Scientists developing poison pill for Asian carp

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Biologist Jon Amberg has spent the last two years obsessed with fish guts, laboring over a singular challenge: Develop a poison pill that will kill Asian carp and leave other fish unscathed.

Voracious and freakishly resilient, the fish has left a trail of destruction on its decades-long migration up the Mississippi River and into Illinois, seemingly undeterred by the ordinary ammo of invasive species warfare.

Now, designer drugs and engineered poisons, often called "bio-bullets," have become increasingly popular among scientists trying to create sniper-shot solutions to unyielding problems, from malignant pests in rivers and fields to tumors in human bodies.

"If you look at Asian carp as being kind of like a cancer, we're in essence developing a drug to be able to target it without killing the 'cells' around it," said Amberg, who works for the U.S. Geological Survey in La Crosse, Wis.

Akin to chemotherapy, attempts chemically to control Asian carp today would require dumping thousands of gallons of pesticide into waterways, possibly harming other aquatic life.

By contrast, an Asian carp bio-bullet would theoretically deliver toxins specifically to silver and big head carp in a digestible micro-size particle, about the width of a human hair. Built to mimic food, the pill would then break apart in the carp's intestine, releasing its lethal load and killing the

fish.

If it works, Amberg and his colleagues foresee an arsenal of similarly elegant weapons designed to control the many invasive species that have wreaked havoc in the Great Lakes and Mississippi River Basin. Preliminary work has already begun on zebra mussels as well as on fish eggs, which they think may be susceptible to electricity and nano-size silver that would be about a thousand times smaller than the Asian carp micro-particle.

Some experts, however, have questioned whether the targeted strategies will really work.

Environmental groups that have lobbied for physical separation of the Great Lakes from the Mississippi River see it as a red herring, a distraction from a permanent solution to the invasive species problem.

Other scientists have also wondered if the reconfigured toxins might result in unintended environmental consequences. Nano-size silver particles, for instance, have been shown to harm a range of species in laboratory experiments, according to Andrew Maynard, director of the Risk Science Center at the University of Michigan.

"From a technology perspective, this is very inspiring," Maynard said. "But if you are releasing new particles into the environment, there are certain questions that you need to ask: What do they do? Where do they end up? How long do they last?"

Amberg's colleague, Mark Gaikowski, got the idea for an Asian carp poison pill in 2009, after watching a presentation by the company Advanced BioNutrition Corp. about a particle it had created to carry vaccines into salmon.

Perhaps, Gaikowski thought, instead of aiding fish, that same technology could be used to kill Asian carp.

Native to the Yangtze River in China, Asian carp were first found in the Mississippi in the late 1970s after escaping catfish ponds and government fish hatcheries. Since then, the large fish has made itself at home, decimating native fish populations and commercial fishing hubs in Illinois while drifting ever closer to the Great Lakes.

Netting, fishing and electrocution have done little to shrink their numbers - a fact that has even left the scientists tasked with eliminating the carp begrudgingly impressed.

"They are, by far, the most interesting species I have ever worked with," Amberg said. "Their resilience is incredible."

Yet Amberg saw promise in a deadly pill that could work as a kind of miniature Trojan horse, allowing scientists to sneak a toxin into more Asian carp than they had ever been able to reach.

In 2010, Amberg and his colleagues began working with Advanced BioNutrition to develop a strategy using the fish's own digestive system.

They wanted to build a particle that would break apart inside Asian carp, but would remain intact if eaten by other fish. To do that, they had to first find something unique in the bowels of the invasive species that could trigger the poison release.

Amberg pondered whether the carp's stomach acid might work, but after slicing into dozens of different species of fish bowels and searching the gooey contents he realized most were too similar. He then focused solely on digestive enzymes, which are proteins that process food, wondering whether those could be used to dismantle the pill.

Two years and hundreds of tests later, Amberg said he and his colleagues have finally found a couple of carp enzymes they think might work. But they must first pursue a host of outstanding questions, including whether those key enzymes will change based on the carp's diet.

Some scientists remain skeptical of the entire enterprise.

Jennifer Sass, a scientist with the Natural Resources Defense Council, said that she is not convinced that the pill would target only carp, because of the similarities in animal digestive systems.

"(It) seems like a lot of scientific arrogance," she said.

Rebecca Klaper, a scientist at the University of Wisconsin-Milwaukee who studies the impact of contaminants on freshwater species, also questioned how the particle might behave differently when moved from lab to river. She wondered, for example, whether micro-organisms in the environment could tear apart the pill's coating, dispersing the toxin into the water.

"Once you start putting stuff into the environment it is sort of a black box where you don't know what is going to happen," Klaper said.

Amberg and his team hope to answer some of those questions in the coming months when they start testing the particle in river water. Subsequent studies may include analyzing the impact on birds that eat the dead carp and whether bottom-feeding fish could be affected if the micro-particles settle in riverbeds.

Still, they acknowledged that once in the environment, it is possible the pill may affect other fish. The goal, they said, is for it to kill far fewer species than would currently be affected by a standard poison dump.

In the meantime, they are continuing work on similar particles for invasive mussels as well as for Asian carp eggs, which would ideally allow them to attack the problem before it hatches.

For the first time, Amberg said, there is a feeling that the scientists may finally be on the offensive in the fight against Asian carp. But he described their position as somewhat delicate.

"It is like you are walking on thin ice," Amberg said. "You want to make sure that next step is going to be on something really solid before you start to put your foot on it."