Desert Fish: Life on the Edge

Linus Chen
U.S. Fish and Wildlife Service, 4401 N. Fairfax Dr., Arlington, VA 22203
linus_chen@fws.gov

Fairbanks Springs, a small oasis in the Nevada desert, resembles a large hot tub from the bottom of which someone forgot to scrub the algae. Fortunately, algae thrive in this spring pool, for they are integral to the life cycle of the Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*).

The subspecies name "mionectes" is derived from the Greek, meaning "one having less." In this case, it refers to a reduced number of scales and fin rays. Besides laying their eggs in the algae, these 1.3" (3.4 cm) long pupfish feed on algae (and the occasional insect or snail in the algae). With its inviting sapphire-colored bottom and warm temperature, which ranges from 81-88°F (27-31°C), the spring-fed pool might be seen as an appealing place to take a bath. But as tempting as it would be, wading into Fairbanks Springs would be a bad idea because the pupfish, an endangered species, could accidentally be harmed.

A few miles away, in Scruggs, Indian, Marsh, and School springs, lives the Warm Springs Amargosa pupfish (*C. n. pectoralis*). The Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) may still be found at Jack Rabbit and Bradford springs, and the only natural population of the Devils Hole pupfish (*C. diabolis*) occurs at, well, Devils Hole. Some Devils Hole pupfish are being held in refugia to form new populations in case anything happens to the species' native habitat.

All 16 desert pupfish taxa native to the American Southwest, in addition to 17 species from México (three of which have not yet been described scientifically), are considered to be endangered, threatened, or of special concern. Pupfish were named for their active, puppy-like behavior. But behind that playful behavior lurks the ferocity of a junkyard dog, at least when it comes to males defending their territory from other male pupfish. (The Devils Hole pupfish, the smallest at 3/4 inch [1.9 cm], is the only pupfish not to show aggressive territorial behavior.) During the year-round breeding season, the more colorful and deeper-bodied males of most pupfish taxa will pursue females into an area with fine sand, silt, and perhaps algae. After an elaborate courtship display by the male pupfish, the female deposits one or two eggs, which the male immediately fertilizes. Large female pupfish can lay about 25 eggs per day and may spawn with different males each day. The eggs may be protected by the territorial behavior of males, but in general there is no parental care of the eggs. In warmer springs, pupfish can reach sexual maturity at 2-4 months, and live for 6-9 months after reaching the free swimming stage. Pupfish living in cooler waters grow more slowly, but they may live for 2-3 years.

Tens of thousands of years ago, in a much different climate, Nevada's Mojave Desert was a region of interconnected rivers and lakes. In recent millennia, as the region became drier, waters receded and many kinds of fish were unable to survive the harsher conditions. With very few competitors, pupfish thrived and later evolved into different species as groups became isolated in scattered springs and streams. This situation is analogous to that of the Galapagos Islands, where Darwin drew inspiration for his theory of evolution, except that the pupfish evolved in "islands" of water within a desert "sea."

But after surviving for thousands of years, these "living fossils"—Ash Meadows Amargosa pupfish, Warm Springs pupfish, and Devils Hole pupfish—face serious threats to their future. Although some of the early identified threats (such as development of the springs within Ash Meadows)

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have been resolved, continuing development near Las Vegas, Nevada, has created more demand for groundwater near the refuge. Because much of the desert area receives less than 2.5 inches (10 cm) of rain annually, virtually all of the water at and around Ash Meadows is "fossil" water, or water that is believed to have entered the aquifer thousands of years ago. When it is extracted from the ground at a rate faster than rainfall enters the ground, less water bubbles up from the springs for the pupfish. What little water remains for the pupfish is being invaded by nonnative species. Some of these species, such as largemouth bass, bullfrogs, and crayfish, may prey on pupfish, while exotic fishes such as mosquitofish (*Gambusia affinis*) and sailfin mollies (*Poecilia latipinna*) may compete with the pupfish for space and food (and prey upon the baby pupfish "pups"). Invasive plants such as saltcedar (*Tamarix* spp.), an exotic plant from Asia and Europe, drain the springs with their thirsty roots and concentrate salts in their leaves, transforming valuable desert streams and ponds into dry, salty basins.

Over the past few years, however, the tide has turned in favor of these endangered pupfish. Vigilant volunteers and biologists from the U.S. Geological Survey's Biological Resource Division, the Nevada Division of Wildlife, and the U.S. Fish and Wildlife Service have been removing exotic species and taking other actions to rehabilitate the spring habitats. As a result, the Service hopes to be able to propose delisting the Ash Meadows Amargosa pupfish and three Ash Meadows plants before long. With improvements in habitat and exotic species control, the future of some pupfish may no longer be going down the drain.

Life on the Ledge

The future of another Ash Meadows species, the Devils Hole pupfish, is still perched precariously upon a narrow ledge. Devils Hole, the only natural habitat for this pupfish, is akin to a community swimming pool with a shallow section and a deep end. The shallow "kiddie" section is a 10 by 20-foot (3 by 6-meter) limestone shelf 0.4-27 inches (1-70 cm) under water. Beyond the ledge lies a second, deeper shelf with a surface area of 10 by 33 feet (3 by 10 m). Past the second shelf lies the real deep end of Devils Hole, which extends to unknown, abyss-like depths. Divers from the U.S. Geological Survey once descended 300 feet (91 m) into the waters of Devils Hole but they never touched bottom.

Although Devils Hole pupfish have been found as deep as 80 feet (24 m), life for this species centers on the shallowest ledge, where the fish lay their eggs and feed on the algae that cover the shelf. The number of pupfish in Devils Hole fluctuates seasonally between 200 and 700 individuals.

In 1976, a Supreme Court decision stopped local pumping that was lowering the water table and threatening the Devils Hole pupfish. The Nature Conservancy purchased Ash Meadows in 1984 and later sold it to the Service to establish a National Wildlife Refuge. This protected the aquifer and ensures that the shallow ledge in Devils Hole, so vital to the pupfish, will not become a "sunbathing deck."