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Can UB harness mussel power to clean waterways?

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Nov 30, 2023

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Could three pregnant freshwater mussels named Elizabeth, Imogene and Nelly residing in a University at Buffalo aquatics lab be the key to a new eff ort to clean up the Niagara

River?

University at Buffalo researchers hope so. The three mussels are at the center of a three-year research project to see if freshwater mussels can be reintroduced to help clean the Niagara River.

The team led by UB assistant professors Isabel Porto-Hannes and Corey Krabbenhoft received a $500,000 grant from the New York Power Authority for a pilot study that could spawn much more research, Krabbenhoft said.

The project aims to improve not just the future of the river, but the future of freshwater mussels, which are the most endangered group of organisms in the U.S. due to decades of water pollution.

"There are 300 species of freshwater mussels in North America, and 75% of them are either imperiled or extinct," Porto-Hannes said. "Native freshwater mussels were here before humans set foot on this continent, and they are disappearing."

While susceptible to many threats, freshwater mussels are also able to digest some contaminants that harm other species.

They filter water as they feed, serving both as cleaners of the water they ingest and as indicators of water quality – the aquatic equivalent of canaries in a coal mine.

For the research to succeed, the UB scientists will need to have their three female mussels procreate, in hopes of creating a colony of thousands of mussels that then can be restored to specially targeted areas of the Niagara River and, ultimately, other waterways. Part of the challenge is raising mussels that will survive in an environment that may prove inhospitable to some native species.

Unlike zebra and quagga mussels – the invasive species of mussels getting all the attention these days – native freshwater mussels burrow into creek, river or lake beds where they oxygenate the substrate and help with nutrient cycling, Krabbenhoft said.

But that also makes them vulnerable to the tiny invasive mussels, which cement themselves to hard surfaces like boat propellers, water pipes and the shells of larger native mussels, effectively smothering them. Porto-Hannes said the most common local family of freshwater mussels, called Unionidae, are in great decline in the Great Lakes because of zebra and quagga mussels.

While conservationists work to stop the invaders, the UB team hopes to restore native mussel species to local waterways to clean polluted water.

They are starting with the Niagara River, which remains a U.S. and Canada "Area of Concern" even after 50 years of remedial cleanup.

The state Department of Parks, Recreation and Historic Preservation and NYPA have done "a ton of physical habitat restoration" of the river, Porto-Hannes said, "and this project would add the biological restoration."

'No mussels without fish'

Porto-Hannes and Krabbenhoft met at UB, started talking research and decided to team up. Port-Hannes, assistant professor in UB's department of environment and sustainability, is a mussel expert. Krabbenhoft, assistant professor in the department

of biological sciences, is a fish expert.

"We realized that collectively we had the expertise to do this," Krabbenhoft said. "Because there are no mussels without fish."

Unionidae are among the mussel groups that have a strange and fascinating reproductive adaptation. After getting impregnated in early summer, female mussels carry thousands of fertilized eggs in their gills that grow into larvae called glochidia.

In spring, the mama mussels lure hosts to harbor their glochidia until they become juvenile mussels. The female sticks out a fleshy piece of tissue as a lure to attract a fish and then blast out glochidia that attach to the fish's gills and scales. The glochidia stay on the fish as temporary parasites for weeks or months before they detach and find a place to burrow.

"Some mussels are generalists and can parasitize dozens of species of fish, but some are only parasitic to a couple of species, and that's another reason some are in trouble, because their host fish are disappearing," Porto-Hannes said.

Porto-Hannes and Krabbenhoft decided to use a species of Unionidae called Fatmuckets for their study because they are the least threatened locally.

"We're starting with a common species and will work our way up to endangered ones," Krabbenhoft said.

The two other members of the UB mussel research team are research technician Jonah Fronk and master's candidate Max Striedl, who is doing his thesis on the project.

The team's lab was outfitted for mussel life support over the summer and they collected Elizabeth, Imogene and Nelly from Ellicott Creek in September and named them after three female founders of a natural science group that became the Buffalo Museum of Science.

Porto-Hannes said female mussels are more rounded and pregnant females have inflated, puffy gills, so they knew the girls were all "gravid," the scientific term for expecting.

Every day, Fronk visits the lab to monitor vitals like pH, oxygen and temperature, and fills a feeding compartment with an algae mixture that gets released into their tank every half hour "so they never go hungry," he said. The mussels are burrowed into sand on a tray

immersed in the tank, and the lab room is essentially a big walk-in refrigerator whose temperature is controlled to mimic what's going on outdoors.

"In spring, we'll bring the temperature back up, which cues them to do their thing," Fronk said.

That's where the fish come in, in this case large-mouth bass to be provided by a local hatchery. The researchers can prompt the female mussels to release their glochidia – "tens of thousands of babies each" – with a poke to the gills, Fronk said, and then introduce them to attach to the fish, who aren't harmed by the process.

Reintroducing mussels to the Niagara River

Once the tiny juvenile mussels drop off the bass, the team will care for them in "nursery" tanks in the aquatics lab. By early next summer, they'll move them into cement silos at four restored areas of the Niagara River, at Buckhorn, Unity, Strawberry and Beaver islands.

By monitoring the mussels' progress, they'll be able to assess the water quality at those sites while learning how best to reintroduce freshwater mussels to local water bodies. Eventually, freshwater mussels might be able to help clean even badly polluted watersheds like Scajaquada Creek or help mitigate sewer overflows caused by storm water runoff, Porto-Hannes said.

Previous experiments have shown that freshwater mussels can consume contaminants that are harmful to other species, including E. coli bacteria.

"Most of them will filter everything, because they are very good at sorting their particles," Porto-Hannes said. "Things they don't want to eat they will release, and things they want to eat they will move into their digestive tract."

When introduced to E. coli from secondary effluent from a local water treatment plant, "the mussels actually ingested it," she said "So they removed it instead of depositing it in the sediment. So hopefully, we can propagate these mussels successfully, because the services they can provide for Western New York, like cleaning our waterways and improving our health, is just enormous."

In addition to those services, the UB Unionidae can also help educate the public about this fascinating, understudied animal and its endangered species. The team is working with the Aquarium of Niagara on a mussel exhibit slated for 2025.

The researchers said they worry that bad press about invasive mussel species causing destruction will dilute concern for native species that are in danger of extinction.

"We want people to know about mussels, care about mussels and conserve mussels," Porto-Hannes said.

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