LAKE HURON

LAKEWIDE ACTION AND MANAGEMENT PLAN

2022 ANNUAL REPORT

Bruce Peninsula. Source: Parks Canada.

In this Issue

What is the Lake Huron LAMP?

Under the 2012 Great Lakes Water Quality Agreement (GLWQA), the governments of Canada and the United States committed to restore and maintain the physical, biological and chemical integrity of the waters of the Great Lakes.

The Lake Huron Lakewide Action and Management Plan (LAMP) is an ecosystem-based strategy for protecting and restoring the water quality of both Lake Huron and the St. Marys River, a connecting river system. The Lake Huron Partnership, led by the U.S. Environmental Protection Agency (U.S. EPA) and Environment and Climate Change Canada (ECCC), develops and implements the LAMP and facilitates information sharing, priority setting and coordination of binational protection and restoration activities.

OVERVIEW

Over the past year, the Lake Huron Partnership agencies have cooperated to protect and restore the lake's water quality through targeted actions and programs. These actions include development of the 2022-2026 Lake Huron Lakewide Action and Management Plan (LAMP) and planning for, and completing, the 2022 intensive field year of the Cooperative Science and Monitoring Initiative.

Members of the Lake Huron Partnership also participated in the 2022 Great Lakes Public Forum and engaged the public in discussing the state of the Great Lakes, progress achieved under the GLWQA over the past three years and priorities that will guide the science and actions for the next three years.

The overall state of Lake Huron continues to be assessed as in fair condition based on the nine general objectives as they relate to the State of the Great Lakes indicators, and the trend is unchanging. The lake is a source of high-quality drinking water, with beaches and nearshore areas continuing to provide opportunities for swimming and recreational use. Continued action is necessary to prevent and address threats to water quality and ecosystem health. In the following sections of this annual report, the Lake Partnership provides updates on activities to reduce chemical contamination, manage nutrients and algae, prevent and control invasive species, restore and protect habitat and species and address climate change challenges.

Lake Huron Shoreline. Source: Emma Kirke.

REDUCING CHEMICAL CONTAMINATION AND POLLUTION

Lake Huron continues to be a good source of high-quality drinking water. Levels of toxic chemicals are assessed as good, and long-term trends indicate that concentrations are declining in Lake Huron. Concentrations of toxic chemicals in fish filets are also declining or remaining stable. Although concentrations of toxic chemicals in Lake Huron fish improved during the 1970s and 1980s, slower improvements have been observed over the past decade. This slowdown is attributed to disturbances in the food web structure of Lake Huron due to invasive species. Lake Huron fish continue to be a nutritious food source. However, restrictions on the consumption of certain fish species continue to be in place, with PCBs being the prime contaminant responsible for the fish consumption advisories. New and emerging chemicals or pollutants such as per- and poly-fluoroalkyl substances (PFAS) are a growing concern to Lake Huron. Efforts to reduce the impacts of chemicals in Lake Huron are continuing through activities that reduce lakewide pollutants in Areas of Concern (AOCs) and by implementing binational strategies for Chemicals of Mutual Concern. The Partnership supports outreach and engagement efforts to inform communities around the lake and raise awareness of the actions the public can take to reduce chemical releases and exposure to these contaminants.

Managing Contaminated Sediment in the St. Marys River AOC

The St. Marys River was designated as an AOC due to historical degradation caused by industrial pollution, insufficiently-treated municipal and private sewage, contaminated stormwater runoff, and habitat alteration. Though the sources of pollution to the river have been largely controlled, the long legacy of pollution to the river has left residual effects on the environment, including degraded sediment quality. In late 2021, the Remedial Action Plan (RAP) Team developed a Contaminated Sediment Management Strategy for the Canadian section of the St. Marys River AOC. Taking a science-based approach, the Strategy outlines current conditions and appropriate actions required to manage contaminated sediment in the connecting river system. Such actions include remedial dredging in the local steel mill's boat slip to remove contaminants from the waterway; monitoring recovery within the riverbed/water lot owned by Transport Canada to confirm improvements over time; and preventing additional accumulation, sediment disturbance and/or re-suspension of contaminants via administrative and source control measures. The Strategy is currently undergoing a community engagement process with the City of Sault Ste. Marie, local agencies, First Nations and Métis communities, stakeholders, the public, and U.S. agencies to review and provide feedback on the Strategy and its approaches for appropriately managing contaminated sediment.

Evaluating Contaminants in Lake Huron Fish and Fish-Eating Birds

The US EPA Great Lakes Fish Monitoring and Surveillance Program's (GLFMSP) latest publicly available technical reports show that whole-fish Lake Trout samples collected at the Rockport Lake Huron sites show declines of 81% in PCB concentrations since 1992, 59% decline in PBDEs since 2001, and a 35% decline in Mercury since 2006. These declines represent a success story for the many governments working around Lake Huron to reduce contaminants loadings to the lake. A GLRI-funded project led by the US FWS entitled "Assessing CMCs in Lake Huron: evaluating persistent CMCs in fish-eating birds and their fish prey." is currently ongoing. The project is collecting eaglet blood samples and herring gull eggs in known and priority PFAS locations. Data will be analyzed during 2023 and reported out shortly thereafter. The state of Michigan provides regular updates on fish consumption advisories through their Eat Safe Fish guides. These can be found at: https://www.michigan. gov/mdhhs/safety-injury-prev/environmental-health/topics/eatsafefish/brochure.

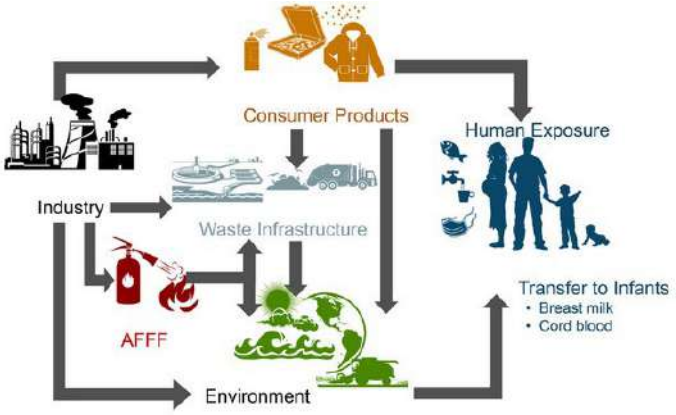
The LAMP continues to prioritize actions that will reduce chemical loadings and ultimately

reduce the contaminant burden in fish.

Lake Trout analyzed for Mercury. Source: USEPA.

PFAS: Their Presence in Consumer Products and how they reach the Environment

Canada and the U.S. designated perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and long-chain perfluorocarboxylic acids (LC-PFCAs) as Chemicals of Mutual Concern under the GLWQA in 2016. These chemicals belong to the broader family of PFAS, which includes thousands of various chemicals. PFAS have been produced and widely used since the 1950s because of their ability to resist grease, water, and oil. This group of human-made chemicals is found in many consumer, commercial and industrial products. Once in the environment, PFAS are highly persistent; consequently, remediation is challenging and expensive. With funding support from ECCC, current research tested various consumer products for PFOS, PFOA, LC-PFCAs, and other PFAS compounds. PFAS was found in some products like cosmetics, food contact materials (e.g., compostable bowls), and children's products. Cosmetics, such as waterproof mascara, liquid lipstick, foundations, and other eye products, had the highest likelihood of containing PFAS, even though PFAS were seldom listed as ingredients. Despite new regulatory restrictions on products containing PFOA and PFOS, trace amounts of these chemicals can still be found in some products and materials. Additional research seeks to better understand the magnitude of contributions from these and other sources. The Lake Huron LAMP supports actions to raise awareness and share results through various scientific publications and groups working on PFAS reduction strategies. The diagram below shows the exposure pathway of PFAS to humans and the environment.



Exposure Pathway for PFAS, Source: Miriam Diamond. The University of Toronto.

MANAGING NUTRIENTS AND ALGAE

Nutrient and algae issues in the lake continue to threaten water quality and ecosystem health, as phosphorus concentrations are deficient in the offshore waters, limiting productivity, but are high enough in some nearshore areas to cause nuisance algae growth. Beaches and nearshore areas, however, continue to provide good opportunities for swimming and recreational use; healthy watersheds and shorelines are a critical component of maintaining water quality for those many uses. The Partnership addresses nutrient and algae issues through actions, research and programs at the local, state, provincial and federal levels, focusing on Saginaw Bay and Georgian Bay.

Targeted Nutrient Reduction in Bad Axe Creek

Bad Axe Creek, a major tributary of the Pinnebog River flowing into Saginaw Bay, with a watershed area of 30 square miles (78 square kilometres), was placed on Michigan's list of impaired waterways in 2014 due to high pathogen and nutrient levels. With funding support from Michigan's Department of Environment, Great Lakes, and Energy, the Huron County Conservation District and their partners developed a septic system database to identify

high-risk septic systems, provided technical and cost-share assistance to agricultural producers who agreed to install best management practices, and conducted outreach and education efforts. Over the 2016 to 2019 timeframe, cover crops were planted on 5,025 acres (2034 hectares), tillage practices were improved on 4,100 acres (1659 hectares), and nutrient management was implemented on 918 acres (376 hectares). These practices resulted in an average annual reduction of 3,100 tons (2812 metric tonnes) of sediment, 4.1 tons (3.7 metric tonnes) of nitrogen, and 2.6 tons (2.4 metric tonnes) of phosphorus for each of the three years, improving overall water quality in Bad Axe Creek. This project supports efforts to address the impairments on Bad Axe Creek and contributes to the implementation of priority actions identified in the Lake Huron LAMP.

Implementing Best Management Practices (BMPs). Wheat stubble field after harvest. Past Practice would be to chisel plow; the field would lay uncovered all winter (Top). Uncovered soil would lead to wind and water erosion with sediment and nutrient loading to adjacent water bodies. Same field with a winter cover crop of clover established (Bottom). Practice will reduce wind and water erosion, sediment and nutrient loading and provide a nitrogen source for next season's corn crop. Source: EGLE.

Stream and Riparian Restoration to Reduce Phosphorus & Bacterial Pollution in Georgian Bay

The Nottawasaga River is the largest tributary of Georgian Bay. It flows 150 km (93 miles) from the Niagara Escarpment World Biosphere Reserve to Lake Huron through a primarily rural watershed with some large and growing urban areas such as Barrie, Ontario. Land use is dominated by agriculture. Healthy reaches of the river flowing out of the Niagara Escarpment first become impacted by land use practices in the agricultural Simcoe Lowlands. With support from ECCC EcoAction Community Funding Program, the Nottawasaga Valley Conservation Authority (NVCA), the Nottawasaga Futures South Simcoe Streams Network, along with local landowners, environmental groups, municipalities, private businesses, foundations, and federal and provincial government agencies targeted cold waters areas of the river for restoration. Efforts focused on improving water quality and aquatic habitat for sensitive cold water stream dwellers like trout and mayflies. In 2021, 570 meters (1870 feet) of eroding riverbank were stabilized using natural channel restoration techniques, including re-grading the banks, installing woody materials, and planting native riparian vegetation. The bank stabilization work reduced sediment erosion into the water, decreasing phosphorus inputs. A river realignment project, also completed in 2021, diverted water away from eroding banks and back into proximity to healthy forest cover, restoring and enhancing 70 meters (230 feet) of trout spawning habitat. Monitoring by NVCA in 2022 is being used to measure the effectiveness of this habitat restoration in improving the cold water fish community and native fish populations within the river.

Before and after photos of bank stabilization, river restoration and channel realignment in Nottawasaga River. Source: NVCA.

PREVENTING AND CONTROLLING INVASIVE SPECIES

Over 100 non-native species have become established in Lake Huron, causing direct and indirect impacts to the ecology and water quality of the basin. Once established, invasive fish, plants, and other organisms are very difficult to eradicate. Aquatic Invasive species such as Sea Lamprey and Round Goby negatively affect native fish species by causing physical injury and/or outcompeting them for food and habitat. Efforts to detect, eradicate, and control invasive species are ongoing.

Design and Construction of the Au Gres and Au Sable Rivers Sea Lamprey Traps

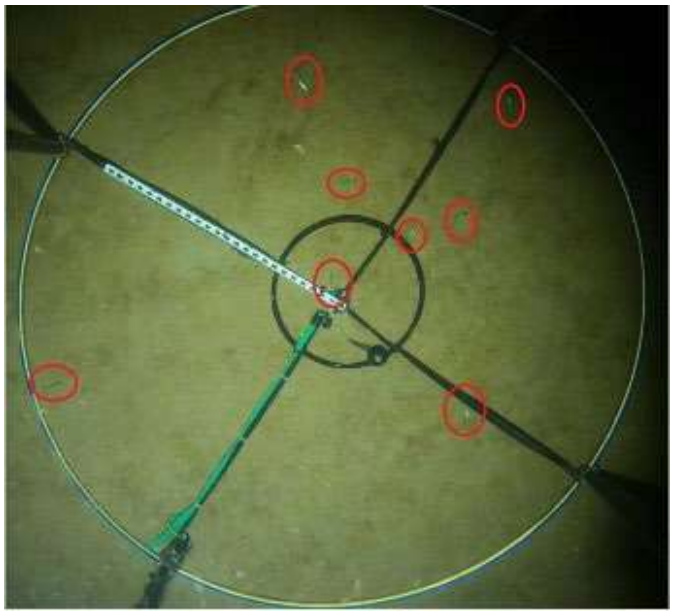
Sea lampreys (*Petromyzon marinus*) are parasitic fish native to the Atlantic Ocean. They attach to fish and suck their blood and other body fluids. Niagara Falls historically served as a barrier to Sea Lamprey accessing lakes Erie, Huron, Michigan, and Superior. In the late 1800s to early 1900s, navigation improvements to the Welland Canal bypassed Niagara Falls, creating a direct shipping connection to the rest of the Upper Great Lakes. Before control methods were implemented, sea lamprey killed more than 100 million pounds of Great Lakes fish annually, five times the commercial harvest in the upper Great Lakes. Over the past 20 years, Sea Lamprey control has reduced populations by more than 90% and has allowed for the rehabilitation of a healthy Great Lakes ecosystem. Continued Sea Lamprey control is critical to keeping the number of sea lamprey down, with the use of Sea Lamprey traps being an effective control tool. The U.S. Army Corps of Engineers, in cooperation with the Great Lakes Fishery Commission, the Michigan Department of Natural Resources, and the U.S. Fish and Wildlife Service, are constructing Sea Lamprey traps in the Au Gres and Au Sable Rivers in Michigan. Traps are carefully designed to capture either juvenile sea lampreys as they migrate from tributaries to the open lake to prey on fish or adult sea lampreys as they return to tributaries to spawn. Construction on the Au Gres Sea Lamprey trap is anticipated to be completed in late 2022. The Au Sable Sea Lamprey trap is currently in the design phase, with an anticipated construction completion date of 2024. Sea Lamprey traps on the Au Gres, and Au Sable Rivers will further limit the number of Sea Lamprey accessing the Great Lakes and spawning habitat in the Lake Huron watershed. For additional information on Sea Lamprey control in the Great Lakes, please see the Great Lakes Fishery Commission website.

Top: A Sea Lamprey Trap. Below: The construction activity taking place to prepare the site for Sea Lamprey trap installation. Source: USACE.

Monitoring and Assessing Round Goby Populations

Round Goby is an invasive species of fish that has spread throughout the Great Lakes since it was first detected in 1990. This small, bottom-dwelling fish has significant ecological effects on the Great Lakes fish populations, including competing with native species for food, habitat, and resources. Estimating the population of Round Goby in the Great Lakes is essential for understanding their ecological impact. However, it is also challenging as the small size and bottom-dwelling nature of Round Goby make them difficult to catch with traditional nets. In August 2021, the Ontario Ministry of Natural Resources and Forestry's (MNRF) Upper Great Lakes Management Unit ran a pilot project to estimate the population of Round Goby in Owen Sound, using a deepwater electrofisher (which employs an electric current to sample fish) and underwater camera to evaluate the utility and feasibility of this un-tested method. Underwater cameras are a relatively new and inexpensive tool for studying Round Goby population size and behaviour. For this study, a GoPro camera was attached to a deepwater electrofisher. The shock of the electrofisher caused the Round Goby to move, making these well-camouflaged fish easier to see on the lake bottom in the video footage. In 1000 video clips, researchers counted 1500 Round Goby, most of which were observed on rocky substrates at depths of 5-20 metres (16-66 feet). The findings estimated that a population of 144 million Round Goby exists in the 120 square kilometres (46 square miles) area of Owen Sound. Deepwater electrofishing is a labour intensive but effective method for estimating Round Goby population densities in nearshore areas with high water clarity. This method can be considered in situations where more accurate Round Goby densities are required.

A lakebed camera image used to count Round Gobies (red circles) seen moving with the application of a shock from the deepwater electrofisher. Source: MNRF.



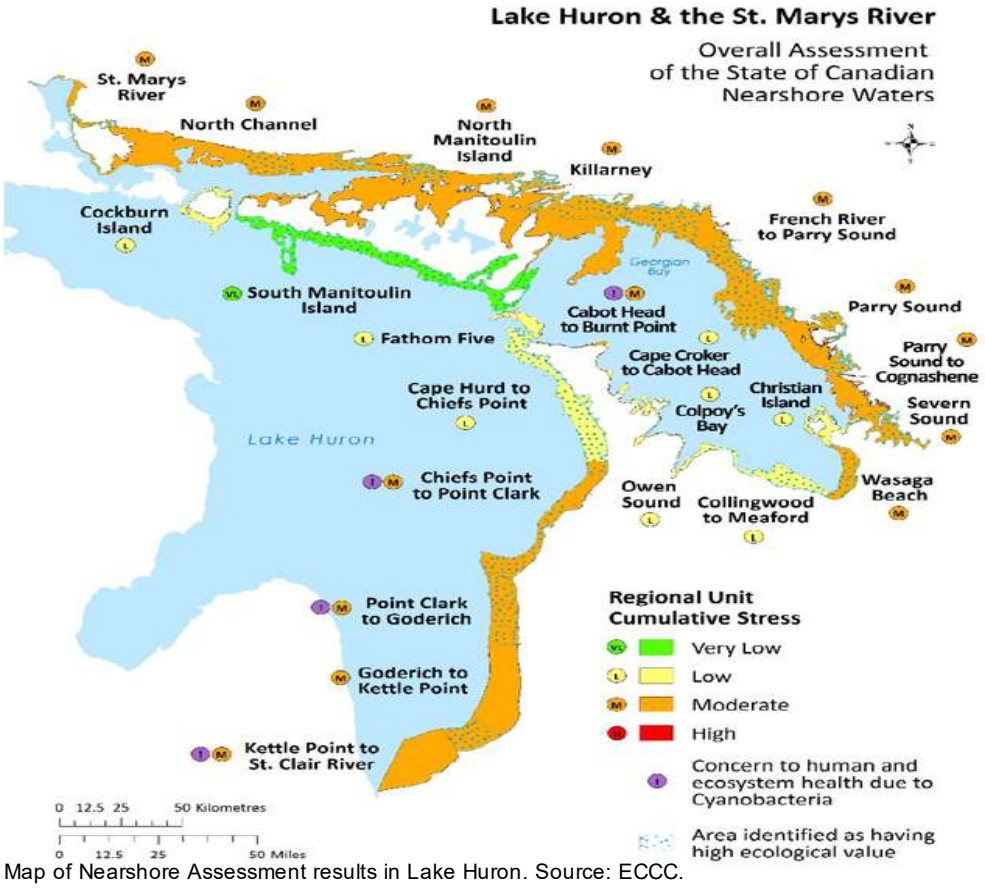
Monitoring equipment for the underwater camera used to count Round Goby and estimate the population in the lake. Source: MNRF.

PROTECTING AND RESTORING HABITAT AND SPECIES

Many intact, high-quality habitats, including many coastal wetlands, are found in the Lake Huron ecosystem. Hard infrastructure, such as retaining walls, dams and parking lots, degrade habitats and can negatively affect native species populations, biodiversity, and resilience to climate change. Continued efforts to assess, protect and restore habitat are important for improving and maintaining water quality and ecosystem health.

Nearshore Assessment for Lake Huron

In 2021, Environment and Climate Change Canada completed a cumulative assessment of Canadian nearshore waters of Lake Huron and the St. Marys River to identify areas subject to high stress and areas of high ecological value. The results are used to help to establish priorities for nearshore prevention, restoration and protection measures. Overall, the assessment indicates that Lake Huron's nearshore waters are under low or moderate cumulative stress from impaired coastal processes, nuisance and harmful algae, human use restrictions, and contaminants in water and sediment. The assessment highlights major and potential threats to Lake Huron's nearshore waters and identified fifteen areas of high ecological value across Lake Huron. In the main basin, from Chiefs Point to the St. Clair River, coastal processes are impaired due to poor tributary connectivity, shoreline alteration, and barriers that restrict natural sediment transport. The nearshore area from MacGregor Point to Goderich was identified as an area of high ecological value because active erosion of gullies and shore bluffs provide sand that maintains beaches at Pinery Provincial Park, Port Franks, and Ipperwash. However, stress on these processes – combined with the impacts of a changing climate – presents significant threats to ecosystem function and resiliency. The assessment results also reveal that nuisance algae are a source of stress from Cape Hurd to the St. Clair River, where Cladophora is known to wash up on beaches and foul the shoreline. Satellite-derived mapping indicates that nuisance algae may also be a source of stress in southern Georgian Bay but requires field verification. Efforts to improve shoreline mapping and better understand the impact on the nearshore from climate change are underway through collaborations with the Maitland Valley and Ausable Bayfield Conservation Authorities. These efforts include public engagement workshops on coastal resilience and watershed restoration efforts, including streambank stabilization and barrier removal projects. Such activities will ultimately improve nearshore water quality and ecosystem health. For more information, visit [Lake Huron Canadian nearshore assessment : 2021 highlights report](#).



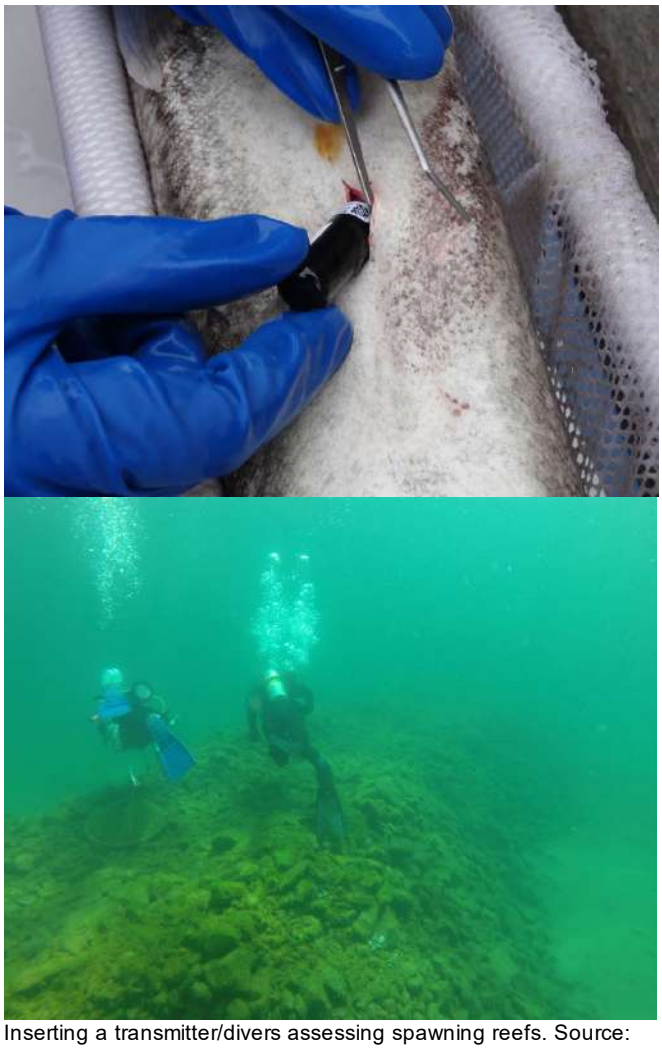
Map of Nearshore Assessment results in Lake Huron. Source: ECCC.

Grand Bend, **Lake**

Trout Acoustic Telemetry to Assess Spawning Success on Artificial Reefs

In 2010-2011, 24 large reefs 5-10 feet high, 20 feet wide, and 75 feet long (1.5-3 meters high, 6 meters wide and 23 meters long) were constructed using quarried rock in Thunder Bay, Lake Huron, near Alpena to assess whether artificial reefs will be used in the near-term or long-term by stocked and wild Lake Trout. Restoration of self-sustaining populations of lake trout has been a goal of Great Lakes resource managers since most populations disappeared from the lakes in the 1960s. Current populations are supported by stocking and protected by fishing regulations and sea lamprey control, but reproduction by stocked fish has been limited. The degradation of lake trout's spawning habitat may have a significant role in the failure of lake trout to reproduce. Reefs in most of the shallow, nearshore areas of the Great Lakes have been fouled by sediments and colonized by zebra mussels, quagga mussels, and Round Goby. As a result, lake trout are less likely to spawn on these sites, eggs are less likely to survive over the winter, and predation on eggs and hatched fry has increased. One strategy to enhance reproduction is to increase the availability of high-quality spawning substrates by building artificial reefs in Lake Huron.

An intensive study of the artificial reefs between 2012 and 2014 indicated that lake trout were spawning on the reefs, and that the reefs were remaining intact and in good shape. Lake trout slowly 'adopted' the new reefs for spawning, but most of them also returned to spawn on a nearby natural reef (East Reef) each year. How lake trout find the reefs and which lake trout (stocked fish or their wild offspring) spawn on the reefs remain unanswered questions. Lake trout may be 'loyal' to reefs they already know so that new reefs may be colonized by young fish with no previous spawning experience or familiarity with a 'traditional' spawning site. If this is the case, complete colonization of artificial spawning reefs could take over a generation. Alternatively, younger lake trout may take cues from older fish who have found a reef, so spawning populations would increase even more slowly as new reefs gradually become populated. Researchers from the University of Vermont, Hammond Bay Biological Station, and Michigan Department of Natural Resources who designed and studied the artificial reefs ten years ago returned to the reefs in 2021 to re-evaluate how they are being used now, more than a generation since their construction. The alternate hypotheses that the colonization of novel spawning habitats occurs primarily by young fish without previous spawning experience or by a gradual increase in the 'popularity' of the reefs relative to historically-used nearby habitats will also be tested. In 2021, 60 stocked and naturally-produced lake trout were tagged with acoustic transmitters. Over the next three years, the researchers will observe changes in the use of the artificial reefs and determine what reefs the younger generation of lake trout is choosing for spawning areas relative to the older fish.



Inserting a transmitter/divers assessing spawning reefs. Source: Michigan DNR.

OUTREACH AND ENGAGEMENT

The Lake Huron Partnership held two *Let's Talk Lake Huron* public webinars in 2022, including one on protecting Lake Huron fish and wild rice (Manoomin) and a second on managing nutrients and nuisance algae. You can keep up to date on GLWQA engagement opportunities in the Engagement section of Binational.net. Information on our partner organizations' upcoming outreach and engagement opportunities can be found in the Great Lakes Commission's "Great Lakes Calendar".

CONTACT INFORMATION

For more information, please visit Binational.net or contact:

In Canada:
Paul Parete
Environment and Climate Change Canada
ec.grandslacs-greatlakes.ec@canada.ca

In the United States:
Elizabeth LaPlante
U.S. Environmental Protection Agency
LaPlante.Elizabeth@epa.gov

Cheboygan Lighthouse. Source: Rainer Grosskopf.

Implementing the 2017-2021 Lake Huron LAMP

SPECIAL INSERT - LAKE HURON LAMP 2022 ANNUAL REPORT

2022 ANNUAL REPORT

Bruce Peninsula. Source: Parks Canada

Lake Huron and Lakewide Management

Lake Huron is the third largest Great Lake by volume, consisting of four distinct but interacting water bodies (Main Basin, North Channel, Georgian Bay, and Saginaw Bay). Its watershed, the largest of the Great Lakes, contains rich boreal and mixed hardwood forests, productive agricultural lands, extensive recreational areas, and over thirty thousand islands. It is a source of inspiration, rejuvenation, and discovery to its visitors and residents. The lake still has relatively-intact fisheries, wildlife, and habitat. Based on the 2022 assessments of the nine State of the Great Lakes indicators, the overall status of the Lake Huron basin ecosystem is rated as “good”, with the trend assessed as “unchanging”. Although the lake ecosystem is relatively healthy, protection, conservation, and restoration actions are essential to address existing environmental issues and prevent future problems. The lake's water quality is dependent on the health of the entire watershed and is affected by five major threat categories: chemical contamination, nutrient and bacteria pollution, invasive species, habitat destruction and other stressors. These other multiple stressors, including the impacts of climate change, limit the health, productivity, and use of the lake.

Through cooperation and collaboration, all stakeholders can collectively take action to restore and protect the valuable ecosystem of Lake Huron.

2017-2021 LAKE HURON LAMP IMPLEMENTATION

This insert highlights the significant actions implemented through the 2017-2021 LAMP to address environmental threats to Lake Huron’s water quality and ecosystem health. The LAMP is guided by the shared vision of a healthy, prosperous, and sustainable Great Lakes region in which lake waters are used and enjoyed by present and future generations. The Partnership has been growing: during the period of the current LAMP, Lake Huron Partnership membership increased by almost 25%. This growth has enabled the partnership to undertake more actions and to work in cooperation with local groups, some of whom are among the most knowledgeable and influential organizations in helping to protect and restore Lake Huron

This special insert to the Lake Huron LAMP 2022 Annual Report provides examples of projects and actions that are delivering on commitments in the 2017-2021 LAMP. In summary there was:

Participation from **23** Lake Huron Partnership agencies, along with over **130** organizations and communities;

Implementation of **43** priority LAMP actions to reduce chemical contamination, manage nutrient and bacterial pollution, prevent and control invasive species, protect and restore habitat and native species, and reduce climate change impacts; and

Completion of **240** projects, including:

- **56** Remediation or restoration projects;
- **38** Preventative actions;
- **80** Monitoring, research, or modelling Projects conducted; and
- **66** New reports, workshops and other Outreach materials or events.

REDUCING CHEMICAL CONTAMINATION

Chinook Salmon Sport Fishing in Lake Huron. Source: Fred Dobbs, NVCA.

Concentrations of toxic chemicals in fish are lower in Lake Huron than in the other Great Lakes, with long-term trends indicating that concentrations are declining. However, fish consumption advisories are still necessary, mainly due to mercury and polychlorinated biphenyls (PCBs). Through the implementation of the LAMP, partners successfully supported chemical contaminant remediation efforts, worked with scientists and Great Lakes experts to improve our understanding of chemical concentrations and cycling in the lake and raised public awareness of emerging chemical issues through educational events, webinars, and community-based monitoring. ***Actions*** implemented include the following:

Chemical Contaminant Remediation

Lake Manitou Area Association and Little Current Fish and Game Club helping install fencing, shrubs, and trees at Green Bay Creek. Source: Seija Deschenes.

.

A coalition of federal, state and local partners, including the U.S. Environmental Protection Agency, the Michigan Department of Environment, Great Lakes and Energy, the City of Flint, Genesee County Land Bank Authority (GCLBA) and Genesee County Parks, have completed targeted cleanups across the Flint, Michigan waterfront to reduce contamination, fill old drains and sewers, and install a soil and vegetative green "cap" over the contaminated area. With support from the Great Lakes Restoration Initiative (GLRI) and the United States Forest Service, over 3,300 trees were planted across 38 acres (15 hectares) of the Chevy Park waterfront site to prevent the mobilization of contaminated sediments. As a result, these efforts have reduced runoff into the Flint River, improved soil and groundwater quality, and slowed the movement of contaminated groundwater. The community now has more economic, social, and cultural opportunities, benefits, and improved quality of life through cleaner air, land, and water. For more information, visit Flint Waterfront Restoration.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) continued to work with the EPA on efforts to clean up dioxins in the Tittabawassee River system. Clean-up activities were completed along 14 miles (22.5 km) of the river and floodplain. These activities continue into the Saginaw River and Saginaw Bay portions of the Superfund site. In 2017 and 2018, clean-up activities focused on the river's lower reaches, resulting in the restoration of approximately 5 miles (8 km) of the river and bringing the cumulative total volume of remediated sediments and floodplain deposits to approximately 170,000 cubic yards

(129,974 cubic meters). Efforts are underway to implement remedial actions for the last 7 miles (11 km) of the Tittabawassee River, including capping and bank stabilization.

Addressing Chemical Contaminants through Monitoring and Innovative Approaches

With support from the GLRI and the Great Lakes Protection Initiative, the United States and Canada continued to work with partners using a science-based adaptive management approach to investigate complex scientific issues affecting the lake. In 2017, ECCC undertook a lakewide survey to determine contaminant levels in sediment. Legacy contaminants, such as mercury, and new and emerging chemicals, such as flame retardants, were investigated. Results found that concentrations were low for most contaminants across the entire lake. Mercury concentrations in Lake Huron in fact, are generally the lowest of the Great Lakes and continue to decline.

Partnership agencies continued to increase the public's knowledge of the risks and benefits of fish consumption. In Michigan, fish consumption advisories were reviewed, updated, and made available through Michigan's Eat Safe Fish guide. The guide provides advice to help protect everyone who eats fish regularly. The contaminants reviewed include mercury, halogenated organic contaminants, dioxin, PCBs, and per- and polyfluoroalkyl substances (PFAS). The current advisory for Lake Huron carp is "Do Not Eat" due to PCBs and dioxins. The guidance for catfish, Lake Trout over 24 inches long, and White (Silver) Bass from Lake Huron is "Limited," which means that children under age 15 and those with certain health conditions should avoid eating these fish, and others should limit consumption to 1-2 times per year. To help you and your family make safe meal choices, visit www.michigan.gov/eatsafefish.

To address the emerging issue of plastics pollution, an innovative and collaborative initiative supported by ECCC's Great Lakes Protection Initiative demonstrated that adding after-market filters to washing machines is highly effective at capturing and reducing microfibers that shed from clothes during laundering. It is estimated that 934 million to 14.1 billion microfibers could be diverted from wastewater treatment plants annually, based on the 97 households in the Georgian Bay area participating in this study. It may also reduce the release of some Chemicals of Mutual Concern (e.g., PBDEs) to Lake Huron and other local waterbodies. For details about the study, see Washing Machine Filters Reduce Microfiber Emissions.

Educational tour of Bass Lake Creek provided by Lake Manitou Area Association to schoolchildren. Source: Seija Deschenes.

MANAGING NUTRIENTS AND BACTERIAL POLLUTION

Most areas of Lake Huron are not impacted by excessive nutrients (phosphorus and nitrogen) that lead to nuisance or harmful algal blooms and bacterial pollution that make beaches unsafe. However, localized nutrient and bacterial pollution is an ongoing issue impacting some areas of the southeastern shore, namely Saginaw Bay and eastern Georgian Bay where periodic harmful or nuisance algal blooms occur. Climate change has also exacerbated nutrient and bacterial pollution due to increased and more severe storm events, leading to increased runoff and flooding.

Partner agencies continued to address point source pollution by enforcing permitted discharges and accelerating the implementation of green infrastructure practices in shoreline cities. Agencies have implemented watershed management plans to reduce untreated stormwater runoff to the nearshore waters of the lake. They have also implemented conservation practices on farms and in streams to reduce and treat nutrient runoff. They have increased the monitoring of nearshore conditions to improve the understanding of bloom drivers, with particular attention to the role of more frequent extreme precipitation, flooding events, and warming waters to improve the effectiveness of controls. ***Actions*** implemented included the following:

Addressing Non-Point Source Pollution

Lime Island, located in the St. Marys River. Source: Mark Chambers.

The Huron Watershed Partnership, supported by the U.S. Forest Service (USFS), acquired, and will permanently protect, sustainably manage, and provide public access to, a parcel of land in the St. Marys watershed that includes 17 acres (68,797 square meters) of coastal wetland and 1,700 feet (518 meters) of Lake Huron shoreline. The parcel consists of forested, emergent, and rare fen coastal wetland types that help filter runoff to the lake. To address nutrient and bacterial pollution on the western coast of Lake Huron, Monitor Township, in Bay County, Michigan, with support from the USFS and the GLRI, reduced runoff from agricultural fields, roads, and developed sites. The partners planted 1,200 acres (486 hectares) of cover crops and 2.6 miles (4.2 kilometres) of buffer strips, as well as 300 trees and shrubs at the 20 acre (8 hectare) township park. As a result, over 17,000 gallons (64,000 litres) of stormwater runoff is now filtered each year, and soil and nutrient runoff from lands that drain into the Bay is reduced.

With support from ECCC's Great Lakes Protection Initiative, the Nottawasaga Valley Conservation Authority (NVCA) completed 46 nutrient and bacteria control projects with

Eastern Georgian Bay. Source: Thom Morrissey.

farmers and rural residents, preventing about 160 kg/year of total phosphorous discharge from entering waterways. Projects included the installation of 3.4 km (2 miles) of livestock exclusion fencing, the construction of manure storages and clean water diversions, and the establishment of stream-side vegetated buffers. In addition, NVCA constructed two rock riffle spawning habitats in Coates Creek near New Lowell, Ontario, to provide a demonstration site for stream habitat restoration. NVCA completed 137 site visits with private landowners to discuss proposed water quality improvement projects and grant opportunities. NVCA also engaged 3,757 volunteers in hands-on environmental restoration work.

Conducting Science, Surveillance and Monitoring

Tributaries to Saginaw Bay contribute significant quantities of nutrients and sediment that degrade the water quality of Saginaw Bay, resulting in nuisance algal blooms, eutrophication, and sedimentation. With support from the GLRI, nutrients, sediment and flow were monitored by the United States Geological Survey (USGS) at the edge-of-field and in two headwater streams within the Saginaw Basin. Monitoring on privately-owned agricultural fields was coordinated with local conservation staff and participating farmers to determine if conservation practices intended to reduce nutrient and sediment runoff are working. Data collection includes calculating volumes of water running off the field through tile drains and surface slopes, collection and chemistry analysis of this runoff, and monitoring of precipitation associated with each storm and soil metrics (such as soil temperature and soil moisture). For more information, visit USGS's Edge-of-Field monitoring project.

Algal bloom on beach. Source: Allan Crowe.

Outreach and Engagement

Healthy Lake Huron: Clean Water, Clean Beaches Initiative (HLH), a collaboration of government, public health, conservation agencies, agricultural producers, rural landowners, and community groups, worked together to improve Lake Huron's water quality. The collaboration, using non-traditional methods, broadened communication and outreach to expert resources not involved in the environmental field but who already had relationships with the target audience of the public and businesses. These expert resources include bankers, municipal leaders, science educators, agribusinesses, and other landowners. By educating the target audience on stewardship opportunities, the experts used existing business relationships to help spread the information in a cumulative effort.

Community group remediating Lake Huron. Source: Seija Deschenes.

PROTECTING AND RESTORING HABITAT AND NATIVE SPECIES

Baie du Doré coastal wetland, located in Lake Huron. Source: LHCCC.

Lake Huron's habitat and species are in relatively good condition compared to the other Great Lakes due partly to less human development and a significant amount of natural coastline. Lake Huron's extraordinarily diverse ecosystem provides critical habitat for spawning fish, amphibians, reptiles, mammals, and birdlife. Notably, the Lake Huron coastal wetlands account for nearly a third of the total wetland area for all five great lakes, with coastal wetlands around the North Channel and Georgian Bay being some of the most pristine in the Great Lakes. However, habitats are still stressed within Lake Huron with loss of biological diversity and habitat alteration, destruction, and fragmentation on the landscape, in streams and rivers, and along the shores of Lake Huron. Other threats include non-point source pollution, non-native invasive species, climate change, unsustainable shoreline development and alterations, dams, and barriers. The 2017 LAMP actions prioritized habitat restoration and protection, improving stream connectivity, and restoring fish populations. ***Actions*** implemented included the following:

Protecting Habitat

Great Blue Heron observed on McNaughton Trail in Ausable River Valley. Source: Daniel Holm.

The Nature Conservancy (TNC), with the support and collaboration of the Friends of the Thunder Bay National Marine Sanctuary, Huron Pines, and the Michigan Department of Natural Resources, acquired a significant parcel of property along the shores of Lake Huron in Thunder Bay, Michigan. The largely undeveloped 1,400-acre (566 hectares) property includes over 4 miles (6 km) of Lake Huron shoreline. The property is vital for fish and wildlife and provides a critical stopover site for migratory birds. With over 6 acres (2.4 hectares) of high-quality Great Lakes coastal wetlands, the property supports a valuable wetland type that many Great Lakes fish species use for at least a portion of their lives. Just offshore from the property is a significant reef spawning complex used by Lake Whitefish, Lake Trout, Cisco, and various other native species. With over 200 acres (81 hectares) of coastal fen and 700 acres (283 hectares) of rich conifer swamp, the North Point Peninsula property not only provides essential habitat to various plants and animals but also helps protect the health of the adjacent shoal and reef spawning habitats. This collaborative effort ensures that this beautiful stretch of Lake Huron shoreline is permanently protected and will continue to provide high-quality habitat for many of Lake Huron's fish and wildlife species.

Restoring Saginaw Bay Reef Habitat

Historically, human and industrial activity has affected critical spawning reefs around the Great Lakes. The Saginaw Bay reef is one such reef, essentially lost to sedimentation from land use changes, such as logging and agriculture. This loss contributed to the 1940s collapse of Saginaw Bay's Walleye fishery and negatively impacted local populations of Lake Whitefish, Lake Trout, Burbot, and other species. To address the issue, federal, state, and local partners, with support from the GLRI and the Saginaw Bay Watershed Initiative Network, constructed and restored rock reef habitat at 2 locations within the inner Bay: the Coreyon and Saginaw River Mouth Reefs. The project placed 5,000 cubic yards (3,823 cubic meters) of rock at each restoration site, mimicking the natural formation of reefs. This project restored 2 acres (0.8 hectares) of rock reef. These restored reefs provide essential spawning habitats for many native fish species. During spawning, the gaps between the rocks will create a sheltered environment where fish eggs can incubate and be protected from predators. The inner Bay's warm and highly productive waters will provide excellent nursery habitat as the eggs hatch. The waters will also provide larval and young fish with abundant food sources allowing for fast growth and increased survival potential for later stages of life. For more information, visit Michigan Sea Grant.

Coreyon Reef restoration site. Source: The Conservation Fund.

Restoring Fish Habitat on Manitoulin Island

The Manitoulin Streams Improvement Association restored habitat and water quality in popular spawning areas for fish. In 2017, the Association brought together Ontario Stewardship Rangers, First Nation students, and local volunteers to help safeguard M'Chigeeng Creek, Mindemoya River, and Smith Bay Creek ecosystems from erosion and sedimentation, and to increase available aquatic and terrestrial habitat. The actions included the establishment of 843 square metres (9,074 square feet) of in-stream fish and aquatic habitat, planting of 1,174 native trees and shrubs improving 1,255 square metres (or 0.3 acres) of riparian habitat, shoreline cleanups (3.1 hectares or 7.7 acres), and removal of log jams impeding fish migration to help improve the continuity of the streams. The work was supported through federal, provincial and municipal governments, corporate and local sponsors, and by the work of many dedicated volunteers.

Manitoulin Streams Improvement Association Site B52 Blue Jay Creek: before 2008 (Top Left), during Summer 2008 (Top Right), during Spring 2009 (Bottom Left), during Summer 2009 (Bottom Right). Source: Seija Deschenes.

PREVENTING AND CONTROLLING INVASIVE SPECIES

Phragmites australis subsp. Australis. Source: Allan Crowe.

Lake Huron is currently home to over 100 non-native aquatic species. These invasive species undermine efforts to restore and protect ecosystem health and water quality by outcompeting native species for food, habitat, water, and space, among other things. For example, zebra and quagga mussels have altered the lake's food web, nutrient cycling, and energy transfer dynamics. The State of the Great Lakes indicators shows a "poor" status concerning invasive species with a deteriorating trend. Lake Partner agencies made significant strides to prevent further invasions through monitoring, early detection, and effective outreach and education events, including discussions with recreational boaters.

Partner agencies also focused on managing the impacts of invasive species already established within Lake Huron. For example, there was a lakewide effort to eliminate *Phragmites australis subsp. australis* (European Common Weed) from the Lake Huron watershed. Agencies surveyed and treated hundreds of acres for invasive *Phragmites*. There was also a continued lakewide effort to control Sea Lamprey (*Petromyzon marinus*) populations, a parasitic fish native to the Atlantic Ocean and lethal to native fish. ***Actions*** implemented included the following:

Management of Invasive Species in Two Canadian National Parks

Application of herbicides to *Phragmites australis subsp. Australis.* Source: Allan Crowe.

Phragmites control is a priority for invasive species management at Parks Canada sites on Lake Huron. *Phragmites* are considered one of Canada's worst invasive species as it out-competes native vegetation for water and nutrients, spreads quickly, and decreases biodiversity. Treatment of multiple small patches of *Phragmites* has been successful as high water levels have drowned several patches along the Lake Huron coast, and several in-land infestations have been reduced in size through management efforts. At Georgian Bay Islands National Park, the "Impede the Reed" project has removed 1.3 hectares (3 acres) of *Phragmites* around Beausoleil Island.

In partnership with Parks Canada, Trent University has tested known stands of native *Phragmites* for the presence of hybrid forms. So far, all samples have come back negative for hybridization. For more information about this management project, visit the Great Lakes Phragmites Collaborative website.

Early Detection

The US FWS partnered with the Sault Ste. Marie Tribe of Chippewa Indians to conduct early detection monitoring of aquatic invasive species at 12 locations from Saginaw Bay to the St. Marys River in 2020. Over 6,000 fish from 63 species were collected, but no novel invasive species were detected. In 2021, the Great Lakes Enforcement Unit of the MDNR partnered with the Motor Carrier Division of the Michigan State Police to identify and inspect fish haulers in southeast Michigan. Over three days, officers monitored commercial traffic and inspected multiple vehicles transporting aquatic cargo that could potentially aid in spreading invasive species. The cargo included pet store deliveries and fresh seafood transported to and through Michigan. All haulers were found to comply with Michigan AIS regulations, including the recently signed MDNR's Director's Order requiring invasive fish species to be eviscerated. This detail marked the beginning of a partnership between two state law enforcement agencies that continues to produce valuable intelligence and a heightened level of protection against AIS.

CCGS *Limnos*, a Great Lakes vessel. Source: ECCC.

Sea Lamprey Control

Over the past 20 years, Sea Lamprey control has reduced populations by more than 90% and has helped with the rehabilitation of a healthy Great Lakes ecosystem. Continued Sea Lamprey control is critical to keeping the number of sea lamprey down, with the use of Sea Lamprey traps being an effective control tool. The U.S. Army Corps of Engineers, in cooperation with the Great Lakes Fishery Commission, the Michigan Department of Natural Resources, and the U.S. Fish and Wildlife Service, are constructing Sea Lamprey traps in the Au Gres and Au Sable Rivers in Michigan. The traps capture juvenile Sea Lampreys as they migrate from tributaries to the open lake to prey on fish or adult sea lampreys returning to tributaries to spawn. Construction on the Au Gres Sea Lamprey trap is anticipated to be completed in 2023. The Au Sable Sea Lamprey trap is currently in the design phase, with an anticipated construction completion date of 2024. Sea Lamprey traps on the Au Gres, and Au Sable Rivers will further limit the number of Sea Lamprey accessing the Great Lakes and spawning habitat in the Lake Huron watershed. For additional information on Sea Lamprey control in the Great Lakes, please see the Great Lakes Fishery Commission website.

Sea Lamprey trap. Source: GLFC.

CONTACT INFORMATION

More information about the Lake Huron LAMP is available at Binational.net.

In Canada:
Paul Parete
Environment and Climate Change Canada
ec.grandslacs-greatlakes.ec@canada.ca

In the United States:
Elizabeth LaPlante
U.S. Environmental Protection Agency
laplante.elizabeth@epa.gov

LAKE HURON PARTNERSHIP MEMBER AGENCIES, 2017

• Algoma University • Bay Mills Indian Community • Chippewa–Ottawa Resource Authority • Department of Fisheries and Oceans Canada • Detroit District Planning Office US Army Corps of Engineers • Environment and Climate Change Canada • Inter-Tribal Council of Michigan • Little River Band of Ottawa Indians • Little Traverse Bay Bands of Odawa Indians • Maitland Valley Conservation Authority • Metis Nation Of Ontario • Michigan Department of Environment Great Lakes & Energy (EGLE) • Michigan Department of Natural Resources • Michigan Sea Grant • National Oceanic and Atmospheric Administration • Nottawasaga Valley Conservation Authority • Ontario Ministry of Agriculture, Food and Rural Affairs • Ontario Ministry of Environment, Conservation and Parks • Ontario Ministry of Natural Resources and Forestry • Parks Canada • Saginaw Chippewa Indian Tribe • Saginaw Chippewa Indian Tribe of Michigan • St. Clair Region