

One day last month, researchers were experimenting with larval carp hatched just the week before. They placed the baby carp into containers of flowing water, an important sensory input for young fish. After three

minutes of swimming, the researchers removed the fish and froze them, later dissecting their brains to see what areas had been activated by the moving water.

"What we're trying to figure out is, once these larvae hatch, how their senses develop and how they use them to move into nursery habitat," said Amy George, a fish biologist at the research center.

The center houses two groups that work on carp, each with 12-15 employees. Studies vary. They're measuring the impacts of toxins on carp. They're developing sterile bighead with tracking tags, in hopes that, once released, they'll lead scientists to existing populations.

They have even charted the growth of carp eggs, every 15 to 30 minutes until they hatched—about 30 hours later.

The USGS in June awarded Mizzou and USGS researchers a $200,000 grant to use computer modeling and field measurements in the Missouri River to predict how the eggs travel.

The team has a new member, who brings a specific expertise. Binbin Wang, an assistant professor of civil and environmental engineering at Mizzou, is an expert on fluid physics and will model turbulence in the Missouri River.

Scientists could even work backward to calculate where the fish are spawning, which would tell them where to intercept and trap larval fish, or where to generate turbulence in an attempt to destroy the eggs.

Carp eggs need Goldilocks-like river conditions — not too slow, not too turbulent. Still water allows the eggs to sink to the bottom and die, and rapidly moving water can destroy them. River managers could eventually exploit water dynamics to damage the eggs.

The work also will help researchers determine if un-invaded rivers have conditions suitable for carp survival, and then prioritize resources to high-risk waterways.

Scientists are particularly concerned about carp traveling north and gaining a foothold in the Great Lakes, putting the ecosystem and fishing industry in jeopardy.

Jacobson, the USGS hydrologist, says their findings will help understand how all sorts of materials spread through rivers.

"It's not just how it applies to the invasive carp," he said. "It's also applied to endangered species, and it's applied to things like transport of contaminants—if there was an oil spill, or something like that."

Now, finally, researchers may gain ground tracking carp eggs.

"People ask, 'Why don't you know more about what these carp do?'" Jacobson said. "Well, because they live dominantly in muddy rivers, we can't actually see what they're doing a lot of the time."