

Endangered Or Not?

Taxonomy of the Kanab ambersnail



View of Vasey's Paradise, a Kanab ambersnail habitat along the Colorado River.



By Joanne Littlefield

When asked to consider the background of an endangered species, University of Arizona conservation biologist Melanie Culver dips into her research toolbox. Genetics is her tool of choice.

"I'm happy to study anything from mollusks to carnivores," she says. Culver's laboratory, in the School of Natural Resources of the College of Agriculture and Life Sciences, has studied Florida panthers, black bears and most recently the tiny Kanab ambersnail.

Culver is often more intrigued by the answers to genetic questions about the species or population than in the individual organism.

Smaller than a thumbnail, the federally listed endangered Kanab ambersnail has had a big impact on the Colorado River. In the days prior to the construction of the Glen Canyon Dam, seasonal flooding scoured sand from some downstream areas while building up beaches and sandbars in other places. Once the dam was completed in 1964, the absence of floods and the subsequent slower moving river water eventually led to drastic habitat changes. Much less sediment was found in the canyon 30 years later, and wildlife, fish, plants and other organisms either adapted and survived or were put in jeopardy, according to Culver.

Concern about the loss of beaches along the Colorado River led to a high-volume release of water in 1996 by the U.S. Bureau of Reclamation.

"One precaution before doing that flood release was sending in a crew of people to hand-pick through the vegetation, gathering any of these little snails they could find and then moving them to higher ground," Culver says.

The flood release was more successful than expected, with a significant amount of sediment deposited on beaches and more backwater eddies formed. Although the snails came through the water release just fine, a federal decision suspended further floods until definitive taxonomic work was completed for the snails. The goal was to determine the genetic connection between the various populations of ambersnail that range along the Kanab plateau through northern Arizona and southern Utah.

Researchers from the University of Arizona, the University of California-Berkeley and the Utah State University collaborated on the subsequent study. As another partner on the project, the Arizona Game and Fish Department sent technicians out to pick up snails in the sedges and rushes. To get the most accurate picture, they wanted to collect as many as 30 snails from each of the 12 different population groups. In the end, small tissue samples of between 20 and 30 individuals from each population were shipped to each of the three participating universities for study.

The research focused on ambersnail habitats in the northern half of Arizona and the southern half of Utah. Of particular concern was the population in an area called Vasey's Paradise, a spring located along the Colorado River in Grand Canyon National Park. There were two questions the researchers were hoping to answer. First, was the ambersnail on Kanab Creek the same as the one at Vasey's Paradise? Second, was either of those populations distinct from the rest of the ambersnails that occur along waterways all the way up to Canada?

Previous morphological and genetic studies had indicated that the Vasey's population was either "unique" or "not as unique."

"It was a confusing story," Culver says.

To clear up the conflict, a postdoctoral researcher in Culver's lab tested hundreds of potential nuclear DNA markers for the snail populations—by cloning and analyzing—to come up with a subset of four nuclear DNA markers. These were combined with two mitochondrial markers optimized at Utah State University.

The conclusion? The Vasey's individuals are actually part of the larger non-endangered ambersnail population. This discovery has the potential to change the federal endangered status of the Kanab ambersnail and could also mean more big water releases from Glen Canyon Dam.

Culver's team saw gene flow occurring between more ambersnail populations than was expected, although at low levels gene flow was detected among many of the populations regardless of how far apart the populations were.

But it's not just river water releases that concern Culver and other conservation biologists. They are also curious about how highways and buildings pose barriers that many wildlife species are unable to overcome. In addition to bisecting portions of land, new roads and subdivisions are also dividing wildlife populations and preventing them from intermingling.

"If you create lots of small populations that no longer can exchange genes with other populations, you have a high likelihood of starting to see inbreeding and a decline in health," Culver says.

Gene flow is a way of looking at the connectedness among populations, she explains. What's required for gene flow is an individual from one population migrating to a second population and successfully reproducing; the two mate and drop offspring that survive. "That's what you're detecting: the genes seen in the offspring that are now members of a new population."

"If we're calling something a population we're assuming that mating goes on randomly among all the members. But if you've got a highway in the middle of their habitat, can members on one side of that highway mate with individuals on the other side? Or have you effectively created two populations from one population?"

To find out if populations are connected, researchers usually look at one type of gene to find all

the variants of that gene (called alleles) and determine the frequency for each variant. Then they do the same in a separate population. If both populations have the same frequencies for all alleles, often the assumption is that the two populations are connected, Culver says. If there are very different frequencies in the two different populations, the conclusion is that there is no gene flow.

"In our study we did see some connections among snail populations," Culver says. "They were not necessarily even from the same drainage."

By looking for evidence of historic population bottlenecks (an abrupt and severe reduction in the number of individuals during the history of a species, often the consequence of a catastrophic event) along the upper Colorado River, the research team estimated what the ambersnail population might have looked like in the days prior to the damming of the river.

"We could actually relate evidence of historic bottlenecks to the idea that prior to the dam this population did experience floods (and potential bottlenecks) every year in the spring, so we think maybe that flood regime actually shaped the genetic character of the Vasey's population."

Because the Kanab ambersnail belongs to the larger group and is not an endangered species, this might mean that occasional high water releases will resume in the Grand Canyon, so that hikers and river runners as well as fish and wildlife will encounter a shift in the habitat characteristics of the popular Grand Canyon and upper Colorado River. ★

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