



A Biodiversity Conservation Strategy for

Lake Superior

*A Guide to Conserving and Restoring the Health of
the World's Largest Freshwater Lake*



Prepared by the Lake Superior Binational Program

February 12th, 2015

How to Use this Strategy

The Lake Superior Biodiversity Conservation Strategy (Strategy) contributes to delivery of the 2012 Great Lakes Water Quality Agreement (GLWQA) commitment to develop lakewide habitat and species protection and restoration conservation strategies (GLWQA Annex 7.B.2). The Strategy provides a common framework for the implementation of actions, and for assessing and reporting on shared progress. The Lake Superior Binational Program will pursue implementation from all organizations with a mandate to undertake some of the strategies and actions. These organizations implement programs that help restore and protect the Great Lakes, including the U.S. Great Lakes Restoration Initiative, and the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health.

Other organizations, local stakeholders and groups have been instrumental in developing the Strategy, and are encouraged to use the information to identify and implement necessary actions within their watersheds, coasts and nearshore waters. Some suggestions on how to use the Strategy include the following:

- Review the actions within the Strategy to identify areas of synergy with the goals of your organization and use the strategies to identify and refine local and regional priorities for conservation actions.
- Review and contribute to the updates of regional plans that have been developed for 20 regions around the lake as a complement to this lakewide Strategy (see Figure 1).
- Link how local actions contribute to lakewide objectives in applications for funding.
- Share the Strategy with other Lake Superior stakeholders. Inform and educate local communities and decision-makers about the lake's unique features and priority actions.
- Recognize and encourage networks of organizations interested in biodiversity conservation. Identify common regional goals and approaches to enhance local partnership networks.
- Incorporate actions from the Strategy into local and regional conservation and land-use plans.
- Apply the indicators used to assess biodiversity health to help identify actions and monitor progress.
- Contact a member of the Lake Superior Binational Program to access GIS data to support mapping and planning in your local area.
- Identify research interests, emerging management issues and monitoring priorities.

Acknowledgements

This report has been prepared by the Lake Superior Binational Program with coordination and support from the Nature Conservancy of Canada.

To access supporting technical information, maps, and regional plans please visit the project website:
www.natureconservancy.ca/superiorbca

Gichigammi - Lake of the Great Waters

Lake Superior is a unique international treasure. Situated at the top of the chain of the Great Lakes, it is the world's largest freshwater lake by area and is rich in natural and human history. It is the deepest of the Great Lakes, with a maximum depth of 406 metres (1,332 feet). It is the coldest of the Great Lakes, but rarely freezes over entirely, even in the coldest winters. Due to its massive size, Lake Superior has a water retention period of 191 years, the longest of all the Great Lakes. It is a lake of extraordinary biodiversity, supporting endemic and disjunct fish, unique deepwater forms of Lake Trout (*Salvelinus namaycush*), diverse coastal wetlands and extensive sandy beaches. The cool, often fog enshrouded coastlines and islands harbor arctic-alpine plants and Woodland Caribou (*Rangifer tarandus caribou*).

Aboriginal peoples have called Lake Superior home for thousands of years. For the Ojibwe people, a long westerly migration ended when they found "the food that grows on the water" (Northern Wild Rice or manoomin [*Zizania palustris*]). From that point, Madeline Island (or Moningwanikaaning) became the center of the Ojibwe nation. The waters, fishes, plants and wildlife continue to provide a sense of identity and continuity with the nation's history. Water is seen as a conduit for the spirit world, and a powerful force to be honoured, respected and protected. Traditional Ecological Knowledge, developed through the long relationship between the Lake Superior ecosystem and the Ojibwe nation, is vital to understanding the biodiversity of the Lake, and for evaluating and improving implementation of the Strategy. According to the Ojibwe world view, Lake Superior and its connected lakes, rivers and streams are not simply the sum total of their constituent parts, or the property of a state, nation, or person, but are integral parts of the web of life that support the continuation of Ojibwe life-ways and provide life-giving benefits to all who now call Lake Superior home.

Today, Lake Superior is the least environmentally impacted of all the Great Lakes, and many of its aquatic habitats, watersheds and coast remain healthy and intact. Large areas of land and water are public, or are protected by the two federal governments, three states, one province, tribal governments, First Nations and Métis, and others that act as the stewards of this Lake of the Great Waters. Although the lake ecosystem is relatively healthy, several areas and features of the lake have been altered by human activities, and it is currently affected by many stressors. Numerous coastal areas, particularly in the U.S., are in private ownership and face rising development pressures. Many watersheds have experienced habitat loss and declining water quality due to increased urbanization and forestry. Dams have reduced access to river habitats for some migratory fish. Contaminants from past environmental practices have persisted because of Lake Superior's cold waters and slow growth rate of fish. Other key stressors include aquatic invasive species, mining, and climate change.

Despite these challenges, Lake Superior provides an unparalleled global opportunity for conservation and maintenance of biological reference sites in the world's largest freshwater ecosystem. This Biodiversity Conservation Strategy provides a summary of the health of and threats to the biodiversity of Lake Superior, and presents a guide to implementing effective lakewide and regional conservation strategies.

The Bad River-Kakagon Sloughs estuary and Chequamegon Point. Photo courtesy of Christina Isenring, Wisconsin DNR.



Goal of the Lake Superior Biodiversity Conservation Strategy

The Lake Superior Biodiversity Conservation Strategy is intended to provide information and guidance that will support the long-term protection and restoration of Lake Superior's habitats and species.

Planning Overview

The Lake Superior Biodiversity Conservation Strategy has been developed to guide and support actions necessary to restore and protect Lake Superior's habitats and species. It has been prepared over a period of two years by the Lake Superior Binational Program with communication with or input from nearly 600 experts and stakeholders.

The Lake Superior Biodiversity Conservation Strategy was started in 2012, with the assessment of key conservation targets and threats. These targets and threats helped identify strategies to conserve Lake Superior's habitats and species.

In addition to the lakewide strategies that are provided in this document, 20 regional plans have been prepared for areas around the lake (Figure 1). These regional plans identify key local actions that support the conservation and restoration of Lake Superior within the context of broader, lakewide objectives. Regional plans, the biodiversity assessment, and details on the planning process can be found on the project website at: www.natureconservancy.ca/superiorbca

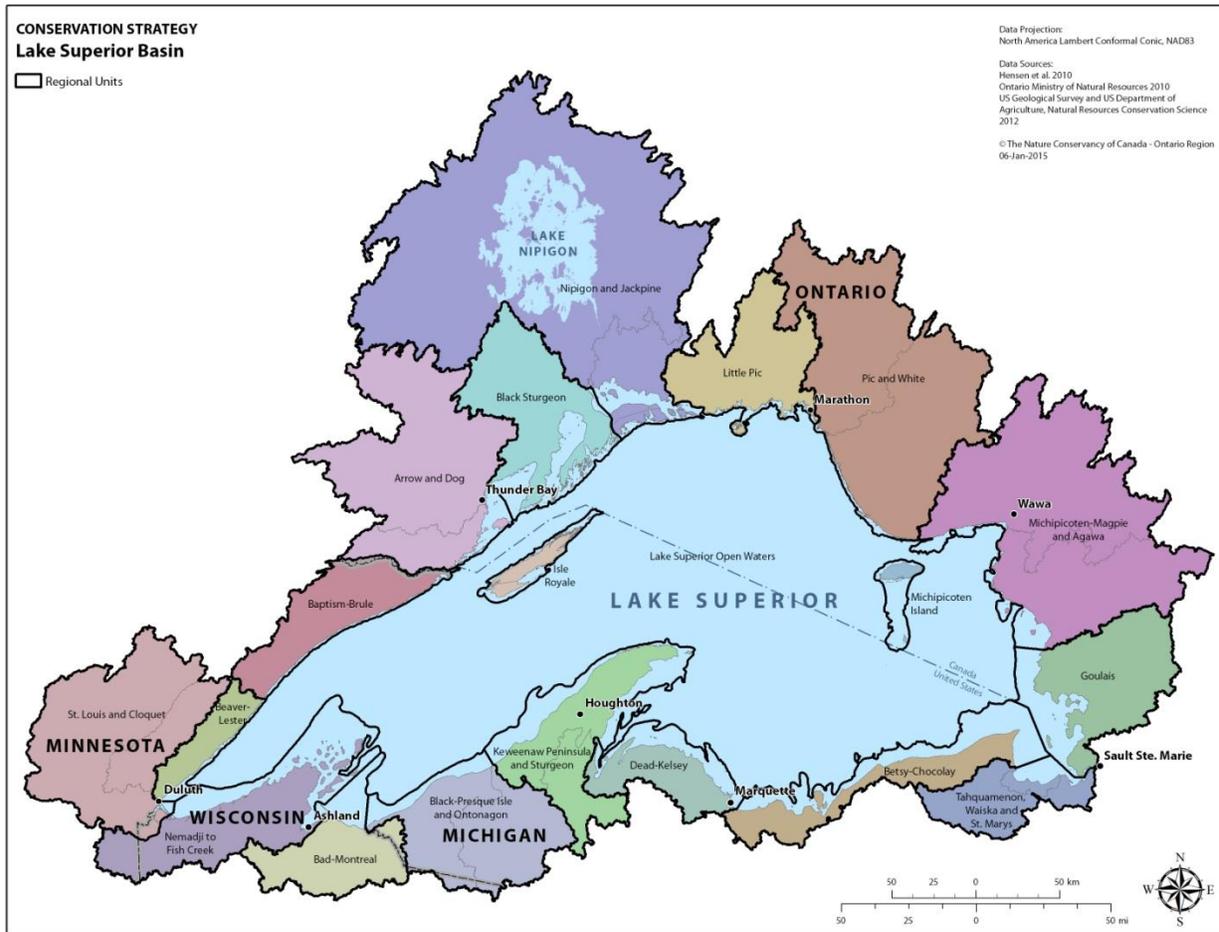


Clockwise from top left: Lake Superior from Au Train, Michigan. Sleeping Giant Provincial Park, Ontario. Photos courtesy of Stephanie Swart, Michigan Department of Environmental Quality. Deer Lake Area of Concern, Michigan. Photo courtesy of Michelle Chambers.

Project Scope

Since the focus of this project is to foster binational action to conserve and restore the biodiversity of Lake Superior, the scope will include the open waters of the lake (to the head of the St. Marys River), islands, coastal areas (roughly 2 km inland from the shoreline) and the watersheds of tributaries with a focus on how they affect the biodiversity of the lake.

Figure 1: Scope of the Lake Superior Biodiversity Conservation Strategy including regional planning units.



Regional Units

1. Goulais
2. Michipicoten-Magpie and Agawa
3. Pic and White
4. Michipicoten Island
5. Little Pic
6. Nipigon and Jackpine
7. Black Sturgeon
8. Arrow and Dog
9. Baptism-Brule
10. Isle Royale
11. Beaver-Lester
12. St. Louis and Cloquet
13. Nemadji to Fish Creek
14. Bad-Montreal
15. Black-Presque Isle and Ontonagon
16. Keweenaw Peninsula and Sturgeon
17. Dead-Kelsey
18. Betsy-Chocolay
19. Tahquamenon, Waiska and St. Marys
20. Lake Superior Open Waters

The Health of Lake Superior's Species and Habitats

The overall health of Lake Superior is “Good”; the lake is in a state of health that is within the natural range of variation, but some management intervention may be required for some elements.

To conserve Lake Superior's biodiversity, seven conservation targets (*e.g.*, offshore waters, coastal wetlands, and islands) were selected that encompass the species and habitats of Lake Superior. **The aim is for each of the seven conservation targets to be in “Good” condition.** The health of these conservation targets was assessed using science-based and publicly-available Great Lakes indicators. The least healthy conservation target was watersheds and tributaries. While Nearshore Zone and Reefs, and Embayments and Inshore are in “good” health, they are approaching the threshold for “fair” (Table 1).



Clockwise from top left: Brook trout from the Cypress River, Ontario. Photo courtesy of Marilee Chase, Ontario Ministry of Natural Resources and Forestry. Bald Eagle. Photo courtesy of Bill Hubick. Northern Wild Rice in the Bad River-Kakagon Sloughs. Photo courtesy of Mike Wiggins, Jr. Powder Islands, Ontario. Photo courtesy of Nature Conservancy of Canada.

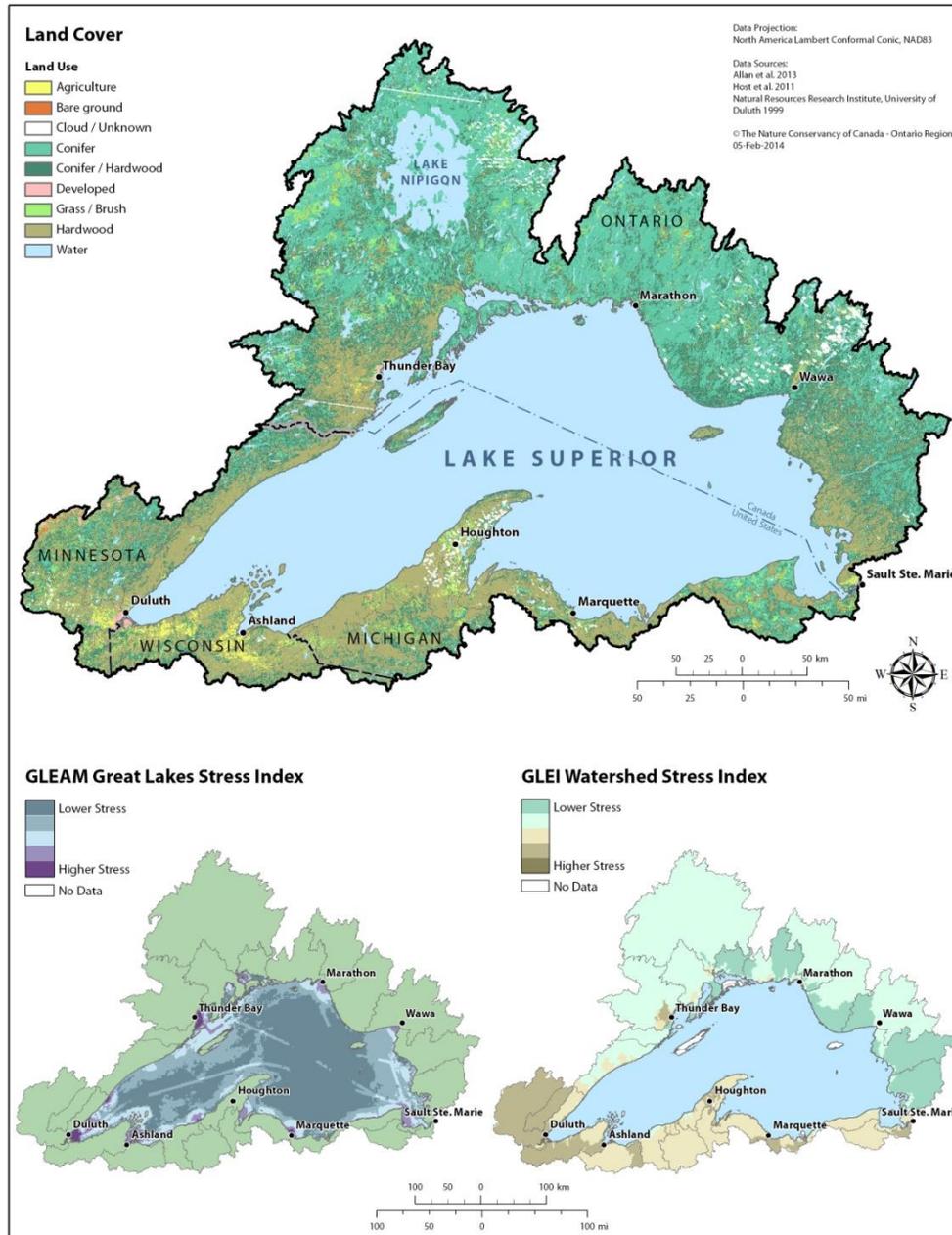
Table 1: Lake Superior Biodiversity Targets

Conservation Target/ Associated Species & Habitats	Overall Health	Why it is Important to Protect and Restore
Deepwater and Offshore Waters: Benthic and pelagic waters that are >80 m in depth. <i>Lake Trout, Kiyi (Coregonus kiyi) and other ciscoes, Burbot (Lota lota), Deepwater Sculpin (Myoxocephalus thompsonii)</i>	GOOD	The offshore waters of Lake Superior provide habitat for a number of native fishes, and the offshore fish community is predominately made up of native fish species.
Nearshore Zone and Reefs: Coastal areas that are between 15-80 m in depth, and shallow reefs. <i>Lake Trout and Lake Whitefish (Coregonus clupeaformis) spawning</i>	GOOD	Lake Superior’s major sport and commercial fisheries are located in the nearshore zone. The shallow reefs are important spawning habitat.
Embayments and Inshore: Embayments and the inshore zone at depths of 0-15 m. <i>Lake Sturgeon, Walleye (Sander vitreus), Yellow Perch (Perca flavescens), waterfowl staging and feeding</i>	GOOD	These habitats are critical for the fish abundance and diversity throughout Lake Superior, since these areas provide spawning and nursery habitat for many nearshore and offshore fish species.
Coastal Wetlands: Wetlands within 2 km of Lake Superior’s coast, with an emphasis on wetlands that have historic and current hydrologic connectivity to, and are directly influenced by, the lake. <i>Northern Pike (Esox lucius), waterfowl, frogs</i>	GOOD	Coastal wetlands are a critical interface between the land and the lake, providing key ecological services, such as water purification, erosion/shoreline protection, and habitat for waterfowl and fish.
Islands: All land masses that are surrounded by water, including both natural and artificial islands. <i>Nesting habitat for gulls and terns</i>	GOOD	Lake Superior has many of the largest and most isolated islands on the Great Lakes. Islands support colonial nesting waterbirds and unique ecological communities.
Coastal Terrestrial Habitats: Habitats within 2 km from the coast or to the extent of delineation. <i>Shorebirds, Bald Eagle (Haliaeetus leucocephalus), rare plant communities</i>	GOOD	Coastal habitats are an important access point to beaches and other shoreline types. Many rare species and habitats are found in this zone.
Tributaries and Watersheds: All rivers, streams, and inland lakes that flow into Lake Superior and their associated watersheds. <i>Brook Trout (Salvelinus fontinalis), suckers, Northern Wild Rice</i>	FAIR	Lakes, rivers, and streams in the basin are influenced by land use, which affects water quality in Lake Superior. Native Lake Superior fishes migrate to and depend on tributaries as part of their natural life cycle.

Good	In a state of health that is within the natural range of variation, but some management intervention may be required for some elements.
Fair	Outside of the range of acceptable variation and requires management. If unchecked, the biodiversity target may be vulnerable to serious degradation.
Poor	Allowing the biodiversity target to remain in this condition for an extended period will make restoration or preventing extirpation practically impossible.

To help further direct restoration and protection efforts, it is important to understand that Lake Superior conditions are not equally 'good' all around the lake. For example, when the Lake Superior basin is broken into 20 regional units for assessment purposes (Figure 1), variations in conditions become apparent. The regional assessments used cumulative stress indices developed by the Great Lakes Environment Indicators (GLEI) project, the Great Lakes Environmental Assessment and Mapping (GLEAM) project and The Nature Conservancy / Nature Conservancy of Canada (Figure 2). Regional assessments have been used in the development of regional plans to support this lakewide strategy.

Figure 2: Lake Superior Land Cover and GLEAM and GLEI stress indices.



Identifying Critical Threats and Issues

Many different threats impact the health of Lake Superior's species and habitats. To focus on the highest priority actions, direct threats to Lake Superior's conservation targets were identified and ranked. Input from regional experts helped identify factors that directly and negatively affect biodiversity. Threats were ranked according to scope, severity of impact, and irreversibility on a lakewide scale. Those with broadest impact, across several features, ranked higher than others.

The overall threat rank for Lake Superior is "High." This is driven by a high rating for climate change, aquatic invasive species, and dams and barriers. These threats impact many of the conservation targets throughout the lake. Many "medium" ranked threats were identified (Table 2). While some threats impact the entire lake, others are localized in their scope and are of more importance to a particular area. Threats that were ranked low on a lakewide scale but that may be important to a particular area include incompatible fisheries management, oil spills, point source pollution, and wind energy development.



Clockwise from top left: Mink Frog (*Lithobates septentrionalis*). At the southern limit of its range in the Lake Superior Basin, Mink Frogs are an aquatic species at risk from climate change. Photo courtesy of Gary S. Casper. Lake Trout with invasive Sea Lamprey attached. Photo courtesy of Great Lakes Fishery Commission. Stream barrier in a tributary west of Marquette, Michigan. Photo courtesy of Matt Preisser, Michigan Department of Environmental Quality. Spiny water fleas clog fishing equipment. Photo courtesy of US Fish and Wildlife Service.

Table 2: Threat Rankings for Lake Superior’s Biodiversity Conservation Targets.

Threats \ Targets	Embayments and Inshore	Nearshore Zone and Reefs	Islands	Deepwater and Offshore Waters	Coastal Wetlands	Tributaries and Watersheds	Coastal Terrestrial Habitats	Summary Threat Rating
Aquatic Invasive Species	High	High	Not Significant	High	High	High	Not Significant	High
Climate Change	High	Medium	High	Medium	High	Medium	High	High
Dams and Barriers	High	High	Not Significant	Not Significant	Low	High	Not Significant	High
Atmospheric Deposition	Medium	Medium	Not Significant	Medium	Medium	Not Significant	Not Significant	Medium
Coastal Development	High	Medium	Medium	Not Significant	Medium	Not Significant	Medium	Medium
Incompatible Forestry	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant	Medium	Medium	Medium
Mining	Medium	Medium	Low	Not Significant	Low	High	Low	Medium
Non-point Source Pollution	Medium	Medium	Not Significant	Not Significant	Medium	Medium	Not Significant	Medium
Terrestrial Invasive Species	Not Significant	Not Significant	Medium	Not Significant	Medium	Medium	Medium	Medium
Summary Target Ratings:	High	High	Medium	Medium	High	High	Medium	High

Very High	The threat is likely to destroy or eliminate the biodiversity target.
High	The threat is likely to <i>seriously degrade</i> the biodiversity target.
Medium	The threat is likely to <i>moderately degrade</i> the biodiversity target.
Low	The threat is likely to <i>only slightly impair</i> the biodiversity target.
Not Significant	The threat <i>does not impact</i> the biodiversity conservation target, <i>or the impacts are very small or localized.</i>

Strategies to Protect and Restore Lake Superior

The Lake Superior Biodiversity Conservation Strategy is intended to provide a framework for coordinated and focused action to protect and restore the health of Lake Superior for future generations. The Strategy development benefited from a strong foundation of existing binational lakewide planning, including, but not limited to, the Great Lakes Fishery Commission’s Fish Community Objectives, the Lake Superior Binational Program’s Lakewide Action and Management Plan, the Lake Superior Aquatic Invasive Species Complete Prevention Plan, the Lake Superior Climate Change Impacts and Adaptation report, and the Critical Chemical Reduction Milestones report.

Six key strategies (Box 1) and associated sub-strategies (Tables 3 to 8) have been identified that will maintain Lake Superior’s species and habitats and abate the most critical threats.

The agencies and organizations responsible for managing Lake Superior have a number of current lakewide and regional initiatives underway to manage Lake Superior’s natural resources. These initiatives will be supported and supplemented by the Biodiversity Conservation Strategy’s proposed strategies, which include the full spectrum of the types of actions needed to protect and restore biodiversity. These include actions ranging from habitat conservation to species management to actions that support laws and policies. In addition, several enabling actions related to information management, outreach and engagement, and research needs are also identified.

Box 1: Key Strategies of the Lake Superior Biodiversity Conservation Strategy.

Strategy 1: Restore and protect a system of representative, high-quality habitats
Strategy 2: Manage plants and animals in a manner that ensures diverse, healthy and self sustaining populations
Strategy 3: Reduce the impact of existing aquatic invasive species and prevent the introduction of new ones
Strategy 4: Adapt to climate change
Strategy 5: Reduce the negative impacts of dams and barriers by increasing connectivity and natural hydrology between the lake and tributaries
Strategy 6: Address other existing and emerging threats that may impact important habitat or native plant and animal communities

Strategy 1: Restore and protect a system of representative, high-quality habitats.

Lake Superior is the most pristine of all the Great Lakes, and provides an unparalleled global opportunity for maintaining environmental quality and showcasing effective conservation. This strategy addresses the protection and restoration of all biodiversity targets and will ensure that priority areas that represent the full spectrum of habitats are protected and restored. Twelve sub-strategies have been identified (Table 3):

Table 3: Strategy 1 Sub-strategies

1.1	<i>Restore or protect wetlands, native riparian forests, and coastal habitats such as rocky shorelines, beaches and dunes.</i>
1.2	<i>Achieve an overall net gain of the productive capacity of habitat supporting fish and wildlife.</i>
1.3	<i>Where feasible, restore habitats that have been degraded and have lost some their ecological capacity to support fish and wildlife communities.</i>
1.4	<i>Protect oligotrophic conditions (i.e. high in oxygen, low in nutrients) in nearshore and offshore waters, and restore and protect water quality in embayments and tributaries.</i>
1.5	<i>Develop or refine ecologically based integrated watershed management plans in priority areas.</i>
1.6	<i>Use special land and water designations to protect important habitat on public property.</i>
1.7	<i>Develop and put into place a policy that results in zero loss of wetland areas and function within the basin.</i>
1.8	<i>Educate and engage people about restoring or protecting important habitat and related ecosystem services.</i>
1.9	<i>Develop comprehensive and detailed inventories of important fish and wildlife habitats.</i>
1.10	<i>Inventory and assess impacts to degraded habitats and communities.</i>
1.11	<i>Develop and distribute information and/or indicators on ecosystem conditions, trends, stressors and important restoration or protection sites.</i>
1.12	<i>Maintain and share data through existing and new mechanisms, as appropriate.</i>

At the local level, implementation of these sub-strategies could include improving riparian cover along streams, developing a sub-watershed plan, conserving important habitat areas or working with local authorities to develop policies that support wetland protection and restoration.



Rosspport Provincial Park, Ontario. Photo courtesy of Marilee Chase, Ontario Ministry of Natural Resources and Forestry.
Tahquamenon Falls, Michigan. Photo courtesy of David Kenyon, Michigan Department of Natural Resources.

Strategy 2: Manage plants and animals in a manner that ensures diverse, healthy, and self-sustaining populations.

Lake Superior has a high diversity and abundance of aquatic and coastal species and habitats. This strategy will focus on the health of selected species populations and species groups that are included in the biodiversity targets, such as fishes, colonial nesting waterbirds, and coastal species. This strategy is important for ensuring that species of concern receive direct management attention. Nine sub-strategies have been identified (Table 4):

Table 4: Strategy 2 Sub-strategies

2.1	<i>Develop and implement plans to detect and prevent disease outbreaks.</i>
2.2	<i>Use local native species, to the extent possible, in restoration projects and natural resource management, supported by the development or maintenance of lists of the native species, use standards, sources, and seed zones.</i>
2.3	<i>Implement native fish and wildlife species restoration, protection or rehabilitation plans, as appropriate.</i>
2.4	<i>Manage the harvest of fish, wildlife and plants to ensure their health, long-term sustainability and balance in the ecosystem.</i>
2.5	<i>Manage over-abundant populations of species where there is strong evidence of sustained detrimental effects on habitats and / or species diversity.</i>
2.6	<i>Educate citizens about the importance and appropriate use of local native plants in restoration and landscaping projects.</i>
2.7	<i>Undertake comprehensive biological surveys in the watershed to identify species of conservation interest and remaining natural communities.</i>
2.8	<i>Catalogue Lake Superior basin's genetic diversity.</i>
2.9	<i>Develop and distribute information and/or indicators on species conditions, trends, stressors and potential rehabilitation locations.</i>

Local practitioners can support these sub-strategies through many types of projects. These could include projects that: restore coastal areas for rare plants; restore native fish to streams; and use native species, from local seed sources, in riparian and shoreline restoration projects.



Lake Sturgeon with radio transmitter attached from the Kaministiquia River, Ontario. Photo courtesy of Marilee Chase, Ontario Ministry of Natural Resources and Forestry. The Wood Turtle is a riverine species at the northern limit of its range in the Lake Superior Basin, and is a species of conservation concern. Photo courtesy of Gary S. Casper.

Strategy 3: Reduce the impact of existing aquatic invasive species and prevent the introduction of new ones.

Aquatic invasive species are identified as one of the highest threats to the health of Lake Superior. This strategy will focus on both the management of existing aquatic invasive species and the prevention of new introductions. Fifteen sub-strategies have been identified (Table 5):

Table 5: Strategy 3 Sub-strategies

3.1	<i>Establish first response control protocols in anticipation of newly discovered aquatic invasive species.</i>
3.2	<i>Implement control and/or eradication plans, where feasible, for priority aquatic invasive species at appropriate geographic scales.</i>
3.3	<i>Undertake actions that greatly reduce the risk of aquatic invasive species being transferred between Lake Superior and the lower Great Lakes, the Mississippi River Basin, or other inland waters.</i>
3.4	<i>Suppress sea lampreys to population levels that cause only insignificant mortality on adult lake trout.</i>
3.5	<i>Perform best management practices to prevent aquatic invasive species introductions during dredging operations, lock operations, construction, and other maintenance activities.</i>
3.6	<i>Establish screening processes to classify species proposed for trade into three lists: prohibited, permitted, and conditionally prohibited/permitted; and place an immediate moratorium on the trade of prohibited species.</i>
3.7	<i>Require permits for shore land work, which identify aquatic invasive species introduction issues and establish best management practices and restrictions.</i>
3.8	<i>Implement compatible, federal regulatory regimes for ballast water discharge that are protective of the Great Lakes for both the U.S. and Canada.</i>
3.9	<i>Use regulations, policies and best management practices to reduce the risk of introduction of aquatic invasive species by all possible pathways, including boaters, travel guides, equipment and bait dealers, plant nurseries, airplane charter companies, and those who recreate in the water.</i>
3.10	<i>Protect exposed or seasonally exposed wetland environments from off-road vehicular use that may be a vector for invasive plants (e.g., Common Reed [<i>Phragmites australis</i>]).</i>
3.11	<i>Undertake outreach, education, enforcement and research on preventing and managing aquatic invasive species.</i>
3.12	<i>Monitor aquatic invasive species movement and establishment in the Lake Superior basin.</i>
3.13	<i>Maintain a list of the aquatic invasive species that are most likely to reach the Lake Superior basin and monitor appropriately.</i>
3.14	<i>Support development, testing and implementation of effective ballast treatment systems.</i>
3.15	<i>Identify ecosystems that may be more vulnerable to new aquatic invasive species under changing environmental conditions.</i>

Many of the actions for this strategy, such as ballast water regulations or species protection, will need to be implemented by higher levels of government. At the local level, implementation of these sub-strategies could include citizen science programs to monitor and report invasive species and angler education programs about the proper disposal of live bait.

Strategy 4: Adapt to climate change.

Climate change is identified as one of the highest threats to the health of Lake Superior. Climate change is a complicated issue as it has both direct impacts (e.g., less ice cover), and can also amplify other threats (e.g., more severe storm events that increase non-point source pollution). This strategy will focus on protection and restoration actions that support ecosystem resilience and adaptation. Thirteen sub-strategies have been identified (Table 6):



Climate changes can negatively impact fish spawning habitat. Photo courtesy of USFWS.

Table 6: Strategy 4 Sub-strategies

4.1	<i>Review and revise conservation, restoration and management plans, guidelines and regulations as required in response to projected climate change impacts (e.g., increased water temperatures).</i>
4.2	<i>Implement adaptation actions to account for changes in variability and/or frequency in air and water temperatures, water levels, storm events, droughts, etc.</i>
4.3	<i>Implement adaptive plant and forestry management practices that respond to climate change to minimize possible disturbances that impact Lake Superior.</i>
4.4	<i>Create coastal development setbacks or rolling easements to allow ecosystems to migrate in response to changes in water levels due to climate change.</i>
4.5	<i>Develop away from potentially newly sensitive and/or hazard-prone areas due to changing conditions.</i>
4.6	<i>Improve the incorporation of climate change information into the communications, management, technical assistance, science, research and development programs of parks and protected areas.</i>
4.7	<i>Undertake climate change education and outreach activities, with a focus on disseminating materials and information available from domestic climate change programs.</i>
4.8	<i>Monitor the effectiveness of the Lake Superior Regulation Plan (i.e., water levels) in responding to changing climate conditions with regard to protecting and preserving Lake Superior coastal ecosystems.</i>
4.9	<i>Modify invasive species pathway analysis and prediction models to include climate change parameters.</i>
4.10	<i>Use parks or sentinel sites as long-term integrated monitoring sites for climate change (e.g., monitoring of species, especially those at-risk or extinction-prone).</i>
4.11	<i>Continue to support and enhance scientific research designed to understand resilience of ecosystems to climate change and other cumulative effects.</i>
4.12	<i>Make climate models, scenarios, and impact information available and accessible to those making large and small scale natural resource management decisions, growth plan decisions, and socio-economic analyses.</i>
4.13	<i>Conduct climate change vulnerability assessments for forests, fisheries, priority habitats and species, and nearshore water quality.</i>

Many of the actions for this strategy will need to be implemented by higher levels of government. At the same time, local actions are critical. These include developing local land use policies, supporting the protection and restoration of “green” infrastructure, and protecting coastal habitats.

Strategy 5: Reduce the negative impacts of dams and barriers by increasing connectivity and natural hydrology between the lake and tributaries.

Dams and other barriers (such as elevated culverts at road-stream crossings) are identified as one of the highest threats to the health of Lake Superior, and are a limiting factor in the recovery of several fish populations. This strategy will support increasing the amount of available spawning habitats for migratory fish, in consideration of the potential benefits of some barriers to limit the spread of aquatic invasive species. Four sub-strategies have been identified (Table 7):

Table 7: Strategy 5 Sub-strategies

5.1	<i>On a watershed scale, assess and prioritize habitat connectivity opportunities (e.g., culvert upgrade, road/stream crossing upgrade) with consideration of the benefits (e.g., quality or amount of habitat connected) versus the costs (e.g., community disruptions, potential spread of invasive species, financial cost).</i>
5.2	<i>Protect and restore connectivity, where appropriate, by removing dams, upgrading stream/road crossing infrastructure, or by other means.</i>
5.3	<i>Adopt flow standards to sustain key environmental processes, critical species habitat and ecosystem services.</i>
5.4	<i>Pursue, continue or enhance sustainable hydropower planning that adequately protects aquatic ecosystems, habitats and species.</i>

Local actions will be critical for this strategy. Local practitioners can support these sub-strategies through projects that inventory and mitigate perched culverts at road-stream crossings, and by supporting effective fish passage in new infrastructure projects.



An example of a perched culvert in Banner Creek, Michigan. Photo courtesy of the Gogebic Conservation District. The Black Sturgeon Dam on the Black Sturgeon River, Ontario. Photo courtesy of the Ontario Ministry of Natural Resources and Forestry.

Strategy 6: Address other existing and emerging threats that may impact important habitat or native plant and animal communities.

This strategy supports necessary actions around other key issues, emerging threats, and adaptive management needs. Some of the new and emerging issues could include impacts associated with new energy infrastructure, mining, or pollution. Nine sub-strategies have been identified (Table 8):

Table 8: Strategy 6 Sub-strategies

6.1	<i>Promote proactive consideration of important habitat areas and species during environmental assessment and regulatory processes for mining, supported by comprehensive binational mapping (existing and historical mining activities and exploration), shared knowledge of best management practices, best available technologies and other activities, as appropriate.</i>
6.2	<i>Track and reduce atmospheric deposition of persistent, bioaccumulative, and toxic pollutants from in-basin sources through research, voluntary action, and enforcement of controls and regulations.</i>
6.3	<i>Where possible, participate in out-of-basin activities to reduce toxic chemicals from being imported into the Lake Superior basin via atmospheric deposition.</i>
6.4	<i>Eliminate contaminants at levels that are harmful to plants, fish and wildlife by reducing non-point source pollution resulting from flooding, transportation and other sources.</i>
6.5	<i>Integrate green infrastructure principles in coastal development projects.</i>
6.6	<i>Use only certified sustainable forestry practices in the Lake Superior Basin.</i>
6.7	<i>Develop, implement, and integrate early detection and rapid response networks for terrestrial invasive species.</i>
6.8	<i>Track and implement control and/or eradication plans, where feasible, for terrestrial invasive species at appropriate geographic scales.</i>
6.9	<i>Research or monitor potentially new or emerging threats to the biological integrity of Lake Superior.</i>

Some actions can occur at the lakewide scale, but many key challenges will need to be addressed at the regional level. These could include the implementation of best management practices to reduce urban run-off, monitoring for forest pests, and promoting corporate social responsibility.



School children stenciled storm drains to remind Marquette, Michigan, residents where dumped chemicals go. Photo courtesy of Superior Watershed Partnership and Land Trust.

Implementing the Strategy Together

Lake Superior's generally good ecological condition is a result of a strong and ongoing history of action to restore and protect the lake's extraordinary biodiversity. Actions are occurring at all scales – from national, state, provincial, tribal, First Nation, Métis, and municipal programs, to lakewide initiatives, to local projects by communities, businesses, and households.

The Lake Superior Biodiversity Conservation Strategy provides a common framework for the implementation of these actions, and for assessing and reporting on our shared progress. The Lake Superior Binational Program (LSBP) will pursue implementation from all organizations with a mandate to undertake some of the strategies and actions.

As a binational effort, the LSBP's shared role will be to:

- Set lakewide conservation priorities, released annually based on the latest science and progress being made.
- Promote and coordinate actions, such as incorporating the Strategy, where applicable, into the U.S. Great Lakes Restoration Initiative, the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, and other work plans and funding programs of LSBP member organizations.
- Assess and report on progress, including accomplishments and challenges.
- Encourage adaptive management, including updating the strategy every five years in response to results being achieved and lessons learned.



Citizen science programs are a good way to educate and involve citizens in conservation efforts. Photo courtesy of Marilee Chase, Ontario Ministry of Natural Resources and Forestry.

Actions related to the threat from aquatic invasive species, climate change, and dams and barriers are currently the highest priority for conserving Lake Superior's habitats and species.

Corresponding Regional Plans

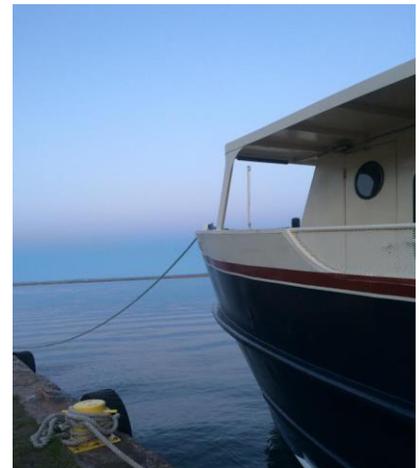
This Strategy recognizes the importance of regional and local actions that conserve Lake Superior's biodiversity. To further guide and support implementation, twenty regional plans have been developed. The regional plans highlight special features, issues and conservation needs that are important to different areas of Lake Superior. These regional plans were developed with regard to detailed mapping of species and habitats, information on threats and issues, and conservation actions that could be taken.

The conditions of Lake Superior's species and habitats are not equal all around the lake. To achieve and sustain the Strategy's goal, it is necessary to understand where species and habitats are in good condition and where they are degraded. It is also necessary to understand what stressors are threatening biodiversity in a particular location to inform future restoration and protection efforts.

Conservation actions in the regional plans are linked to the lakewide conservation targets, threats, and sub-strategies described in this Strategy. These linkages aim to assist in evaluating and demonstrating

the contribution of local projects to conservation goals for Lake Superior and the Great Lakes. Examples of local conservation opportunities that may be found in the regional plans include:

- Michipicoten-Magpie and Agawa region: Local interests could determine the likelihood that mining claims and leases will be surrendered and added to the South Michipicoten River Superior Shoreline Conservation Reserve. This action would contribute to implementation of Strategy 1.1: Restore or protect wetlands, native riparian forests, and coastal habitats, such as rocky shorelines, beaches, and dunes.
- Pic and White region: In line with federal and provincial recovery goals for Woodland Caribou, a strategy could be put in place for the Lake Superior Coastal Range to ensure the population is self-sustaining over the long-term for this range. This action would contribute to implementation of Strategy 2.3: Implement native fish and wildlife species restoration, protection or rehabilitation plans, as appropriate.
- Keweenaw Peninsula and Sturgeon region: Further education and outreach could be taken to and by local anglers and tour operators about how to prevent the establishment and spread of invasive species. This action would contribute to implementation of Strategy 3.11: Undertake outreach, education, enforcement and research on preventing and managing aquatic invasive species.
- St. Louis and Cloquet region: Ways to protect the habitat of the Interstate Island Wildlife Management area from extreme wind and wave actions could be explored. This action would contribute to implementation of Strategy 4.2: Implement adaptation actions to account for changes in variability and/or frequency in air and water temperatures, water levels, storm events, droughts, etc.
- Bad-Montreal region: Replacing selected perched culverts that prevent fish from reaching important habitat, with fish-friendly infrastructure could be undertaken. This action would contribute to implementation of Strategy 5.2: Protect and restore connectivity, where appropriate, by removing dams, upgrading stream/road crossing infrastructure, or other means.



Tour boat on Lake Superior at Marquette. Photo courtesy of Michelle Bruneau, Michigan Department of Community Health.

Regional plans will be adaptive documents that respond to local conservation needs and opportunities.

The latest information available for each regional plan can be found at:

www.natureconservancy.ca/superiorbca

Resources

<http://www.epa.gov/greatlakes/lakesuperior/>

<https://www.ec.gc.ca/grandslacs-greatlakes>



Lake Superior Binational Program members

1854 Treaty Authority

Bad River Band of Lake Superior Chippewa

Bay Mills Indian Community

Chippewa-Ottawa Resource Authority

Environment Canada

Fisheries and Oceans Canada

Fond du Lac Band of Lake Superior Chippewa

Grand Portage Band of Lake Superior Chippewa

Great Lakes Indian Fish and Wildlife Commission

Keweenaw Bay Indian Community

Michigan Department of Environmental Quality

Minnesota Department of Natural Resources

Minnesota Department of Health

Minnesota Pollution Control Agency

National Oceanic and Atmospheric Administration

Natural Resources Conservation Service

Ontario Ministry of Natural Resources and Forestry

Ontario Ministry of the Environment and Climate Change

Parks Canada

Red Cliff Band of Lake Superior Chippewa

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency

U.S. Forest Service

U.S. Fish and Wildlife Service

U.S. Geological Survey

U.S. National Park Service

University of Minnesota Sea Grant Program

University of Wisconsin Sea Grant Program

Wisconsin Department of Natural Resources

Biodiversity Conservation Strategy Website

www.natureconservancy.ca/superiorbca

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