

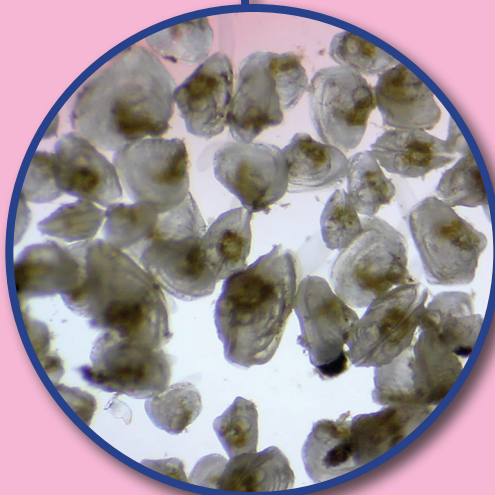
Mussel Maternity Ward

Gregg Elliott



*The unusual story of
three heroes behind
the Cumberland River
Aquatic Center*

by K. Gregg Elliott



*(clockwise from top): Oyster mussels, Cumberlandian
Combshell mussels, and Pale Lilliput mussels*

Dr. Dan Hua may have the strongest maternal instincts of any aquatic biologist in Tennessee. She keeps her invisible babies alive by making sure they don't get too hot or too cold, by feeding them instant algae every day, and bathing them weekly. They respond by growing from microscopic size to a whopping half-inch in less than nine months.

What is Hua raising? She plays solicitous nursery maid to four, federally-endangered species of freshwater mussels native to Tennessee, while also directing operation of the Cumberland River Aquatic Center, or C-RAC (pronounced sea-rack), located at the Tennessee Valley Authority's (TVA) Gallatin Fossil Plant. She was offered the job of leading Tennessee's nascent mussel propagation efforts in 2015, thanks to the vision of Bill Reeves, Chief of the Tennessee Wildlife Resources Agency's (TWRA) Biodiversity Division and Dave McKinney, TWRA's Chief of Environmental Services.

Dr. Hua is a native of China and protégé of Richard Neves from Virginia Tech, a pioneer in freshwater mussel conservation in North America. In 2006, Hua astounded a roomful of mussel biologists at a meeting in Tennessee by showcasing a propagation technique that successfully nurtured Rainbow mussels to a half-inch size sufficient for reintroduction into Appalachian

streams. Until that time, biologists had little problem growing mussel glochidia (microscopic larvae), but they could not raise significant numbers to the juvenile stage—essentially a smaller version of the adult mussel.

When Hua, a freshwater pearl culture specialist, came to the United States in 2003, one of the first things that struck her was the way in which mussel culture here differed from the same practice in China, a country with a 3000-year track record of freshwater aquaculture.

"I thought, this is not how we do it in China," said Hua. "Later, when I understood the propagation bottleneck, I decided to go back to our common Chinese practice of using water from fish ponds to raise mussels." She developed a system to pump water from her managed fish pond into her mussel culture facility at Virginia Tech, and her success made it clear that, despite the addition of many types of food organisms, the carefully conditioned municipal water

of U.S. university labs had been lacking something essential to the young mussels. "We still don't know exactly what it is," said Hua, "but it's something I want to study."

Out with the vultures, in with the fish tanks

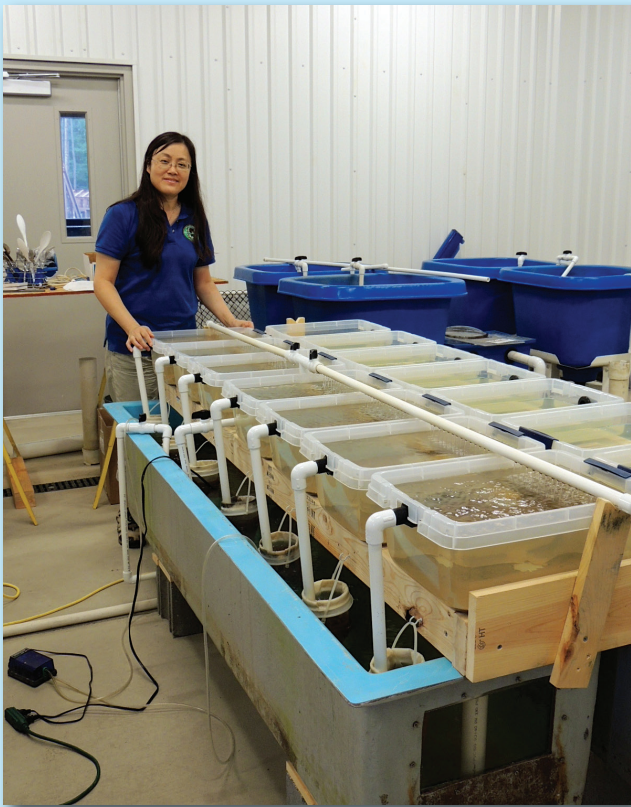
After seeing Dr. Hua's presentation, David Sims was fired up. A TWRA biologist, he specialized in aquatic habitat protection enforcement. He immediately saw the opportunity to start something new using this ancient culture technique. He zeroed in on an abandoned fish hatchery at TVA's Gallatin Fossil Plant as the best place to help mussels stage a comeback in Tennessee.

"Nobody knew about the hatchery," said Sims. "It was located right on the Cumberland River. It had a dilapidated roof, vultures all over, trash piles, rusted plumbing, and no electricity whatsoever, but I thought, we can do this!" Sims made his case to Don Hubbs, TWRA's state malacologist and their common supervisor, Dave



The C-RAC team (from left): Don Hubbs, David Sims, and Dr. Dan Hua

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Dr. Hua in the “nursery” with the juvenile mussel tanks, which contain sterilized sediment, free of parasitic worms and other pathogens. The juveniles are fed instant algae twice per day for 9-24 months, until they are ready to be crated up for their journey to a wild river.

Don Hubbs, gathering wild brood stock mussels from their tanks to be returned to their native habitat.



McKinney, as well as the plant manager at TVA’s Gallatin Plant. Eventually, over a period of three years and with the assistance of many multi-talented TWRA employees, they succeeded in refurbishing the hatchery to create Tennessee’s first freshwater mussel culture facility fed by river water. This marked the beginning of a growing mussel reintroduction and augmentation program targeting both the Cumberland and Tennessee River systems.

When TVA began its upgrade of the Gallatin Fossil Plant in response to Environmental Protection Agency (EPA) pollution regulations, Sims’s original hatchery became a casualty to progress. But TWRA and TVA decided the partnership was too valuable to let go. TVA constructed the current \$1.2 million C-RAC, a state-of-the-art aquatic center, which opened in 2014 under long-term TWRA management.

The Tennessee-Cumberland River Basin: Epicenter of global freshwater aquatic diversity and endangerment

Don Hubbs likes to call himself the state Mollusk Recovery Coordinator, and as a fisheries biologist who has developed an expertise in mussels, he is the person who knows better than anyone what and where the rarest freshwater mussel species are. He helped to prepare the Cumberland region’s Plan for Population Restoration and Conservation of Imperiled Freshwater Mollusks, which guides the selection of mussel species to be propagated at the C-RAC and where they will be reintroduced.

Together with Hua and Sims, Hubbs completes the unusual team of heroes saving obscure freshwater mollusk species in Tennessee. Despite their varying backgrounds, they were brought together by one thing; the ability to spot an opportunity.

“In graduate school, I realized that fisheries research offered little chance for original discovery,” said Hubbs. “Freshwater fish species have been studied to death. But when I was offered the opportunity to get involved in mussels, I realized that just about anything you do is ground-breaking research. Even basic life history studies: it’s all new.”

Mussels are also unique among mollusks in requiring fish hosts for a portion of their life cycle, often dependent on just one or a handful of species. “You’ve got to learn to think like a host fish to find where the best mussel populations are,” explained Hubbs. “The resting areas where fish hang out tend to have the highest concentration of mussels, which means if you’re nervous about climbing through an underwater brush pile while diving, you won’t find many mussels.”

Those mussels have become harder and harder to find over the past few decades. The United States is a world center for mussel diversity with more than 300 species, compared to about 60 species in China, and the Tennessee-Cumberland River Basin tops the list of fresh-

water fish and mussel biodiversity hotspots, according to a 1998 report by The Nature Conservancy. With about 137 species in Tennessee historically, over one-third of the state's mussel species are now listed as threatened or endangered and 14 are considered extinct.

The mussel is your friend

The question, you might ask, aside from their interesting life histories and quaint, old-fashioned names, is why should we care about these non-charismatic microfauna? The answer is, if you like to drink clean freshwater, then the mussel is your friend. They are the proverbial “canary in the coal mine” for freshwater ecosystems.

Mussels are exquisitely sensitive indicators of stream health, affected by both pollutants and sediment in the water, stream water levels, and fish communities. They are so sensitive, in fact, that the EPA recently lowered clean water ammonia standards explicitly to protect freshwater mussels and other sensitive aquatic species that fish feed on. The Oyster mussel provides a good illustration of mussel interdependence with stream conditions. It has greater reproductive success during drought periods, when lower water levels and a stable river bed foster more interaction with their host fish. The opposite holds true during flood years, which unfortunately are projected to increase under warmer, wetter climate cycles in the future.

“If you like to drink clean freshwater, then the mussel is your friend.”

Mussels are also filter feeders, providing a “service” to society, by removing algae and biological contaminants and continuously clarifying our sparkling Appalachian mountain streams. (One large mussel can filter 50 gallons of water per day.) They are also a critical component of the aquatic food web, serving as dinner for everything from raccoons to waterfowl, and depositing their waste in the stream bed as organic matter, which provides a food source for many other invertebrates and fish.

It takes a community

Mussels have ways of partitioning their filtered foods in a way not yet understood by science. With as many as 80 species able to live together in dense concentrations, scientists believe that mussel restoration over the long haul will require a focus on entire communities, rather than a species by species approach.

David Sims emphasizes that even though there are many reasons to value mussels, the reality is they are just plain interesting. “If I can talk to someone for 15 minutes about mussels, they are hooked,” he enthused. “The more you look at them, the more you

become interested in them.”

That is the logic behind C-RAC's school program, created lovingly from scratch by David Sims, Don Hubbs, and Dan Hua. It began with a mussel shell display that can travel to area schools, and has grown into a program that brings students into the center to touch the mussel shells, learn how to age them (their shells are laid down in layers, leaving rings like a tree), exclaim about their life spans (some live over 100 years), and view videos shot underwater of what Hubbs calls “a world that most people aren't aware even exists.” TVA is also a supportive partner in this community outreach effort.

It takes a community of dedicated individuals to restore propagated mussels to their rightful habitat as well. Reintroducing mussels into streams must be done carefully. “You plant them in the river, like beans,” said Hubbs. The C-RAC staff has organized community and school groups to assist in these events. In 2015 alone, Hua produced more than 20,000 baby Oyster mussels to release into the Clinch River. According to Hua, the mussel matriarch, these are the kinds of babies we can be happy to let go into the world.

Gregg Elliott is a communications consultant and freelance writer. Her business is K. Gregg Consulting.

A Wartyback by any other name...

The colorful common names of U.S. freshwater mussels evoke a bygone era when kids waded barefoot through backwoods streams, and farm chores and the outdoors were part of daily life.

<i>Heelsplitter</i>	<i>Spectaclecase</i>
<i>Rabbitsfoot</i>	<i>Rock Pocketbook</i>
<i>Deertoe</i>	<i>Pistolgrip</i>
<i>Pigtoe</i>	<i>Washboard</i>
<i>Fawnsfoot</i>	<i>Fragile Papershell</i>
<i>Sheepnose</i>	<i>Purple Wartyback</i>
<i>Butterfly</i>	<i>Orangefoot Pimpleback</i>
<i>Birdwing</i>	<i>Threehorn Wartyback</i>
<i>Monkeyface</i>	<i>White Wartyback</i>
<i>Elephantear</i>	<i>Threeridge</i>

