

Facial recognition for fish? Researchers test technology to stop invasive species

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There may come a day on the Illinois River when a fish swims up a

chute, slides through a scanner, and, after being recognized as a feared silver carp, is sorted and removed, eventually ending up in a carp burger on your dinner plate.

Keeping invasive carp out of the Great Lakes has involved a series of less-than-silver bullets—from commercial fishing to carbon dioxide experiments to the forthcoming Brandon Road barriers near Joliet from the U.S. Army Corps of Engineers.

Now, fish recognition is entering the fray.

Illinois researchers are preparing for another test run of a system that could get Asian carp out of waterways while also helping native fish travel. The technology comes from Whooshh Innovations, a company "disrupting the world of fish passage"—and popularly known for the viral fish tube, or salmon cannon. The experiment is taking place at the Nature Conservancy's Emiquon, a more than 6,000-acre wetland restored along the Illinois River that is teeming with wildlife, biodiversity and, like many places these days, Asian carp.

Those working on the project—the Nature Conservancy, Illinois Department of Natural Resources, Illinois Natural History Survey and Whooshh—are hopeful it can become another tool to deal with the carp problem, which threatens the health of food chains and the fishing industry with each fish's plunge toward Lake Michigan.

In a reversal, researchers are hoping for the opposite of what they've wanted since Asian carp made their way into the Mississippi River decades ago—that the invasive carp will come.

Worth the expense?

On a soggy day in Lewistown, Illinois, a group of hefty silver carp leaped

up near a water control structure, which connects the Emiquon wetlands to the river. Their splashes served as an interruption to the squeaks of cliff swallows. A snake glided along the water's surface, and across from the control structure on the river, a barge passed by.

Doug Blodgett, the Nature Conservancy's director of river conservation, looked out above what looked like a ladder in the water, tubing and a large silver box with the Whooshh branding.

The chutelike structure, called a steppass, was installed last year at Emiquon. Researchers wanted to see if fish would enter the contraption, which sends down water from the wetlands—offering a higher-quality food supply—to lure the carp from the river. Now the next part of the system—a "FishL Recognition" scanner—is being tested.

Ideally, Whooshh says the system would attach to a floating structure, making it resilient against fluctuating water levels. In an effort to cut costs, the Emiquon version is more fixed, meaning it's beholden to high water, and researchers are saving expensive testing days for when the system can operate fully.

In a short trial last year, nearly 80 fish from seven species ended up in the holding pool.

In the few days the project has been up and running this season, nearly 2,000 fish have passed through—almost all native gizzard shad—with nearly 1,000 in one day at the end of April.

Three relatively small grass carp are included in this year's count but no silver carp or bighead carp—the most alarming species because of how much plankton they can eat and how much space they can take up, leaving little for native fish.

"We want to know—can we get numbers of carp moving up this thing to make it worth the expense?" Blodgett said.

Other fish that feed on plankton are moving through the system, said Jim Lamer, a large river ecologist with the Illinois Natural History Survey and director of the Illinois River Biological Station in Havana. So it would make sense the plankton-eating bighead and silver carp might also be inclined to enter.

Again, the river has been uncooperative—too cold or too high. On a May morning, water covered the entrance to the system because of typical spring flooding, which results from rains made more intense by climate change, wetland loss, channelized streams and stormwater runoff.

With high water, the steep pass is partially submerged, changing the downward flow and making the entrance less attractive to fish, and other parts of the system are adversely affected. So researchers are waiting for the water to subside.

"The carp haven't really caught up with us yet, or we haven't caught up with the carp because it's too early in the season, and now with the flood we have to hold," Blodgett said.

In the next few weeks, if silver carp or bighead carp enter the system, moving forward with the project will become more likely.

Still, Blodgett said, "It's not a silver bullet."

Facial recognition

If you're a fish entering the Whoosh system, you swim, slide, glide and dive, said Vince Bryan, the Seattle company's CEO.

The fish swim up the about 30-foot chute, slide through a scanner that uses six cameras to take 18 shots for aquatic facial recognition and then glide through a misted tube until they dive into water.

From the time a fish leaves the water to the time it's inside the tube can be as fast as a second, Bryan said. Inside the tube, travel is about 25 feet per second.

The idea to move fish grew from a system used to gently transport apples. One day, Bryan tried out the trip on tilapia. The fish passage technology has been employed out West for dwindling populations of salmon to help them cross dams and migrate upstream to reproduce.

Bryan, who was born in Chicago, was familiar with the invasive sea lamprey, an eel-like creature that latches onto fish and drains their blood. The parasitic fish devastated Great Lakes trout populations. So Bryan could imagine the potential damage Asian carp could cause.

"It was not a difficult leap to think about, OK, what is the problem here, and what kind of chaos is this going to cause?" Bryan said.

Not yet added to the Emiquon experiment is a sorting system—a series of tubes to send fish toward their fates. Along with the photos, the scanner takes measurements of the fish so they can be directed to the right-size tube.

"The concept is really, let's clean up the river, not just try to manage it," Bryan said. "Let's try to reverse what's been happening and thereby also decrease the spread of the fish into areas where nobody wants them."

The Whooshh team is working on classifying fish that pass through the system now to create algorithms that will recognize and identify various species with the eventual goal of replacing that step with artificial

intelligence.

"All of these different fish species are going to have different fingerprints, if you will, and different signatures," Blodgett said.

About 1,000 images of any one species are needed to reach a desirable level of accuracy, Bryan said. That can happen in a day if enough fish pass through. The scanner can make determinations at about 40 fish per minute.

"Good fish, bad fish, red fish, blue fish," said Kevin Irons, manager of the aquatic nuisance species program with the Illinois Department of Natural Resources. "We can put the invasive carps in one holding bin, in one bag, one net. And we can let the good fish pass, whatever situation it is—either back into the river, over a levy, into Emiquon, over a lock and dam somewhere else where they can't do it."

Moving native fish

If the first step is getting fish to use the system, the next is figuring out why they're using it.

"What drives that and how can we turn up that dial so we get a lot of the fish instead of just a few?" Blodgett said.

There are a few hypotheses as to what might be attracting the grass carp. They might spawn earlier, and so be drawn to the flowing water. They also eat plants, lacking in the turbid river, and the Emiquon water might have been appealing.

"A place like Emiquon, you've got a high-quality food source inside the refuge," Irons said. "It's cotton candy to the carp."

Emiquon, which has previously served as testing grounds for carp research from the U.S. Geological Survey, was seen as an ideal spot for the experiment. Today, the preserve is filled with verdant stretches of freshly burned willows, pops of yellow butterweed and maybe a flash from an indigo bunting flying by. Just under 300 bird species have been documented on-site, and the 33 fish species stocked at the beginning of restoration have expanded beyond 50.

When restoration began in 2007, invasive common carp could be found in Emiquon, but silver and bighead carp were not believed to be inside. Controversy swirled around the proposed connection and exchange between the preserve and the degraded river. Some feared the carp might get in after the connection.

The more prudent concern may have been major floods. In 2013, and then 2015 and 2016, water came over the levee surrounding the preserve, transporting new species. The 2013 flood crested early in the season before the invasive fish's spawning period, Blodgett said. But the 2015 flood came later.

"A few feet out from the edge of the river you could see this dark line," Blodgett said. He noticed some fish-eating birds congregating around a boil—a flow of water coming through the levee.

"I went and watched and every once in a while a cloud of these larval fish would come through that boil," Blodgett said.

While common carp can reproduce inside of the preserve, it's believed the conditions are not right for Asian carp, which spawn in turbulent water and depend on currents for their eggs to hatch. So the population is more manageable in the preserve.

Scientists are trying to figure out how many Asian carp may now be

inside. Current estimates range from below 100,000 to more than 200,000, said Lamer, the natural history director. With the feast inside Emiquon, the carp tend to be larger than their Illinois River counterparts.

As is the case with fears about bighead and silver carp taking over in the Great Lakes, the invasive fish could throw the delicate and robust ecosystem at Emiquon out of balance.

"We're worried about getting more carp in," Blodgett said. "Another thing we're worried about is getting too many seeds of things like phragmites, which is an invasive species."

Reducing numbers of Asian carp is one goal overall, Blodgett said. But also important is moving native fish.

"A lot of fish want to get into Emiquon—to spawn, to feed, to overwinter—and right now we don't want to just open the door and let things move helter-skelter."

Emiquon uses wire screens and nets to filter fish when letting river water in. But the new system's sorting may allow for a simpler entrance to the ecosystem.

"They can say, yep, you're a good fish, open door 1, you get into Emiquon, and you're a grass carp, we don't want you," Blodgett said.

"Hopefully, if it works out, we'll be able to help reduce the numbers in the river. But if we can't get rid of all of them in the river—and we don't want them coming into Emiquon—it gives us a managed connection with the river so that the paddlefish that need to get in, that want to get in, we still provide a pathway for them to get in."

Far-reaching implications

Lamer said he remembers a fisheries conference years ago when he saw the fish tube.

"I didn't know those guys then, but I remember they had a display there and they were shooting a little stuffed fish through the Whooshh system," Lamer said.

If the Illinois experiment ends up being a success, the implications for other waterways and species could be far-reaching.

"It appears that we've got all sorts of invasive species that are wreaking havoc and to have what we call selective fish passage has really got to be where things go in the future," said Bryan, of Whooshh.

Researchers envision the passage and sorting system along pinch point dams, like Starved Rock, or connected to barges, which would allow flexibility in moving toward fish and toward the right conditions to attract them.

Bryan envisions systems set up along the Mississippi, Missouri and Illinois rivers.

The tool could also assist native fish in swimming upstream of dams, aiding reproduction and helping some endangered mussels that depend on the fish to reproduce.

"The diamond in the rough here is the ability to selectively pass fish," Irons said. "With a positive outcome, the sky's the limit."

The large number of gizzard shad that have passed through the Emiquon system might help inform work with the American shad, running low on the East Coast. The system may also assist in dealing with common carp, which can be a nuisance.

Irons said the project may inform the Brandon Road project, and even what's happening along the Yangtze River in China, where fish run into dams and pollution.

"I would guess the Chinese would be very interested in ways to pass these fish and reestablish reproducing fish where they're now just not effective anymore," Irons said.

Irons said he could see an arrangement where fishermen could pick up live carp after sorting that could be used for human food. An ongoing effort from Great Lakes agencies and groups seeks to rebrand Asian carp as a tasty menu option.

"I think human food is the top of the ladder, but it could be any other protein product," Irons said.

Researchers still need to gain confidence that the system won't mistakenly identify and pass along carp. It's not difficult to imagine how a series of misidentifications—or an elusive new invasive species—could create an even greater problem.

Concern about invasive black carp is growing, Lamer said, and more detections are happening in the Illinois River. Unlike bighead, silver and grass carp, black carp eat mussels—a threat to the many already threatened and endangered species in Illinois. And, able to grow more than 100 pounds, the [fish](#) can eat a lot.

"I think there will always be a need," Lamer said about developing new technologies. "Because it's not always just going to be bighead or silver carp. There's always the next big invader that's lurking in the weeds."

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