LAKE SUPERIOR

LAKEWIDE ACTION AND MANAGEMENT PLAN

2022 ANNUAL REPORT

Lake Superior coastline. Source: Jocelyn Sherwood.

In this Issue

What is the Lake Superior LAMP?

Under the Great Lakes Water Quality Agreement (GLWQA), the governments of Canada and the United States committed to restoring and maintaining the physical, biological, and chemical integrity of the Waters of the Great Lakes.

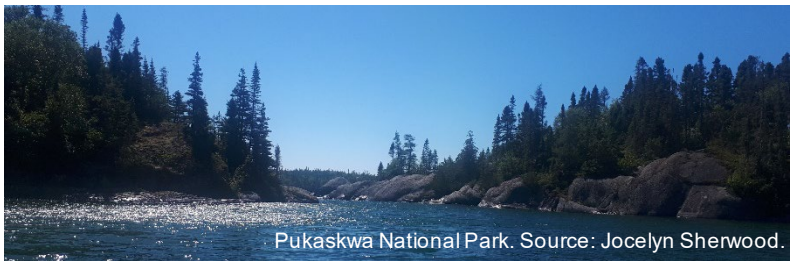
The Lake Superior Lakewide Action and Management Plan (LAMP) is an ecosystem-based strategy for protecting and restoring Lake Superior's water quality. The LAMP is developed and implemented by the Lake Superior Partnership, which is led by the U.S. Environmental Protection Agency (U.S. EPA) and Environment and Climate Change Canada (ECCC) and includes other federal, state, provincial, tribal, First Nation, Métis, and local watershed management authorities. The Partnership facilitates information sharing, sets priorities, and assists in coordinating environmental protection and restoration activities.

OVERVIEW

Over the past year, the Lake Superior Partnership agencies released an updated Lake Superior Lakewide Action and Management Plan. Thirty-six Lake Superior Partnership agencies are leading the implementation of the 49 LAMP actions in cooperation with academia, non-governmental organizations, community groups, and others.

The Lake Superior Partnership agencies also contributed to the State of the Great Lakes 2022 Report and the 2022 Progress Report of the Parties. These reports provide information on the ecosystem status of Lake Superior and significant accomplishments in implementing the Great Lakes Water Quality Agreement (GLWQA).

The Lake Superior basin ecosystem continues to be in good condition based on the assessment of nine State of the Great Lakes indicators, with an unchanging trend. The lake is a safe, high-quality source of drinking water with many healthy habitats including coastal wetlands. While the lake is doing well, protection and restoration actions are necessary to make it more resilient to the impacts of climate change and to prevent and address threats to ecosystem health. This annual report highlights some recent activities by the Lake Superior Partnership agencies: reducing pollution, managing nutrients and algae, preventing and controlling invasive species, and restoring and protecting habitat and species.



Pukaskwa National Park. Source: Jocelyn Sherwood.

REDUCING CHEMICAL CONTAMINATION

Current concentrations of toxic chemicals in Lake Superior fish are much lower than in the 1970s. However, chemicals such as mercury, polychlorinated biphenyls (PCBs), dioxin, toxaphene, and per- and polyfluoroalkyl substances (PFAS) can accumulate in fish tissues and may cause harm to human health if consumption advisories are not followed. Canada and the United States are coordinating efforts under the GLWQA Chemicals of Mutual Concern Annex to identify and reduce anthropogenic sources of these chemicals through binational strategies. Actions include taking innovative approaches for identifying sources, including the projects described below.

Mercury Source Tracking in Lake Superior

Partners around the lake are working to determine current mercury sources and loads to Lake Superior from tributaries and atmospheric deposition. The United States Geological Survey (USGS), is implementing a Great Lakes Restoration Initiative project with partners including Parks Canada, Lakehead Region Conservation Authority, Lakehead University, the U.S. Forest Service and the Bad River Band of Lake Superior Chippewa to monitor 39 tributaries and 4 atmospheric mercury collection sites. Mercury isotope analyses were used to distinguish different sources of mercury to water, air, soils, and sediments. Results show that mercury loads from tributaries are comparable to or lower than measurements from a previous assessment in 1996. In the U.S., the Ontonagon and St. Louis rivers contributed the most significant mercury loads to the system. In Canada, scientists found that the tributaries in Pukaskwa National Park have the highest concentrations, comparable to the two large U.S. tributaries noted above. Isotope analyses show that the source of mercury in tributary waters is related to releases from soil during large rain events or spring melt. This differs from offshore regions, where sediments, waters, and biota receive mercury predominately from atmospheric deposition. This work shows that overland runoff of mercury, stored in soils, is a key source to tributaries and potentially nearshore regions in Lake Superior. This data also indicates that mercury releases from the land will potentially increase with frequent storm events and high flow conditions. See the Great Lakes Binational Strategy for Mercury Risk Management to learn more about mercury management.

Water collection for mercury investigation in Lake Superior tributaries. Source: USGS.

Métis Guardians Environmental Monitoring in Ontario

Métis People in the Lake Superior basin closely connect to the natural environment. Like many other Indigenous People, Métis communities rely on the land and waters for food, medicine, spiritual fulfillment, and livelihood. The Métis Nation of Ontario (MNO) has initiated a community-based Métis Guardians environmental monitoring program. With support from the Crown-Indigenous Relations and Northern Affairs Canada and ECCC, this water quality monitoring program will help to monitor the effects of climate change and pollution on important waterbodies across the MNO. In summer of 2021, over 50 citizens from multiple rights-bearing Métis communities in 6 MNO regions were trained to monitor various water quality parameters, including pH, dissolved oxygen, temperature, and turbidity. Métis Guardians will sample waterbodies annually under

spring, summer, and fall conditions. Monitoring locations in Lake Superior include the Black Bay, Red Rock Bay, Jackfish/Moberly Bay, St. Marys River, and Garden River. In 2022-23, water from all sites will be analyzed to determine methylmercury concentrations. Minnows from the Black Bay and Garden River sites will also be analyzed for mercury bioaccumulation. The data from this program will help the MNO advocate for better environmental protection when engaging proponents of future development projects and build and contribute to long-term databases to assess how climate change is affecting the health of the waters over time. To learn more, visit MNO's Lands, Resources & Consultations' Current Activities page.

MANAGING NUTRIENTS AND ALGAE

Lake Superior beaches and nearshore areas provide good opportunities for swimming and recreational use. However, an emerging concern is an increasing frequency of small, short-lived algal blooms, especially on the southwest shore in Wisconsin. This increase in algal blooms is thought to result from warmer lake temperatures and changing precipitation patterns, including an increased frequency of intense storms. Current management actions include research to understand historical and current nutrient conditions in Lake Superior and to identify the conditions and locations for potential algal blooms. One such project is described below.

Addressing Lake Superior Algal Blooms in Wisconsin

Lake Superior has experienced some small, short-lived cyanobacterial blooms in recent years. There is concern by many communities that a perception of increasing frequency of algal blooms could impact summer tourism and that blooms could potentially impact public health. A science priority in the Lake Superior LAMP is analyzing the causes and effects of the algal blooms on the lake. A Lake Superior Partnership Algal Bloom Sub-committee, comprised of states, the province of Ontario, tribes, academics, and federal agencies, is advancing the understanding of algal blooms in Lake Superior.

In 2021, several partners participated in an effort to obtain baseline water quality data from the surrounding watershed to the offshore waters along Wisconsin's shoreline to investigate conditions supporting algal bloom formation. The USGS sampled water quality in streams to characterize nutrient and sediment movement from the watershed before and after a storm event and to document the timing and magnitude of the biological response from a storm. The Wisconsin Department of Natural Resources (WDNR) measured physical conditions as well as nutrient levels in waters immediately adjacent to land where water depth is 5 meters before and during algal bloom events to characterize bloom supporting conditions. Finally, the EPA measured conditions and indicators of algal activity across the full nearshore zone using two autonomous gliders that measured water temperature, phytosynthetic active radiation, concentrations of chlorophyll, phycocyanin, Colored Dissolved Organic Matter (CDOM) and dissolved oxygen, as well as optical backscatter and particle size distribution, from between 10 and 100 meters water depth. These data will be used in collaborative papers as a special issue in the Journal of Great Lake Research. You can find more information regarding Lake Superior research during the 2021 field season at https://lake-superior-csmi-2021-1-umn.hub.arcgis.com/.

Collecting water samples in the nearshore of Lake Superior. Source: WDNR.

PREVENTING AND CONTROLLING INVASIVE SPECIES

Lake Superior's ecosystem continues to be dominated by native species, with fewer new aquatic non-native species finding their way to Lake Superior compared to decades past. Invasive species that have been established in the area have altered Lake Superior's ecosystem at all trophic levels and reduced the ecosystem's resilience. Creative measures, described below, are being used to combat invasive species such as Sea Lamprey.

Controlling the Sea Lamprey population in Lake Superior

The Sea Lamprey is a parasitic, jawless invasive fish that, if left unmanaged, will again devastate the populations of many fish species in the Great Lakes. In particular, Sea Lamprey contributed to the collapse of Lake Superior Lake Trout populations in the mid-twentieth century. The Great Lakes Fishery Commission (GLFC), in cooperation with Fisheries and Oceans Canada, the U.S. Fish and Wildlife Service, the USGS, and the U.S. Army Corps of Engineers, currently operates a Sea Lamprey control program. This program in Lake Superior has resulted in an estimated 90% reduction in Sea Lamprey populations. At the same time, Figure 1 below illustrates that the Adult Sea Lamprey index target is not being met, mostly because in some areas, populations are sparsely distributed and lampricide treatments are less effective. Work continues to suppress Sea Lamprey to population levels that cause insignificant mortality in adult Lake Trout. In 2021, 16 tributaries and 7 embayments were treated with lampricides, killing Sea Lamprey larvae in streams but causing minimal impact to other fish. Other control techniques applied in Lake Superior include barriers to Sea Lamprey migration in 18 tributaries and trapping to remove Sea Lamprey from rivers before spawning. To learn more about Sea Lamprey and schedule and location for lampricide treatments, please visit Great Lakes Fishery Commission - Sea Lamprey.

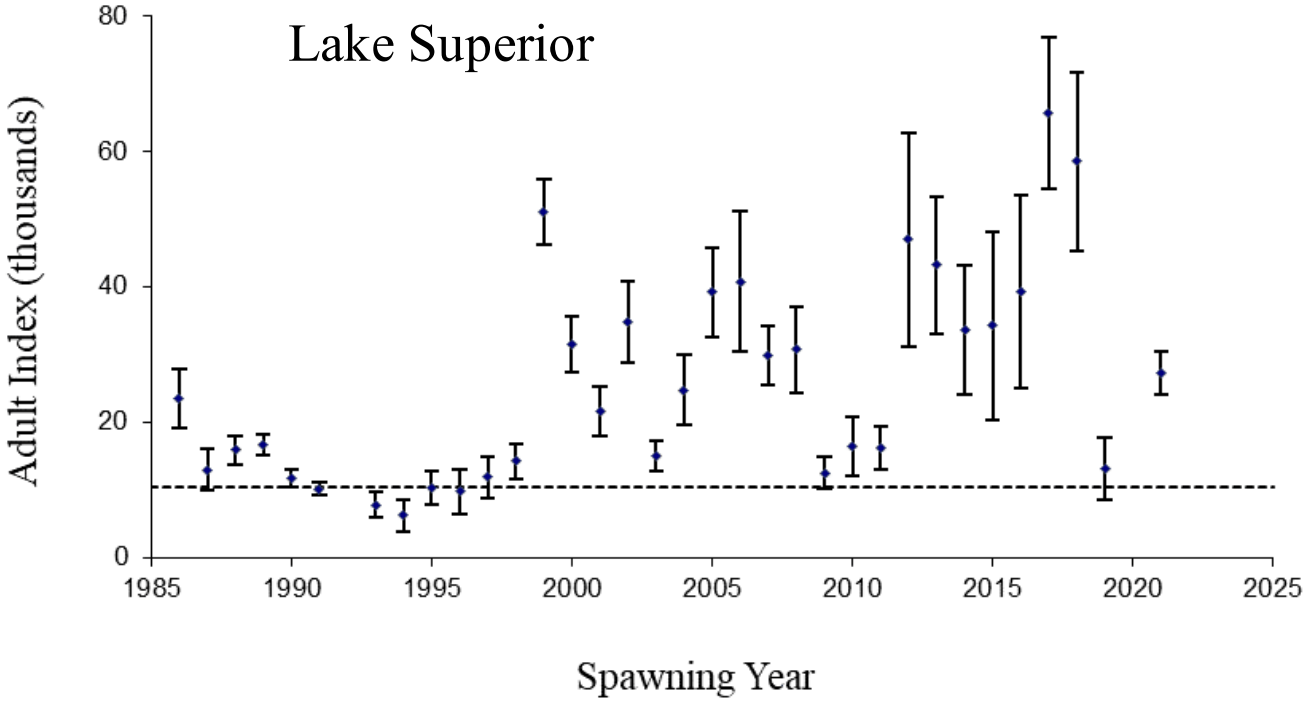


Figure 1. Sea Lamprey population indices for Lake Superior represented on the Y axis. The horizontal line represents the population target. Source: GLFC.

PROTECTING AND RESTORING HABITAT AND NATIVE SPECIES

Many intact, high-quality habitats, including abundant coastal wetlands, are found in the Lake Superior ecosystem. Hard infrastructure in the watershed, such as dams and parking lots, alter habitats and can negatively affect water quality, native species populations, and resiliency to climate change impacts. Current management actions like the projects below will help protect and restore Lake Superior's habitats and species.

Francis Hilb Preserve in Goulais Bay, Ontario

The 9-acre Francis Hilb Preserve is a rare fen-type wetland in Goulais Bay, Ontario, protected for perpetuity as one of the Lake Superior Watershed Conservancy's land trust properties. In 2021, with funding from the Ontario Ministry of the Environment, Conservation and Parks, a boardwalk across the wetland was completed to provide a link between protecting the many plants, insects, fungi, birds, and animals, and providing the public an opportunity to learn, appreciate and care about Great Lakes wetlands. Interpretive signs explain the Indigenous community's historical and cultural perspective on the importance of protecting Goulais Bay, also known as *Chi Wehn Kwe Dohn* "The Place that Hugs You". Gaining a better understanding of the importance of Lake Superior's habitats and species helps ensure these biodiverse, high-quality habitats can be protected and passed down to future generations. To learn more about Francis Hilb Preserve, please visit https://www.superiorconservancy.org/francis-hilb-preserve.

Children exploring the Francis Hilb Reserve. Source: Ryan Walker, Forest the Canoe.

Ontonagon River Dam Removal in Michigan

Dams and barriers disrupt connectivity for aquatic organisms and impede streamflow, the movement of woody debris, sediment, and nutrients that are vital to the health of nearshore ecosystems. At the same time, dams and barriers can also prevent the spread of invasive species (e.g., Sea Lamprey, Gobies, Ruffe, Rusty Crayfish, etc.) and protect native species like Brook Trout in their riverine habitat from predation by naturalized Salmonids such as Rainbow Trout. In 2021, the Michigan Department of Natural Resources (MDNR) and the Michigan Department of the Environment, Great Lakes and Energy completed a project to restore the natural connectivity of a lower Ontonagon River coastal wetland by removing a 1960s-era water control dam. This dam prevented fish movement within the estuary, a critical habitat for fish (including Lake Sturgeon) to complete their lifecycle.

Restoring natural connectivity of a lower Ontonagon River coastal wetland through dam removal. Source: MDNR.

Restoring Wildlife Habitat in Thunder Bay, Ontario

During the twentieth century, contamination from the forest products industry, waste disposal, urbanization, and changes to the watershed led to degraded water quality and environmental health in Thunder Bay, Ontario. In 1987, Thunder Bay was designated as an Area of Concern (AOC) under the GLWQA. Since then, actions taken under the Remedial Action Plan (RAP) have improved water quality and ecosystem health. One such action, the *Thunder Bay Area of Concern Wildlife Habitat Strategy,* prioritizes projects to meet habitat restoration targets for the AOC and has improved fish and wildlife habitat in coastal and riparian areas. Projects include the creation of 10 hectares (25 acres) of riparian habitat along the McIntyre River, the revitalization of 2.1 hectares (5.1 acres) of aquatic habitat along the Kaministiquia River and Neebing-McIntyre

floodway, restoration of 1 kilometer (0.6 miles) of riparian habitat along McVicar Creek, revitalization of a brownfield site at the mouth of the Current River, and improvements to a fish passage between Thunder Bay and a 50 kilometer (31 mile) segment of cold-water spawning habitat upstream in the Current River. ECCC is supporting these projects through funding under its Great Lakes Protection Initiative.

Restoring Wildlife Habitat in the St. Louis River, Minnesota, and Wisconsin

The St. Louis River Area of Concern is one of the 31 U.S. AOCs pursuant to the GLWQA. Draining 3,634 square miles (9,412 square kilometers) of the watershed and encompassing a 1,020 square-mile (2,641 square kilometers) area, the St. Louis River AOC is the second largest AOC in the U.S. The watershed includes Superfund sites, large ship slips, critical wildlife habitat, and Spirit Lake - a place with spiritual significance to the Fond du Lac Band of Lake Superior Chippewa.

Before the onset of modern pollution laws, historical industrial and municipal discharges to the river resulted in sediments contaminated with mercury, dioxins, PCBs, polycyclic aromatic hydrocarbons, and other heavy metals. Early development of Duluth, MN, Superior, WI, and their shipping harbors resulted in the loss or degradation of thousands of acres of aquatic habitat. Habitat restoration in Minnesota and Wisconsin is, therefore, an essential component of the St. Louis River AOC's Remedial Action Plan. The restoration of nesting habitat for Common Terns on Interstate Island and Piping Plovers on Wisconsin Point has already been completed. Restoring various aquatic habitats, including wetlands, has been completed at these project sites: Radio Tower Bay, Grassy Point, 21st Ave West, 40th Ave West, Kingsbury Bay, Chambers Grove, and Hog Island. The Knowlton Creek and Little Balsam Creek projects have restored fish passage and cold-water stream habitat, while the Wisconsin Point project restored and protected dune habitat. Eight more habitat projects are slated for completion by 2026.

Details about each completed and pending project may be found in this story map.

Each project has its combination of habitat improvement goals. The projects include:

- capping or removing low-level sediment contamination;
- removing wood, sediment, and invasive species;
- restoring wetlands, shorelines, and hydrologic connectivity; and
- adding different depths and restoring fish, bird, and benthic habitats.

Another significant component of the St. Louis River AOC habitat restoration strategy is to restore Manoomin (wild rice). Until recently, only a few remnant Manoomin beds were found in the 12,000-acre (4,856 hectare) St. Louis River Estuary. Historically, it may have sustained 2,000 to 3,000 acres (809 to 1,214 hectares) of Manoomin, but over the past 125 years, industrial development, pollution, and logging decimated it. Manoomin is a vital nutritional grain and holds important cultural significance for indigenous people, a key food source for waterfowl and other wildlife, and a provider of important wetland habitat. Manoomin also keeps the water clean by cycling nutrients and holding sediments in place. A comprehensive restoration plan was first developed in 2014 by many partners including tribes, state agencies and non-governmental organizations. The plan is currently being updated to build upon recent successes in restoring Manoomin beds. Thousands of pounds of Manoomin have been seeded in the past eight years to begin establishing self-sustaining Manoomin beds at priority sites. Restoration strategies include site preparation, invasive species management, and goose herbivory control, along with annual monitoring to measure changes in Manoomin density and acres. The AOC restoration project is beginning to see an increase in density and coverage of Manoomin and plans to continue restoration efforts through 2024. Interpretive signage has been installed at boat landings throughout the estuary to highlight the ongoing project.

Once completed, these habitat projects will enhance, rehabilitate, and protect against further habitat loss in the estuary.

OUTREACH AND ENGAGEMENT

GLWQA Engagement Opportunities

The Lake Superior Partnership agencies held a *Let's Talk Lake Superior* public webinar in 2022 on algal blooms. You can keep up to date on future public webinars and other GLWQA engagement opportunities in the Engagement section of Binational.net. You can find information on many of our partner organizations' upcoming outreach and engagement opportunities in the Great Lakes Commission's "Great Lakes Calendar."

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