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Transgenic glowing fish invades Brazilian streams

Aquarium curiosity appears to be thriving after escape from fish farms and may threaten local biodiversity

11 FEB 2022 • 6:05 PM • BY SOFIA MOUTINHO

Genetically modified zebrafish (*Danio rerio*) are sold in fluorescent red, blue, and green. PAULO DE OLIVEIRA/MINDEN

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Fish genetically engineered to glow blue, green, or red under blacklight have been a big hit among aquarium lovers for years. But the fluorescent pet is not restricted to glass displays anymore. The red- and green-glowing versions, more vivid than normal zebrafish even in natural light, have escaped fish farms in southeastern Brazil and are multiplying in creeks in the Atlantic Forest, a new study shows. It is a rare example of a transgenic animal accidentally becoming established in nature, and a concern for biologists, who worry the exotic fish could threaten the local fauna in one of the most biodiverse spots on the planet.

"This is serious," says ecologist Jean Vitule at the Federal University of Paraná, Curitiba. Vitule, who was not part of the research, says the ecological impacts are unpredictable. He worries, for example, that the fluorescence-endowing genes from the escapees could end up being introduced in native fish with detrimental effects, perhaps making them more visible to predators. "It's like a shot in the dark," he says.

The unwelcome visitors are well known to scientists who have used zebrafish (*Danio rerio*) for developmental and genetic studies for decades. Native to Southeast Asia, the match-size freshwater fish were engineered to glow for research purposes in the late 1990s by endowing them with genes from fluorescent jellyfish (for blue and green colors) and coral (for red). In the 2000s, companies saw the potential of the neon fish as pets. Trademarked as Glofish, they became the world's first genetically engineered species to be commercially available.

Now, they are one of the first to escape and thrive in nature. Early on, environmentalists worried about the possibility, and Glofish sales were banned in some U.S. states such as California and several countries—including Brazil.

In 2014, a single Glofish was spotted in canals near ornamental fish farms in the Tampa Bay region of Florida. But it had not multiplied, probably because native predators such as the eastern mosquitofish (*Gambusia holbrooki*) and the largemouth bass (*Micropterus salmoides*) ate the interloper, says the biologist who spotted the transgenic animal, Quenton Tuckett of the University of Florida.

Brazil is proving more hospitable. André Magalhães, a biologist at the Federal University of São João del-Rei's main campus, first spotted groups of the engineered zebrafish swimming in the Paraíba do Sul River Basin in 2015, in slow-moving creeks. The waters border the largest ornamental aquaculture center of Latin America, in Muriaé, and Magalhães says the fish probably escaped some of the center's 4500 ponds, which release water into the streams.

Unlike Florida, the Brazilian creeks don't have any local predators for zebrafish, and Magalhães believes they are now thriving. In 2017 he and colleagues began to survey five creeks in three municipalities, finding transgenic zebrafish in all of them. Every 2 months over 1 year, they collected and measured the animals and their eggs and analyzed their stomach content to see what they were eating.

The fish are reproducing all year round, with a peak during the rainy season—just as native zebrafish do in Asia. But the transgenic fish seem to achieve sexual maturity earlier than their forebears, which allows them to reproduce more and spread faster. The invaders are also eating well: a diversified diet of native insects, algae, and zooplankton, the researchers reported this week in *Studies on Neotropical Fauna and Environment*.

"They are in the first stages of invasion with potential to keep going," Magalhães says. Before long, he says, the fish could become plentiful enough to directly affect local species by competing for food or preying on them.

Despite Brazil's ban on sales of the fish, local farms keep breeding them, and stores all over the country sell them as pets. They may soon colonize other parts of the country: Isolated Glofish individuals were spotted in ponds and streams in south and northeast Brazil in 2020.

Tuckett, whose lab in Florida is close to U.S. farms that grow hundreds of thousands of glowing fish, says the Brazilian detection "should be a wake-up call" for fish producers and natural resource managers in Brazil. But he is not terribly worried about impacts. He suspects the transgenic fish will encounter predators as they move to larger bodies of water. And the animals' bright colors will make them vulnerable.

For now, the glowing fish "could be considered little weeds growing up out of the concrete," Tuckett says. Magalhães likes the metaphor, but points out that even little weeds can grow to cause a lot of damage.

doi: 10.1126/science.ada1221

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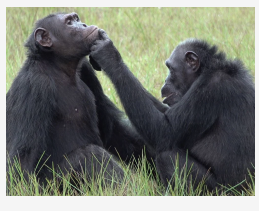

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