

An all-too-common sight: Zebra mussels envelope an empty mussel shell pulled from the Rideau River in Andrewsville, once a hotspot for native mussels in eastern Ontario

the mussel crisis

Shockingly, more than half of North America's freshwater mussels are in danger of going extinct. With the clock ticking, a small band of committed researchers is determined to save a group of molluscs that is critical to the health of our aquatic ecosystems

By Moira Farr
Photography by Tony Beck

Spread across biologist Todd Morris's palm is a cluster of mussels just scooped from the Grand River in Kitchener – to the untrained eye, a pile of clams. To the expert, a variety of thriving native invertebrate species with unique biologies as intriguing as their names: fatmucket, elktoe, creeper, flutedshell and – the one that has Morris most excited – the wavy-rayed lampmussel. “These guys are very cool,” says Morris, pointing to the distinctive “wavy rays” emanating from the mussel’s “beak” outward to the edge of its smooth, yellow green shell. The gravelly bottom of the shallow “riffle” (fast-flowing) section of the Grand River we are standing by is one of the few places in Ontario they are found. Since 1999, the wavy-rayed lampmussel has been listed as a species at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and since 2004 designated endangered under the Species at Risk Act (SARA), as well as the Fisheries Act.


Morris is a research biologist with the Great Lakes Laboratory for Fisheries and Aquatic Sciences (Fisheries and Oceans Canada), based in Burlington, and a member of the Ontario Freshwater Mussel Recovery Team, formed in 2003 to gather information about, monitor and create a strategy for restoring the province's threatened indigenous mussel species (see “The crisis”, page 38). The situation

is critical: of the 41 native mussel species found in Ontario (all of them in the family Unionidae), 11 are endangered and one threatened. The declining populations of these species reflect North American trends: freshwater mussels are considered the most endangered species group on the continent; 65 percent of all North American freshwater mussel species are at risk of extinction.

Why should the average person care about freshwater mussels? The answer is simple, says Morris. “What threatens them, threatens us. When they disappear, it's an early sign you'll lose other species too.”

Freshwater mussels might also be called conservation underdogs. Because they lack the endearing faces of mammals or the beautiful colouring of birds or butterflies, their plight has not exactly captured the public's imagination or the research dollars devoted to other species. That only makes malacologists (mollusc biologists) more determined to expand the knowledge base about freshwater mussels, spread the word about their precarious status and make a concerted effort to save the many species at risk.

Freshwater mussel beds provide stability and aerate the sediment at the bottom of lakes, rivers and streams, according to *The Photo Field Guide to the Freshwater Mussels of Ontario*,



Is it safe to eat freshwater mussels? Not a good idea. As filter feeders in water systems carrying many pollutants, mussels are probably filled with concentrated toxins. Besides, according to researcher Dave Zanatta, a Canadian malacologist now at the University of Central Michigan, people who have tried them say they taste like “mud-flavoured latex.” (It is illegal to collect live native mussels, or their shells, without a permit from the Ontario Ministry of Natural Resources.)


an excellent reference book by Burlington-based, National Water Research Institute biologist Janice Metcalfe-Smith (with Alistair MacKenzie, the late Ian Carmichael and Daryl McGoldrick). Individual mussels can filter up to 40 litres of water a day. They convert particles of organic material (including algae and bacteria), excreting phosphorus and nitrogen, which are important to other aquatic species such as plankton; they are a food source for fish, mammals and birds. Fish lay eggs in empty mussel shells, crayfish hide in them and insect larvae attach to them. They can live for decades, but are extremely sensitive to pollution and habitat changes. By accumulating toxins, they serve as early indicators of environmental degradation.

Native people harvested mussels, using them for food, jewellery and tools. Freshwater pearl hunting thrived in the 19th century. From the late 1800s until the 1940s, when plastics became commonplace, the Grand River supplied massive numbers of mussels to the button industry. Since the 1950s, freshwater mussel shells from the Mississippi River basin in the United States have been shipped in large quantities to Japan, where the shells are cut and placed inside oysters to produce cultured pearls.

But the chief culprit in recent regional declines of freshwater mussels is the notorious zebra mussel, native

to European bodies of water and believed to have been dumped into the St. Lawrence Seaway in the ballast water of an ocean vessel from the Caspian Sea. Since 1988, when biologist Gerald Mackie (now retired from the University of Guelph) identified the first members of this invasive species found in North America, on the shores of Lake St. Clair, they have done more than clog water pipes and become a nuisance to boaters. Zebra mussels – unlike members of the Unionidae family, which require host fish to reproduce – broadcast their larvae into the water, robbing other species of the nutrients and oxygen they need to compete and survive. Zebra mussels also spread disease (such as avian botulism) that has devastated the native fauna of the Great Lakes. As a result, struggling populations of native mussels remain in river areas only, primarily in southwestern Ontario, though also in eastern and north-eastern areas of the province.

Here in the southwest, native mussel species are threatened by changes in the ecosystem caused by agricultural runoff, damming and loss of habitat due to urban and suburban development, as well as declines in the host fish population that many need in order to reproduce. Unusual rain patterns due to climate change will affect water levels and the survival of wetland areas, where native species



The crisis: The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has listed eight Ontario mussel species as endangered. They are currently protected under the federal Species at Risk Act SARA and are also listed as endangered in Ontario's Endangered Species Act (ESA):

Kidneyshell *Ptychobranchnus fasciolaris*
Mudpuppy mussel *Simpsonaias ambigua*
Northern riffleshell *Epioblasma torulosa rangiana*
Rayed bean *Villosa fabalis*
Round hickorynut *Obovaria subrotunda*
Round pigtoe *Pleurobema sintoxia*
Snuffbox *Epioblasma triquetra*
Wavy-rayed lampmussel *Lampsilis fasciola*

COSEWIC is assessing the status of four other species for protection under SARA:

Rainbow *Villosa iris* (endangered; threatened in ESA)
Eastern pondmussel *Ligumia nasuta* (endangered)
Fawnsfoot *Truncilla donaciformis* (endangered)
Mapleleaf *Quadula quadula* (assessed as two separate designatable units: threatened in the Great Lakes area but endangered in Manitoba; threatened in ESA)

Faucet snails (pictured here) were the dominant invasive molluscs in the Rideau River before the introduction of zebra mussels

have found refuge. Fish species that serve as hosts to mussel larvae are affected by changes in water temperature and could decline in number, causing a subsequent crash in mussel populations. The decline of wetland habitats could force vulnerable species farther into water systems now overrun with zebra mussels, which will probably out-compete native mussels for resources.

Unfortunately, the zebra mussel is here to stay in many of Ontario's lakes and river systems. Conservationists advocate measures to keep them from spreading, such as thwarting reproduction, manually removing them, placing tighter restrictions on ballast-water releases from foreign vessels and educating recreational boaters about cleaning zebra mussels off their boats. It is important that we increase our knowledge of the biology, behaviour and genetics of our native mussel species and pass that knowledge on to the public, who must be a part of any strategy to preserve unspoiled habitat, restore or create new refuges for native mussels, augment existing populations and reintroduce threatened species to their historic living areas.

Study has begun, but much more is needed. Morris is most intrigued by the way the wavy-rayed lampmussel interacts with its host fish, the smallmouth bass – a key piece of the knowledge puzzle biologists need to understand to enhance the chances of mussel survival. For the past three summers, he and his research team of students from the University of Guelph have donned chest waders and travelled to this site once a week to spend hours surveying the river bottom with underwater viewers that look like red traffic cones. The researchers count mussels, recording

species, determining their sex, measuring them, photographing and tagging them with tiny numbers affixed to the shells with glue. Shells and occasionally live mussels are taken back to the university's research lab for further study. "They are truly a remarkable example of evolution," says Morris. "Part of our focus has been on the complex lures this species has evolved to attract the smallmouth bass. The mussel actually mimics a small minnow as one way to get the attention of the predatory smallmouth. When the smallmouth tries to feed on the lure, the female mussel releases her immature young into the mouth of the fish and they become parasitic, living on the gills for a few weeks while the young develop."

The lack of general understanding about freshwater mussels is definitely out of proportion with the importance of these species to the healthy functioning of ecosystems. "Freshwater mussels are more than just living rocks under the water," says Dave Zanatta, a Canadian malacologist. Now at the University of Central Michigan, Zanatta researches genetic factors in the survival of mussels.

Researchers are fascinated by the complexity of freshwater mussel behaviour and biology, a complexity most of us never imagined. Morris, Zanatta and their colleagues, a small but passionately dedicated corps of mollusc experts and boosters, are working hard to change our lack of awareness. Research teams in both Canada and the United States have documented the disastrous impact of the zebra mussel. Still, there is much the scientists do not understand, and little is known about the nature of the mussel population in many areas of the province. So each year, about 20 mollusc researchers from around the province select a body of water

More on mussels: You can purchase a copy of *The Photo Field Guide to the Freshwater Mussels of Ontario* at Ontario Parks stores, or through the St. Thomas Field Naturalist Club, Box 23009, St. Thomas ON N5R 6A3.

Fred Schueler's website, Pinicola (www.pinicola.ca), contains a wealth of information on freshwater mussels in eastern Ontario. Another useful resource is Fisheries and Oceans Canada's website about the Species at Risk Act (www.aquaticspeciesatrisk.gc.ca). The Freshwater Mollusk Conservation Society (FMCS), a North American group (of mostly U.S. experts) concerned with mussel conservation, also has an informative website (ellipse.inhs.uiuc.edu/FMCS).

For a more complete list of resources, visit *ON Nature* online (www.ontarionature.org).



Biologist Todd Morris shows off mussels scooped from the bottom of the Grand River in Kitchener; the endangered wavy-rayed lamp-mussel is second from the right

in Ontario and spend a weekend surveying its mussels. This year, the Nottawasaga River near Orillia was slated for survey, but the trip was cancelled when water levels rose to dangerous levels at the time of Hurricane Ike.

That research group includes Morris and Zanatta, as well as Kelly McNichols of the University of Guelph research lab; Daniel Spooner of Trent University, whose research is helping to uncover the secret lives of bivalves, answering big questions about how each species' biology affects water quality in both forested and agricultural areas, as well as how species co-exist; and Fred Schueler, who in 2006 uncovered living eastern pondshells, a species severely affected by the zebra mussel, in the Lyn Creek watershed near Brockville.

Schueler, a naturalist specializing in leopard frogs, became hooked on monitoring and exploring the world of mussels in the mid-1990s, working with André Martel of the Canadian Museum of Nature to determine the extent of the spread of zebra mussels in eastern Ontario. A trip with Schueler to the fast-flowing waters of the Rideau River at Andrewsville shows the problem all too graphically. Schueler, in duct-taped wading shoes, walks into the thigh-deep water, stares down and fills a green garbage bag with specimens. He then wades back and lays them out on rocks along the bank. Of the couple of dozen examples of native species in his catch, such as the eastern elliptio, only two are living. The rest are empty, eroded shells, to which clusters of zebra mussels have attached themselves, depriving the native mussels of oxygen and food. He says that, back in 1995, though zebra mussels were beginning to encroach, "I would have said this was one of the best spots to come and see native mussels in eastern Ontario." In less than a decade the

invaders had almost completely destroyed the native populations in the area.

"Almost" being the operative word. As we prepare to leave the Rideau, Schueler throws the two live mussels back into the water. Will they and the millions of other Ontario mussels currently in peril survive? If they don't, it won't be for lack of concern, hard work and advocacy on the part of a growing number of committed researchers.

"We are making some progress," says Morris. The provincial freshwater mussel recovery team is midway through its five-year strategy for monitoring and restoring Ontario's endangered mussel species. He points to the wavy-rayed lampmussel as a conservation success story in the making. Documentation shows its population declined through the 1970s to the 1990s, and the species may be extirpated from the Great Lakes. But today in the Grand River, it is the dominant mussel species. Soon COSEWIC will re-evaluate the status of the wavy-rayed lampmussel and might even move this species from the "endangered" category to "threatened" or a category of even lower risk. Morris attributes the species' increasing population since the mid-1990s to the "general cleanup of the watershed," which includes better agricultural land management and improved sewage systems in urban areas. "Can we bring every species back from the brink? Probably not," says Morris. "But, for some, I truly believe we can make a difference." 🐾

Moirra Farr is a freelance writer whose articles have been published in More, Cottage Life, Canadian Geographic and The Walrus. Her last article for ON Nature was "The butterfly effect" (Summer 2008).