Trinidad's guppy-filled streams provide natural lab for genetic rescue research

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Sarah Fitzpatrick on her way to catch guppies in a stream in Trinidad. Credit: Jedediah Smith

Trinidadian guppies, ubiquitous in freshwater aquariums around the world, are no bigger than your thumb. But for Sarah Fitzpatrick, assistant professor in Michigan State University's Department of Integrative Biology and W.K. Kellogg Biological Station, or KBS, faculty member,

these small fish came up big.

The fast generation time and well-studied characteristics of guppies make them an ideal model for studying evolution in the wild. Their native habitat of Trinidad is an ideal natural laboratory for her research on genetic rescue—as long as she was willing to individually tag close to 10,000 guppies.

Fitzpatrick focused her work on guppies who populated small headwater streams above waterfalls in Trinidad that acted as barriers to guppies and other fish. With low genetic diversity, the isolated populations were ideal proxies for studying small, fragmented populations of conservation concern.

A separate project was planning to translocate guppies from a large downstream river into two, small headwaters upstream from these isolated populations, so Fitzpatrick and her colleagues could study how gene flow from guppies adapted to a different environment affected small, native populations.

"It was really exciting because we didn't know what to expect," Fitzpatrick explained. "Would the new genetic variation be a good thing for the small populations and cause genetic rescue? Or would the introduced guppies bring in traits that disrupted local adaptation?"

To solve the mystery, Fitzpatrick and her team visited the sites in the Northern Range mountains of Trinidad every month for two and a half years to catch, photograph and tag individual guppies with a unique, colored elastomer tattoo.

By linking each tattooed guppy with their DNA "tattoo," Fitzpatrick was able to build a detailed guppy pedigree that tracked relationships between each guppy over several generations.

Her painstaking work meant that she was able to show it was the wild hybrids, rather than the introduced population alone, who had higher survival and reproductive success.

Fitzpatrick plans to apply the findings of her guppy research to inform management of species of conservation concern: the eastern massasauga rattlesnake, Michigan's only venomous snake with a rapidly declining population, and the Florida scrub-jay, which has been reduced to less than 10 percent of its historical range due to human development.

She also plans to use guppies and their close relatives in future experiments to address questions about longer term benefits of gene flow when organisms are exposed to a novel stress.

"Given today's rates of rapid global change and habitat fragmentation, gene flow may be an important source of variation that wild populations need in order to keep up pace and avoid extinction," Fitzpatrick said.

Provided by Michigan State University

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