Mussels Can Say A Lot About Environmental Concerns

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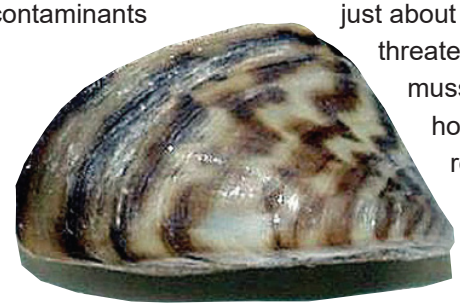
Few scientific questions are answered without collaboration. Researchers work together across disciplines, and agencies and universities share resources when one group has a piece of equipment the other needs. When it comes to federal agencies' efforts to keep track of the health of the Great Lakes, the collaborations develop the same way.

NOAA's Mussel Watch Program has been in operation since 1986, when it was designed to monitor the status and trends of a broad suite of chemical contaminants at sites that represented large coastal areas in order to construct a nationwide assessment. In 1992 the Great Lakes were added to this monitoring effort, and involvement with CSMI and funding under the Great Lakes Restoration Initiative (GLRI) helped the program ramp up its efforts in 2010. Connecting Mussel Watch with the EPA's research vessel *R/V Lake Guardian* gave the scientists access to offshore sampling sites that previously couldn't be accessed with their smaller boats, adding additional sampling trips and sites and expanding the program's scope beyond mussel tissue and sediment contaminant sampling.



Program scientists use dreissenid mussels – zebra and quagga mussels, mostly – as sentinel organisms for contaminant monitoring; as mussels are filter feeders, they tend to come in contact with most waterborne contaminants or chemicals attached to suspended particles. Those contaminants can include complex mixtures of legacy contaminants like polychlorinated biphenyls (PCBs) that have a long history of affecting the Great Lakes, as well as contaminants of emerging concern, including biologically active chemicals like pesticides, pharmaceuticals, and hormones, many with limited information on their effects on development, reproduction and immune system response in humans and wildlife.

While people may wonder why scientists are interested in an invasive species' health, the non-native mussels actually make for the perfect "lab rat": they're found in just about all parts of the Great Lakes, they're not threatened or endangered like many native mussels, and they're excellent predictors of how native mussels, fish or birds would react to the same contaminants. Therefore, processing mussel samples, particularly from impacted rivers and harbors, and comparing them with mussels collected from deepwater offshore sites, can give researchers an idea of contaminants that may be causing problems in other organisms, using an animal that's abundant all across the Great Lakes basin.

In addition to analysis for contaminants, the scientists are also studying the health of the bivalve mussels by measuring biological chemicals they produce in response to environmental stressors to see how the contaminants affect their metabolism and other processes going on inside their cells. This can be particularly helpful when it comes to emerging contaminants like pharmaceuticals and personal care products, the effects of which on wildlife are only beginning to be understood.

Because they are found dissolved in water, pharmaceuticals and personal care products travel from

bathrooms to water treatment plants with wastewater, and current treatment processes don't remove all of them before the discharge water is released into neighboring streams or rivers. This means that anything from the hormones in birth control pills to active ingredients in pain medication can end up affecting wildlife in those bodies of water.

Samples of mussels and sediment for this project were gathered at more than 200 sites across Lake Erie, ranging from nearshore areas to the deepest parts of the lake. Passive samplers – specialized plastics about the size of a credit card that can accumulate chemicals – also collected information on contaminants in the water to show what mussels are exposed to from that particular source over a period of three to six weeks. With caged mussels at the same sampling sites also acting as passive samplers, the two types of approaches help to cover both water soluble chemicals and those more likely to accumulate in biological tissues.

Few laboratories in the country do this kind of work on emerging contaminants at the moment because it's an expensive and complicated process, so the researchers are only just starting to track these new pollutants. But their work is building a baseline of information for future studies on contamination in both water and mussel tissues, with complementary CSMI work on Great Lakes sediments and fish tissues expanding their knowledge towards a better understanding of the larger ecosystem. While those collaborations often take some time to produce impactful results, the work is no less important, and provides the foundation for keeping Lake Erie and its neighbors healthy for future generations.

The Cooperative Science Monitoring Initiative (CSMI) is an yearly coordinated monitoring program between the US and Canada to support the restoration and protection of the waters of the Great Lakes and led by the GLWQA Science Annex to address the science priorities of the Lakewide Management Annex.