CSMI Cooperative Science and Monitoring Initiative

Local Surveillance, Global Conclusions

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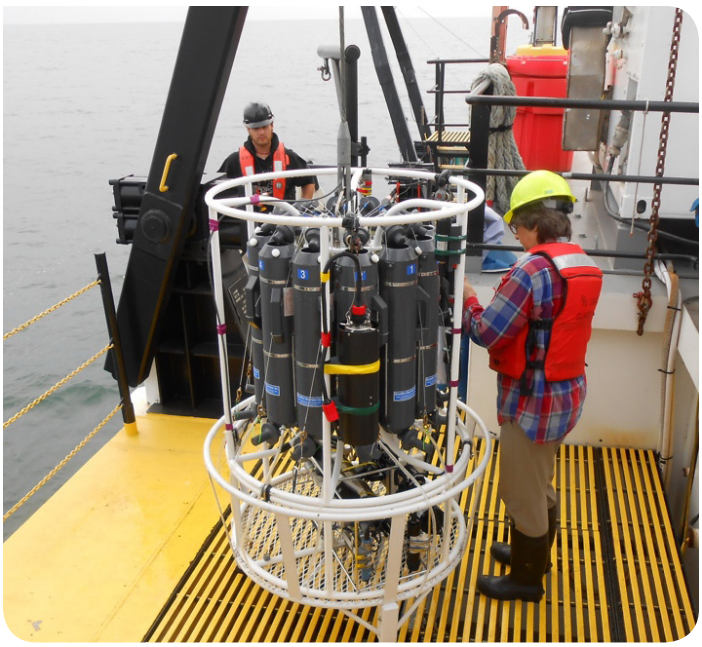
In an industrialized world, pollution is a constant. From carbon emissions in manufacturing plants to pharmaceutical residues in wastewater, humanity still has a long way to go in balancing technological advances with their impacts on the natural world. One important step in that direction are monitoring programs to keep track of those impacts.

In the Great Lakes, the Great Lakes Sediment Surveillance Program (GLSSP) is one of those efforts. Started in 2010 as part of the Great Lakes Restoration Initiative (GLRI), the program completed sampling in all five Great Lakes, and analyzed more than 1,000 sediment samples for a wide range of organic pollutants.

As part of the 2014 CSMI research cruise, the GLSSP teams obtained a total of 166 sediment samples from Lake Erie. Samples include both 46 surface samples with a ponar grab – a scooping tool that looks a lot like a small excavator – and five sediment cores that preserve the layered structure of the lake bottom. The cores were up to 46 cm long, and each was divided into 20-25 slices. Depending on the length of the cores and the rate of sedimentation in a given lake, those cores and the chemicals embedded in them can tell the story of a region through time. In remote locations, such as Lake Superior and some sites in Lake Huron, the cores can bring up sediments that were deposited more than 500 years ago because of the low sedimentation rate, and bottom segments in cores from Lake Michigan could date back to the 1800s or earlier. This allows the researchers to see clear trends in pollution, such as changes to the sediments after the Industrial Revolution and commercial manufacturing along the Great Lakes shoreline.

Sediment core samples preserve the layered structure of the lake bottom for analysis.



In Lake Erie, on the other hand, it's a different story. The shallow western basin in particular receives lots of sediment runoff from the Maumee River, where the watershed is mostly agricultural, meaning sediments accumulate quickly on the lake bottom. The Detroit River brings in contaminated sediments as it flows through heavily populated and industrialized areas, and over the

past few decades, researchers have found a range of organic pollutants at comparatively high concentrations in the western basin of Lake Erie.

For example, the scientists compared the concentrations of polychlorinated biphenyls (PCBs) in sediments among the five Great Lakes, and found Lake Erie is generally more contaminated than other lakes. Within the lake, average PCB concentration in the western basin is more than double the concentrations in the central and eastern basins. Since industrial production of PCBs ceased in the 1970s, their inputs to the lakes have been declining, and by measuring PCBs in sediment core slices, this trend shows up clearly at most sampling sites in the Great Lakes, including sites in Lake Erie where sediments have not been disturbed.

At other sites, historical trends of pollution are not so clear. Remediation efforts and dredging of shipping channels, both a common activity in Lake Erie, disturb and mix sediment layers, as do mussels digging up and down through the sediment. PCBs do not degrade easily in the environment, so their disappearance from the Great Lakes may take years or even decades. At present, PCB contamination is still a major reason for government agencies in the region to issue fish consumption advisories. As for many other chemicals, GLSSP scientists are still analyzing their samples, and hope to begin publishing more data soon. Things like flame retardants that are part of many consumer goods and plasticizers that make plastics more flexible can leach out of the products that include them, either through washing or after they've ended up in landfills, and they've been found in all parts of the Great Lakes system. Polybrominated diphenyl ethers (PBDEs), for example, were built into various electronics, fabrics, resins and furniture to prevent fires from quickly spreading, starting in the 1970s until the 2000s. They became so widespread that they were detected in all the sediment samples collected from the Great Lakes. Among other industrial chemicals measured in this project, some are still produced and used widely, and continued research is needed to determine how these chemicals affect the health of people and ecosystems.

The sources of those pollutants depend on how the chemicals are used: in some cases, they enter the lake via discharge from local wastewater treatment plants or factories. In the past, some chemical manufacturing plants released waste into rivers and streams that run into the Great Lakes, before it was known what effects that discharge could have on the environment. And sometimes chemicals are just so ubiquitous to everyday life that the only way to keep them out of the lakes would be to ban them completely.

Water isn't the only element that transports these chemicals though. Many can become airborne, either alone or by attaching to other particles, and are transported over long distances by the air currents that circle the globe before being deposited back to the ground, usually via precipitation. Migrating animals like fish and birds can also carry pollution to areas where industrial sources are scarce.

This is how a remote place like Lake Superior receives much of the pollution that's found in its sediments, but the problem extends beyond the Great Lakes system as far as the polar regions. Global agreements like the Stockholm Convention on Persistent Organic Pollutants aim to eliminate or restrict the use of these chemicals because they often stay in the environment for a very long time, potentially causing more harm than scientists may yet be aware of.

It's why monitoring programs like CSMI and the GLSSP are such an important part of protecting the global environment: most things in nature are connected somehow, and it's hard to make decisions without some solid data to inform potential solutions.

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.