

Mussel fatigue April 30, 2010

It has been 20 years since the sinister little zebra mussel arrived and began to carpet the bottoms of the Great Lakes. They've had a huge impact, but not all the dire predictions have come to pass, DANIELLE BOCHOVE reports. The ecosystem is adapting, and some even say the invader's arrival hasn't been 'such a bad thing'.

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On June 1, 1988, Paul Hebert sent two of his undergraduate students into Lake St. Clair to collect clams, using a dredging tool called a "ponar grab." As head of the Great Lakes Institute at the University of Windsor, he wanted to measure pollutant levels in the bivalves. But what his students plucked from the bottom sent those plans famously awry.

"The device came up with a rock caught in its jaws, and on the rock, was the first zebra mussel," recalls Prof. Hebert, now director of the Biodiversity Institute of Ontario at the University of Guelph.

His initial reaction, he admits, was far from prescient. "I said: 'I've never seen one of those before; we'd better take a picture in case it's the last one I ever see.' "

Within two months, his team had found mussel densities as high as 200 per square metre. The creatures were all the same size, and the researchers deduced that they had been hatched from larvae dumped from a ship in the fall of 1986. Shortly after being discovered, the first generation spawned and the invasion became, in Prof. Hebert's words, "an explosion."

So did the media coverage.

First came a barrage of apocalyptic predictions. Female zebra mussels were capable of producing 40,000 eggs a year and would carpet the Great Lakes, eradicating countless native species. Early cost estimates to unclog power-intake pipes, dredge harbours of shells and absorb the loss to Ontario's fishing and tourism industries ran in the billions of dollars. The invasion was covered heavily for years. (Who can forget the encrusted "mussel car" pulled from the Detroit River in the early 1990s?)

And then, abruptly, the risk appeared to fade. There were sporadic reports of treatments -- both natural and chemical -- that might eradicate the mussels, and evidence that they would thrive only where the bottom was rocky. The colder water of the more northerly Great Lakes proved less hospitable than Erie and Ontario. Some researchers speculated the population would peak and taper off.

And then came an even more radical departure from conventional thinking. Just as some optimists hail global warming (heating bills will go down), reports appeared suggesting that *Dreissena polyorpha* was actually providing a service to mankind, by vacuuming up some of the pollutants clogging the Great Lakes.

So what, looking back 20 years after it all began, has really happened?

Early estimates of the financial impact were probably on track -- the most recent figures put the cost to Great Lakes utilities alone at \$200-million to \$500-million (U.S.) a year, on top of the damage to a \$4.5-billion fishing industry and tourism in the region.

The environmental toll has been much more difficult to assess. For one thing, the zebra is not acting alone. Scientists now believe that it has been largely muscled out by its own cousin, the quagga mussel, *Dreissena bugensis*, which looks almost identical and arrived from the same part of the Caspian Sea in the early 1990s. There's no doubt that, together, they have virtually wiped out several species of insect and native mussels, while seriously jeopardizing certain fish populations. They are also, literally, changing the terrain of the Great Lakes.

It's true that *Dreissena* mussels clarify water. Like tiny vacuum cleaners, they suck in vast amounts of algae and other particulates, producing feces from the organic matter while binding the non-organic sand and pollutants with mucous to create an unappealing glop called pseudo-feces. Both wind up on the bottom of the lake, meaning that over time the mussels remove tonnes of material from the water.

The visual impact is stunning. "I'm old enough to remember when Lake Erie was dead -- remember those headlines? -- but it was, in fact, so alive, it was choking itself," says David Barton, a biology professor at the University of Waterloo. "The water was so green that sometimes in the summer, the wake from boats was green -- it was thick."

Prof. Barton says, "Things really improved when the mussels came along because they're so good at pulling stuff out of the water column, and incorporating some of it into their own tissues and the rest on the bottom, where it can be eaten by other organisms that are good fish food. So, ecologically, it's not such a bad thing."

This may seem tantamount to blasphemy, but Prof. Barton says most organisms driven from the lakes survive in streams, and some day the mussels' time will be up too. He hopes that when that happens, the "lost species" will reclaim their old territory.

Tim Johnson, a research scientist with Ontario's Ministry of Natural Resources, says news of the *Dreissenas*' "cleansing" property triggered the entrepreneurial spirit in some quarters. He shakes his head as he recalls the day a businessman proposed using the mussels to treat toxic waste. "He planned to fill a rail car with them. He saw it as a semi-portable thing." Sadly, mussels require much time to filter thoroughly, and it was never made clear where their contaminated bodies would wind up.

Mr. Johnson's job is to monitor the health of the Great Lakes, particularly as it affects fish. Formerly based on Lake Erie (whose Canadian commercial fishery is worth roughly \$30-million a year), he recently moved to a research station on Lake Ontario's Bay of Quinte. The shelves of his office are stacked with studies on the interaction of native and invasive species while living examples of both can be found in the waters lapping at the jetty just outside his window. In 20 years of study, he says glumly, nobody has come up with a single productive use for *Dreissena* mussels.

He also believes that the mussels' cleansing effect creates more problems than it solves. Clear water not only drives many fish to greater depths, it promotes the growth of *microcystis*, a blue-green algae that releases microcystin, a toxin harmful to many creatures, including humans. Sadly, it's one of the few algae unpalatable to *Dreissena* mussels, and he believes increased levels of microcystin may be partly responsible for Lake Erie's famed "dead zone" -- a lifeless patch of 500 to 1,000 square kilometres primarily attributed to chemical pollutants.

That said, "the single biggest effect of zebra mussels has been their alteration of the physical habitat," Mr. Johnson says. Twenty years ago, scientists knew the mussel preferred a hard bottom to a soft one -- but they didn't count on its ability to grow on its own kind. It is common to find three or four generations bound together in cantaloupe-sized clusters, or "drusses" anchored to something as small as a popsicle stick in the mud.

"Suddenly the earlier maps of where the mussel could live were grossly underestimated," he says, estimating there could be as many as 52 trillion *Dreissena* mussels -- that's more than 15,000 railcars full -- in the Great Lakes today. Densities as high as 600,000 per square metre have been found.

As the layers of mussels grew thicker, native species of insects, fish, and mollusks -- many of which live or spawn in the shallows -- began to suffer. Among the first casualties were the big clams Prof. Hebert's students were sampling for pollutants back in 1988. Within two years of his study, he says, they had been all but wiped out. "The Lake St. Clair bottom went from being the rich mussel bed it had been for many thousands of years to being stripped. The most charismatic of the big mollusks in the Great Lakes were gone, because of this single invading species."

Charismatic? "I will admit," Mr. Hebert says sheepishly, "there aren't many people who wake up in the night thinking about clams." But the native species could live for centuries (versus five years for the mussels), and they had beautiful iridescent shells once harvested for buttons. "They were some of the oldest organisms

in the Great Lakes -- certainly the oldest organism on the bottom -- and they were destroyed in one fell swoop."

And then there was the impact on the fish.

Roxy Lancaster is 61 and among the fifth generation of his family to fish the waters of Lake Ontario off Point Traverse in Prince Edward County. (His great-great-grandfather is buried under a black rock near the spot where Mr. Lancaster keeps his boat.)

Like Prof. Hebert, he remembers the thick green algae of the mid-sixties, and the effect it had on his primary catch, the whitefish. "They didn't spawn for five years." And he has seen the impact of the mussels first-hand. "The whitefish are now eating small zebra mussels, which is remarkable," he says. "Our food processor in town says when he splits them open, their gut is full of zebra mussel shells."

As unappetizing as that may sound, Mr. Johnson says it poses no risk to people, but it has substantially reduced the health of the whitefish, because the mussels lack a fatty acid they need for membrane development. (The acid is present in *Diaphoreia amphipod*, a tiny shrimp once favoured by the whitefish whose disappearance some suspect may also be linked to the mussel invasion.)

So now the fish are thinner, grow half as quickly, and spawn every seven years instead of every four. They are also being driven to greater depths to escape the clear water because the extra light causes cataracts on their eyes.

These developments concern Mr. Johnson, but Mr. Lancaster believes that the lake can fight back. "Our experience . . . is there are whitefish wherever we go, which suggests to me the assessment process has made a huge mistake."

He also says that this year there are more native clams among the mounds of mussel shells that carpet the beach, and the "windrows" of shells in the shallows are becoming smaller, suggesting that now-dominant quaggas reproduce less rapidly than zebras.

That said, mussels have plugged the entrance to Point Traverse harbour three times in the past five years; the dredged mounds of gravel and shell Mr. Lancaster points out are easily three metres high. And the beach, like many in the province, is carpeted by a thick layer of shards that makes it excruciating to walk barefoot.

Mr. Lancaster is also concerned by the number of dead birds he has seen in recent years, a phenomenon he thinks may be linked to botulism in the mussels. Mr. Johnson agrees, saying biologists are studying whether the round goby fish, another invasive species, may be acting as a "vector," by eating tainted mussels, struggling to the surface to die and be eaten by birds.

Companies such as Ontario Power Generation have used chlorine to control mussels on intake pipes, but eliminating them altogether would require treating all the water in the Great Lakes simultaneously. That's clearly impossible, so most scientists focus on keeping the next invasive species from coming in.

Since June, oceangoing ships that use water for ballast have been required to flush their tanks with saltwater to expel any unwanted hitchhikers before entering the St. Lawrence. However, most use cargo for stability, and so have the option not to flush -- a loophole that Natural Resources Minister David Ramsay is trying to close. Many scientists would like to have all shipboard ocean water treated -- Prof. Hebert suggests boiling it -- before it is released. The question becomes whether shippers, and ultimately consumers, will bear the cost.

Prof. Barton -- the most sanguine about the mussels' impact -- offers the most radical solution. A sad consequence of globalization may be the inevitability of invasive species, he says. In that context, perhaps we should consider introducing new species into the Great Lakes to compensate for what's being lost.

For example, he says, the little shrimp that's disappearing is "literally the only major, year-round food source for deep-water fish in the Great Lakes." Replacing it with another deep-water shrimp would hedge our bets and have the added benefit of increasing "global diversity," he says.

The idea makes many of his colleagues nervous. "Most biologists would be immensely cautious about plans to introduce species beyond their natural bounds because they're quite unpredictable things," says Prof. Hebert, clearly restraining himself.

"You really don't know what's going to happen." He cites the case of a tiny European fly that the Americans introduced in the eighties to control the gypsy moth population. Unfortunately, the tachinid proved to have a broader-than-anticipated palate, and now some of the more interesting species of large-winged moths -- including the luna -- are "basically gone from the eastern part of North America because of this goddamn thing," he adds, restraint slipping.

It is that kind of loss to biodiversity that may be the greatest consequence of invasive species. A new invader arrives in the Great Lakes every eight months -- 173 have been identified so far -- and each creates a chain reaction often too complicated to measure, much less control.

"We have a whole new ecosystem now that we have zebra mussels," Mr. Johnson says flatly. "And while 50 to 100 years of research on the Great Lakes hasn't exactly gone out the window, we're pretty close to starting from scratch."

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