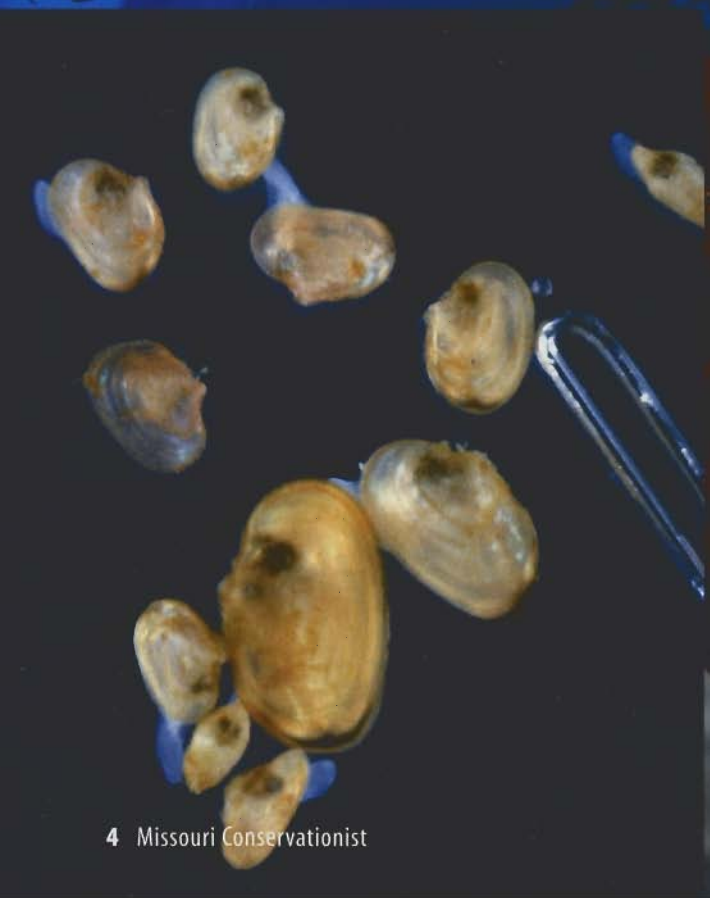
Kevin White

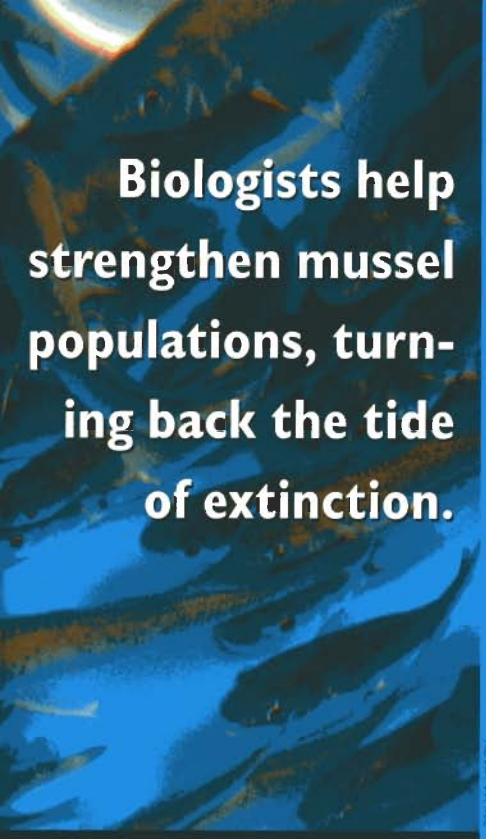


Chris Barnhart

Biologists help strengthen mussel populations, turning back the tide of extinction.

Making Mussels

by Chris Barnhart



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Science comes to the aid of diminishing native mussel populations as biologists place glochidia of fat pocketbook mussels (left) on native fish. Juvenile mussels (bottom left) are tiny and seldom seen. Little is known about their habitat requirements.

At least 65 species of native freshwater mussels are found in Missouri waters. These humble shellfish once paved the bottom of rivers in incredible numbers, filtering the water and providing habitat and food for other animals.

Mussel populations, however, have crashed in a relatively short time, raising alarms about the health of Missouri's streams and rivers. Of nearly 300 North American species, 38 are presumed to be extinct, and 77 others are critically imperiled. In Missouri, these unique creatures are among our most endangered freshwater wildlife.

It's not surprising that mussels are in trouble. Mussels can be harmed by just about any of the many problems that affect our rivers. Adults live for decades on the bottom of the river. They can't move far to escape. They become victims if their part of the stream dries up in a drought, gets drowned by a reservoir, or is cut off by a channelization project. Mussels can also be uprooted by streambed erosion or buried by silt. They are at least as sensitive to water pollution as fish are, and they may be even more affected by pollutants in the bottom sediments in which they live.

As vulnerable as adult mussels are, their reproduction seems to be most at risk. Our native mussels cannot reproduce without the help of native fish. Female mussels produce thousands of tiny larvae called glochidia. Each is smaller than the head of a pin. These larval mussels must attach to the gills or skin of particular kinds of fish, where they remain attached for a few days or weeks. They grow very little during this time, but they complete their development and get a free ride to new habitat before leaving the fish.

Each species of mussel needs particular species of native fish to reproduce. Non-native fish, such as trout and carp, won't do. Biologists suspect that

Oscar Grossheim collection

Mountains of freshwater mussel shells were harvested for button manufacture near the turn of the century.

reduced populations of native fish are one of the reasons mussel populations have declined.

Concern for native mussels is not new. A century ago, mussels were harvested in huge numbers in Missouri and other parts of the Midwest. Their shells were the basis of a multimillion-dollar, button-manufacturing industry. Two prominent University of Missouri biologists, George Lefevre and Winterton Curtis, studied the biology of mussels from about 1906 to 1914 and concluded that overharvest was decimating mussel populations.

Recognizing that natural reproduction was insufficient to maintain populations, Lefevre and Curtis devised methods for artificially propagating mussels. Their work led the U.S. Bureau of Fisheries to establish the Fairport Biological Station in Iowa, where further research took place from 1914 into the 1930s.

In that era, before extensive flood control, large numbers of fish were stranded each summer in flooded areas along large rivers. These fish were rescued for return to the rivers, but before they were released, mussel biologists at Fairport Biological Station and elsewhere placed glochidia on them. In the 1920s, 16 fisheries stations throughout the Mississippi River basin released millions of fish, to which were attached billions of glochidia of commercially valuable mussel species.

These efforts were designed to sustain a valuable commercial mussel fishery. Unfortunately, continued overharvest and increasing pollution of the large rivers by municipal and industrial sewage overwhelmed efforts to maintain mussel populations. The numbers of both fish and mussels dwindled, to the point that mussel propagation efforts essentially ended by the early 1930s. At the same time, the great era of dam building began. Over the next 40 years, reservoirs inundated thousands of river miles, further decimating and fragmenting mussel populations.

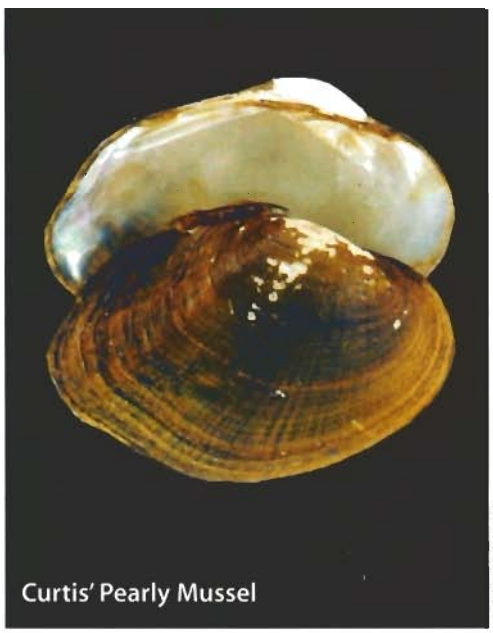
In 1972, President Richard Nixon signed into law the Clean Water Act. One of its goals was to provide for "the protection and propagation of fish, shellfish, and wildlife."

By the 1980s, improvements in water quality were evident, but so was an increasing realization of what had been lost or was about to be lost. The Endangered Species Act of 1973 reflected public concern for the loss of biological diversity and, through the U.S. Fish and Wildlife Service, gave real support to efforts to prevent extinction.

Mussels were among the first aquatic species to be listed as endangered. In Missouri, naturalist Ronald Oesch wrote *Missouri Naiades*, a field guide that described the diversity of native mussels in the state. Alan Buchanan, biologist with the Missouri Department of Conservation, surveyed mussels to determine what species might be at risk. Buchanan's reports formed the basis for understanding recent trends in mussel distribution and abundance in Missouri. He documented the last populations of Curtis' pearly mussel, which, despite efforts to protect its remaining habitat, has now disappeared.

In the 1990s, research on Missouri mussels intensified. The Conservation Department used surveys to determine which species were endangered and where the best populations remained. They also identified new threats to the survival of native mussels, including the introduced zebra mussel. Researchers at Southwest Mis-

Curtis' pearly mussels were found only in the Ozarks, and may now be extinct. A live specimen was last seen in 1991.



Curtis' Pearly Mussel

Alan Buchanan

Mussel Fishing Tackle

Western fanshell

Chris Barnhart

Female mussels attract their host fish with an amazing variety of lures. These include packages of larval mussels resembling worms (fanshell mussel, upper left) or aquatic insects (kidneyshell mussel, lower, left). Bass striking the minnow-like mantle flaps of the pocketbook (bottom right) and the crayfish-mimicking lure of the rainbow mussel (below) will break the female mussel's gills, releasing larvae that are held within.

Rainbow mussel

Bill Roston

Kidneyshell

Chris Barnhart

Pocketbook

Chris Barnhart

souri State University focused on mussel reproduction and determined which fish species act as hosts of threatened species.

Gradually, a working group of concerned biologists came together. We concluded that it was time to pick up what Lefevre and Curtis had started nearly a century ago. Like them, we recognized the enormous reproductive potential of native mussels. We reasoned that we could increase mussel reproduction by putting glochidia on the proper fish hosts, recovering the transformed juvenile mussels, and then releasing the juveniles into suitable habitat.

For our first attempts at mussel propagation, we chose the Neosho mucket (*Lampsilis rafinesqueana*). This large and distinctive mussel is found only in the western Ozarks. Surveys showed that the species has declined drastically, particularly along the western edge of its range. It was relatively easy to find Neosho mucket "brood stock" in a few localities, and our hatcheries provided largemouth bass, a suitable fish host for the Neosho mucket.

In July 1999, we placed glochidia collected from the Fall River on several hundred fingerling largemouth bass at the Conservation Department's Chesapeake Fish Hatchery. About a month later, we sent Kansas biologists more than 19,000 juvenile Neosho muckets. Although the number sounds impressive, all would fit comfortably in a teaspoon!

Our first batches of "babies" were released at two sites in the Fall and Verdigris rivers in Kansas in the summers of 1999 and 2000, and later at several sites in the Spring River and Shoal Creek in Missouri. You can imagine our excitement when, in January 2002, several dozen shells of young Neosho

Biologists at SMSU used special aquaria to determine which fish species hosted native mussels. Shells of young Neosho muckets (right) found 16 months after their release confirmed that mussels grown in controlled conditions could survive when released into their native habitats.

Chris Bamhart

Low water had led to a feast for raccoons, which obliged us by leaving the shells of their shellfish dinners. Far from being upset, we were glad to see the species again filling its ecological role in the food chain.

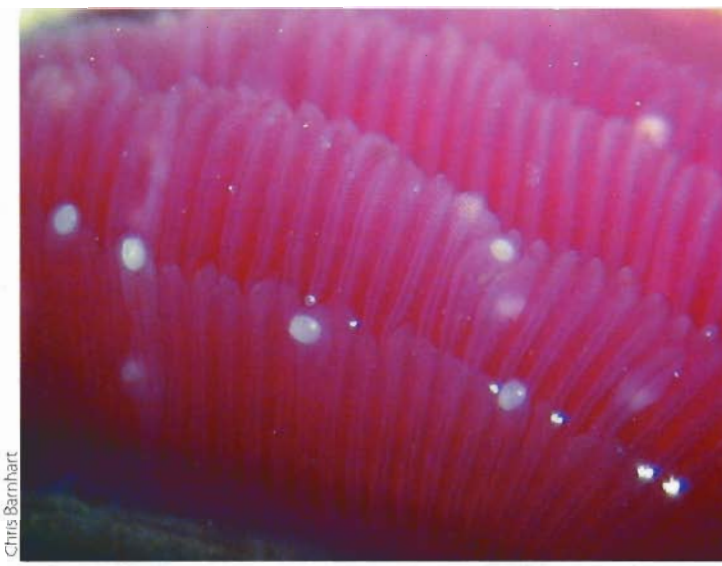
Kevin White

muckets were found at our original release sites. Low water that winter had led to a feast for raccoons, which obliged us by leaving the shells of their shellfish dinners. Far from being upset, we were glad to see the species again filling its ecological role in the food chain. Once these new recruits grow large enough to discourage raccoons, they should live more than 30 years, giving us decades to investigate and correct factors that have limited their natural reproduction.

Over the past two years, our mussel propagation efforts have expanded to include several federally listed endangered species, including the pink mucket, fat pocketbook and scaleshell.

An important development is that the new Lost Valley State Fish Hatchery at Warsaw is also propagating endangered species. Last summer, Lost Valley produced two mussel species, snuffbox and black sandshell, as well as an endangered fish, the Topeka shiner. Similar efforts are taking place in several other states.

Artificial propagation is a measure of last resort. We use it to preserve species while researchers are working to reduce the factors that limit their natural reproduction. Our ability to prevent extinctions will depend completely on protecting and restoring the health and condition of our rivers. Public support for conservation and responsible stewardship of private lands are critical if we are to preserve the natural world and its living inhabitants for our children and the generations to come. ▲



Chris Barnhart

Tiny larvae mussels resemble white dots on the gills of host fish (above). Artificial propagation bolsters natural mussel reproduction and may save some species from extinction.