JACK SALEN

THE SWEETWATER SEA

STRATEGIES FOR CONSERVING LAKE HURON BIODIVERSITY

GRACE WONG

THE SWEETWATER SEA

Clear waters chasing up sandy beaches and rippling through mazes of reefs and islands; Osprey screaming and circling overhead; piping plovers darting for insects along the shore; lake sturgeon, lake trout and walleye gliding through the cool, deep water; thousand year-old cedar trees surviving at the edge of sheer limestone cliffs; moss- and lichen-encrusted alvars baking in the sun; red-winged blackbirds bobbing on cattails in sprawling wetland complexes… these are the sights and sounds of Lake Huron.

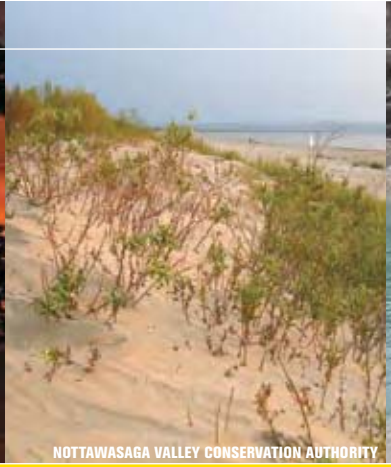
Lake Huron is an ecologically rich and globally significant ecosystem, but its biodiversity is at risk. Invasive species, climate change, water pollution, rapid and poorly planned residential and industrial growth, altered hydrology, and incompatible agricultural, fishery, and forestry practices are all having a negative effect. Degradation and loss of historical habitat has been identified as a major stressor to Lake Huron and its watershed.

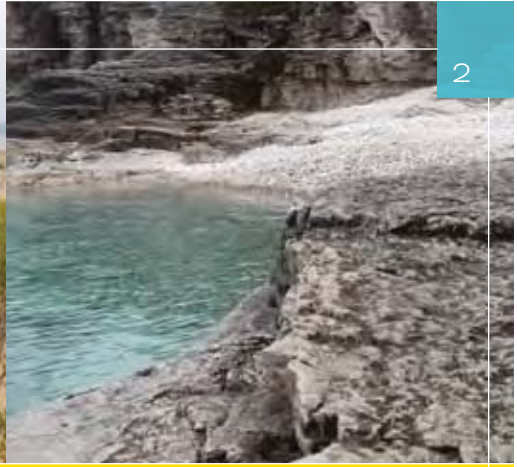
The Lake Huron Biodiversity Conservation Strategy is an international initiative designed to identify what actions are needed to protect and conserve the native biodiversity of Lake Huron. The most critical biodiversity threats and needs of the lake were determined through a collaborative, science-based process. The recommended strategies are meant to restore and conserve a functioning ecosystem. By applying a biodiversity focus to synthesize and prioritize existing related efforts, the Strategy reaffirms and advances complementary plans and initiatives.

This project will increase awareness and collaboration among organizations and communities active in biodiversity conservation with the Lake Huron watershed, and provide a lake-wide context to local conservation actions. The project was led by The Nature Conservancy, Environment Canada, Ontario Ministry of Natural Resources, Michigan Department of Natural Resources and Environment, Michigan Natural Features Inventory, Michigan Sea Grant and The Nature Conservancy of Canada.

WHAT IS BIODIVERSITY?

Biological diversity, or biodiversity, refers to the variety of life, as expressed through genes, species and ecosystems, and is shaped by ecological and evolutionary processes. The full spectrum of biodiversity is essential to maintaining the ecological functions, processes and connections that sustain us and deliver many economic and social benefits. When we conserve biodiversity we also conserve these benefits, such as clean water and air, healthy beaches, hunting and fishing opportunities, productive soils, crop pollination, resilience to weather extremes and drought, flood and pest control.





Project Goals

- Assemble available biodiversity information
- Define an international vision of biodiversity conservation for Lake Huron
- Develop shared strategies for protecting important areas and abating threats
- Promote international coordination of biodiversity conservation
- Provide a framework for measuring, managing and reporting biodiversity conservation efforts
- Support, connect and advance the efforts of previous and ongoing conservation planning efforts across the basin

Overview

The Lake Huron Biodiversity Conservation Strategy is the product of a two-year planning process involving nearly 400 individuals from more than 100 agencies and organizations from around the Lake Huron basin. The Nature Conservancy's Conservation Action Planning process – a proven adaptive management approach for planning, implementing and measuring success for conservation projects – guided the development of the Strategy. This approach helps project teams develop the most effective conservation strategies based on the best available scientific information. The Strategy incorporated scientific information through the scientific literature and consultation with experts. Workshops, conference calls, on-line surveys and meetings provided many opportunities for organizations and individuals to contribute to and review the content of the Strategy.

This process produced the following:

- Selection of biodiversity features that represent the full suite of Lake Huron biodiversity and a health assessment for each feature.
- Identification and ranking of threats to Lake Huron biodiversity including in-depth analysis of the five most critical threats and how they affect biodiversity features.
- Recommended strategies to abate the most critical threats and enhance the health of the biodiversity features.
- Identification of priority biodiversity conservation areas for implementation of strategies based on spatial data analysis.
- Suggested next steps to implement recommendations.

Each of these accomplishments comprises a chapter of the full technical report: *The Sweetwater Sea: An International Biodiversity Conservation Strategy for Lake Huron – Technical Report*, available at www.conserveonline.org/workspaces/lakehuron.bcs

PROJECT SCOPE

The Lake Huron Biodiversity Conservation Strategy focuses on the conservation of the native biodiversity of Lake Huron.

However, threats to biodiversity and the conservation actions needed to abate them may originate from the lake, inland areas in the basin, and even occur outside of the basin. Therefore, scope is dually defined as:

Biodiversity features scope: Lake Huron and associated nearshore and aquatic habitats. This scope focuses on biological diversity of conservation interest.

Planning region scope: Lake Huron basin. This scope focuses on the geographic area that may impact the biological diversity of interest.

SELECTING BIODIVERSITY FEATURES AND ASSESSING HEALTH

Biodiversity features were selected for their ability to represent the full suite of biodiversity within the project area, including its species, natural communities and ecological systems, which are referred to as nested features in Conservation Action Planning terminology. Each biodiversity feature's current "health" status, or viability, was evaluated by defining a set of science-based indicators representing the feature's landscape context, condition and size in the project area (see sidebar). Each indicator is assigned thresholds defining acceptable ranges of variation. These indicators and thresholds provide the basis for rating the status of each feature based on the best available information. Through literature review and expert consultation, work groups evaluated the indicators and developed suggestions for desired condition. The overall state of Lake Huron biodiversity was determined by aggregating the assessments of all the biodiversity features. All indicators are detailed in the technical report.

KEY TERMS

BIODIVERSITY FEATURES: Species, natural communities or ecological systems chosen to represent the overall biodiversity of the project area.

NESTED FEATURES: Species, natural communities or ecosystems whose conservation needs are largely included in a biodiversity feature.

INDICATOR: Measure of the condition of a key ecological attribute that indicates the health of a biodiversity feature or nested feature. A good indicator meets the criteria of being measurable, precise, consistent and sensitive.

OPEN WATER BENTHIC AND PELAGIC ECOSYSTEM: Open water ecosystem beyond the 30-meter bathymetric contour from the mainland or islands, including reefs and shoals.
Nested feature examples: diporeia, lake trout, lake whitefish.
Status: FAIR

NEARSHORE ZONE: Submerged lands and water column of Lake Huron starting at 0 meters in depth (shoreline) and extending to 30 meters in depth, not including areas upstream from river mouths and riverine coastal wetlands.
Nested feature examples: walleye, yellow perch, lake herring, turtles.
Status: FAIR

ISLANDS: Land masses within Lake Huron that are surrounded by water, including artificial islands that are 'naturalized' or support nested targets.
Nested feature examples: colonial nesting waterbirds, globally rare species, migratory bird stopover sites.
Status: GOOD

NATIVE MIGRATORY FISH: Native fish that migrate to and depend on tributaries, nearshore areas, or wetlands as part of their natural life cycles.
Nested feature examples: lake sturgeon, suckers, redhorse, walleye.
Status: FAIR

COASTAL WETLANDS: All types of wetlands with historic or current hydrologic connectivity to, and directly influenced by Lake Huron.
Nested feature examples: migrating waterbirds, eastern fox snake, northern pike.
Status: FAIR

COASTAL TERRESTRIAL SYSTEM: Natural communities from the line of wave action to 2 km inland.
Nested feature examples: sand or cobble beaches, alvars, piping plover, Pitcher's thistle.
Status: FAIR

AERIAL MIGRANTS: Migrating species with high fidelity to Lake Huron, and for whose survival migratory corridors and stopover habitat associated with the lake are crucial.
Nested feature examples: migratory birds, bats, butterflies, dragonflies.
Status: FAIR

The map on page 7 shows the distribution of the biodiversity features across the Lake Huron basin. Note that not all biodiversity features can be mapped due to lack of data or the nature of the phenomenon (e.g. open water benthic and pelagic ecosystem, nearshore zone). Some features were mapped indirectly (e.g., aerial migrants are represented by important bird areas).

INDICATORS AND ADAPTIVE MANAGEMENT

Existing efforts such as the State of the Lakes Ecosystem Conference, Great Lakes Environmental Indicators Project, Lake Ontario Biodiversity Conservation Strategy, The Great Lakes Conservation Blueprint for Biodiversity and accepted science-based indices of ecological health and function such as the Water Quality Index, were considered in selecting indicators and defining thresholds. Indicators identified in the Lake Huron Biodiversity Conservation Strategy can be tracked over time and allow management actions to be adapted in response to the changing status of biodiversity features. In this way we can learn more about which actions and strategies are most effective over time and adjust our actions accordingly. Such an adaptive management approach is recognized as the best way to manage towards sustainability in complex ecosystems where there is considerable uncertainty about the long-term effects of interventions.

IDENTIFYING CRITICAL THREATS

Direct threats to Lake Huron's biodiversity features were identified and ranked to determine which were most critical to maintaining and restoring ecological structure, function and overall health. Expert input helped identify factors that are directly and negatively affecting biodiversity features. Threats were ranked according to scope, severity of impact and irreversibility. Those with broadest impact, across several features, ranked higher than others.

The most critical threats to Lake Huron's biodiversity were:

- Non-native invasive aquatic and terrestrial species
- Housing / urban development, and shoreline alteration
- Climate change
- Dams and barriers
- Agricultural, forestry and urban non-point source pollution

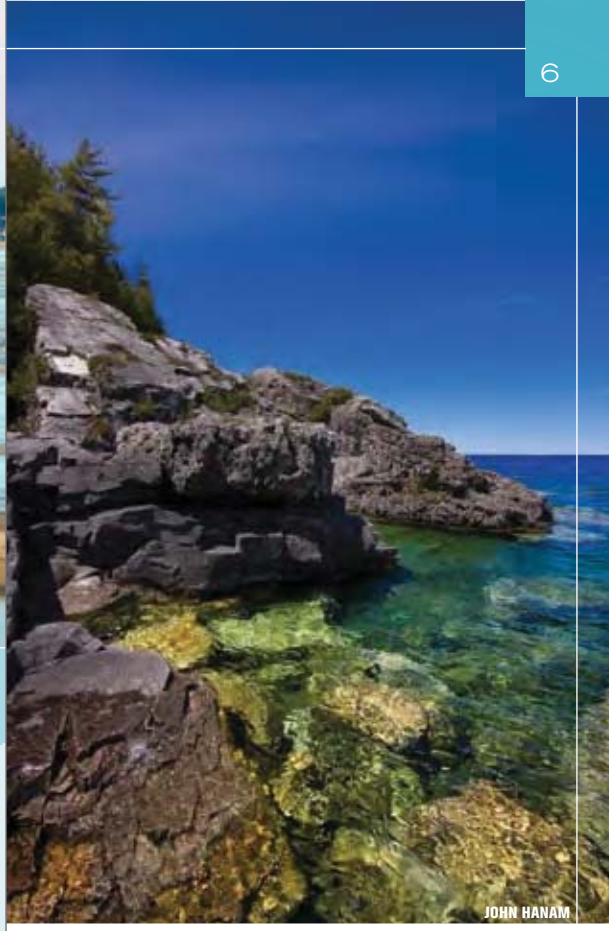
GIS analysis illustrated the location of some of the threats. Some are difficult to map due to the nature of the phenomenon or lack of data (e.g. non-native invasive species, climate change). Coastal Development Footprint is a cumulative index of indicators (building density, road density, artificial shoreline and land cover) that approximates the relative condition of the following biodiversity features: coastal wetlands, the coastal terrestrial ecosystem, islands, aerial migrants and nearshore zone. The map on page 9 displays the Coastal Development Footprint for coastal land units across the basin.

DEVELOPING CONSERVATION STRATEGIES

A thorough understanding of how critical threats and their causal factors influence the health of biodiversity features is necessary for developing conservation strategies. Conceptual models were created to visually illustrate a common understanding of how social, political, economic and environmental systems work together to perpetuate direct and indirect threats to biodiversity features. This effort provided the foundation for identification and development of conservation strategies. Specific conservation strategies were identified along with the threats they address, and how stakeholders and partners might play a role in implementation. After being ranked, the strategies anticipated to be the most effective and feasible were further detailed with goals and objectives. See the table on page 14 for an abbreviated summary of recommended conservation strategies.

IDENTIFYING PRIORITY AREAS

Effective biodiversity conservation requires the identification of priority areas or best bets to better focus limited resources. Priority areas for coastal wetlands, coastal terrestrial features, islands and aerial migrants were identified in a GIS to analyze and map feature distribution, viability and threats. Criteria for analysis were based on key ecological attributes of each feature and critical threats identified in public workshops, a literature review and subsequent expert consultation. Based on these criteria a biodiversity score was calculated for each coastal watershed unit to determine areas with highest concentration of multiple biodiversity features. The map on page 11 highlights areas that are most significant to basin-wide biodiversity.



How to Use this Strategy

- Review the actions within the Strategy to identify areas of synergy with the goals of your organization. Then use the Strategy to:
  - Identify and refine local and regional priorities for conservation actions
  - Justify applications to fund protection or restoration of native biodiversity
  - Inform and educate watershed residents about what they can do to conserve biodiversity in their region
  - Strengthen and enhance your local partnership network
- Incorporate actions from the Strategy into local and regional plans
- Refer to the technical report for consensus-driven principles and themes to guide implementation and monitoring
- Share this summary document with other Lake Huron stakeholders
- Recognize and encourage networks of organizations interested in biodiversity conservation
- Contact a member of the coordinating organizations to access GIS data to support mapping and planning in your local area
- Review the conceptual models of how threats operate on biodiversity features to identify areas for research
- Identify research interests, emerging management issues and monitoring priorities

ECONOMICS OF BIODIVERSITY CONSERVATION

Protecting and enhancing biodiversity makes sense, not just from an ecological perspective, but from an economic perspective as well. Restoring biodiversity is an investment worth making. Austin[1] et al. estimate that full implementation of the Great Lakes Regional Collaboration Strategy[2] (GLRC) would cost $26 billion but could lead to $30-50 billion in short-term benefits for the regional economy, and $50 billion in long-term benefits to the national economy (2007 $US). The recommendations of the GLRC overlap with those of the LHBCS in three important areas: Aquatic Invasive Species Control ($694 million), Habitats and Conservation ($1.43 billion) and Non-Point Sources ($500 million). Such investment in Great Lakes restoration will yield a positive return at multiple scales and time frames.

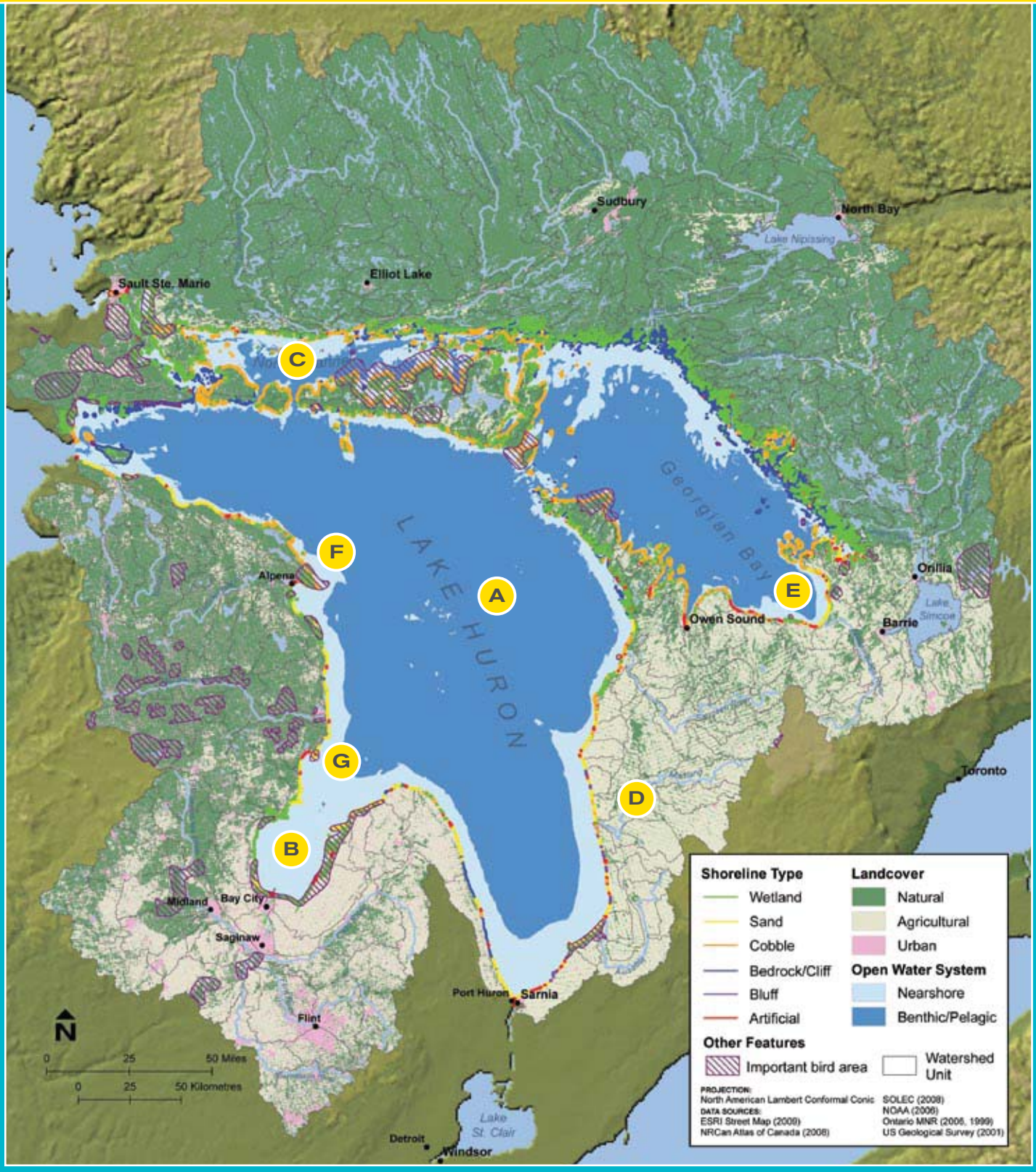
[1]Austin, J. C., S. Anderson, P. N. Courant, and R. E. Litan. 2007. America's North Coast. A Benefit Cost Analysis of a Program to Protect and Restore the Great Lakes. Brookings Institution.

[2]Great Lakes Regional Collaboration. 2005. Great Lakes Regional Collaboration strategy to restore and protect the Great Lakes.

Lake Huron's Biodiversity Features

The following biodiversity features were selected for their ability to represent the full suite of biodiversity within the project area, including its species, natural communities and ecological systems. Effective conservation of these biodiversity features will ensure the conservation of all native biodiversity within functional aquatic and coastal terrestrial ecosystems. These features provide the basis for setting goals, carrying out conservation actions and measuring conservation effectiveness.

Biodiversity Features: Species, natural communities or ecological systems chosen to represent the overall biodiversity of the project area.



A

OPEN WATER BENTHIC AND PELAGIC ECOSYSTEM

Open water ecosystem greater than 30m in depth, including reefs and shoals.
Status: FAIR – 20 indicators; 4 are at target, 6 are close to target, 10 are well below target.
Image: lake trout

B

NEARSHORE ZONE

Submerged lands and water column starting at the shoreline and extending to 30m in depth
Status: FAIR – 23 indicators; 7 are at target, 9 are close to target, 7 are well below target.
Image: fishing Saginaw Bay

C

ISLANDS

Land masses within Lake Huron that are surrounded by water, including both naturally formed and artificial islands that are 'naturalized' or support nested targets.
Status: GOOD – 5 indicators; 4 are at target, 1 is close to target
Image: North Channel islands

D

NATIVE MIGRATORY FISH

Native fish that migrate to and depend on tributaries, nearshore areas or wetlands as part of their natural life cycles.
Status: FAIR – 20 indicators; 6 are at target, 8 are close to target, 6 are well below target
Image: Maitland River

E

COASTAL WETLANDS

All types of wetlands with historic or current hydrologic connectivity to, and directly influenced by, Lake Huron.
Status: FAIR – 13 indicators; 6 are at target, 7 are close to target
Image: Georgian Bay coastal marsh

F

COASTAL TERRESTRIAL SYSTEM

Natural communities from the line of wave action to 2 km inland.

Status: FAIR – 14 indicators; 10 are at target, 4 are close to target
Image: ninebark on Thunder Bay Island shoreline

G

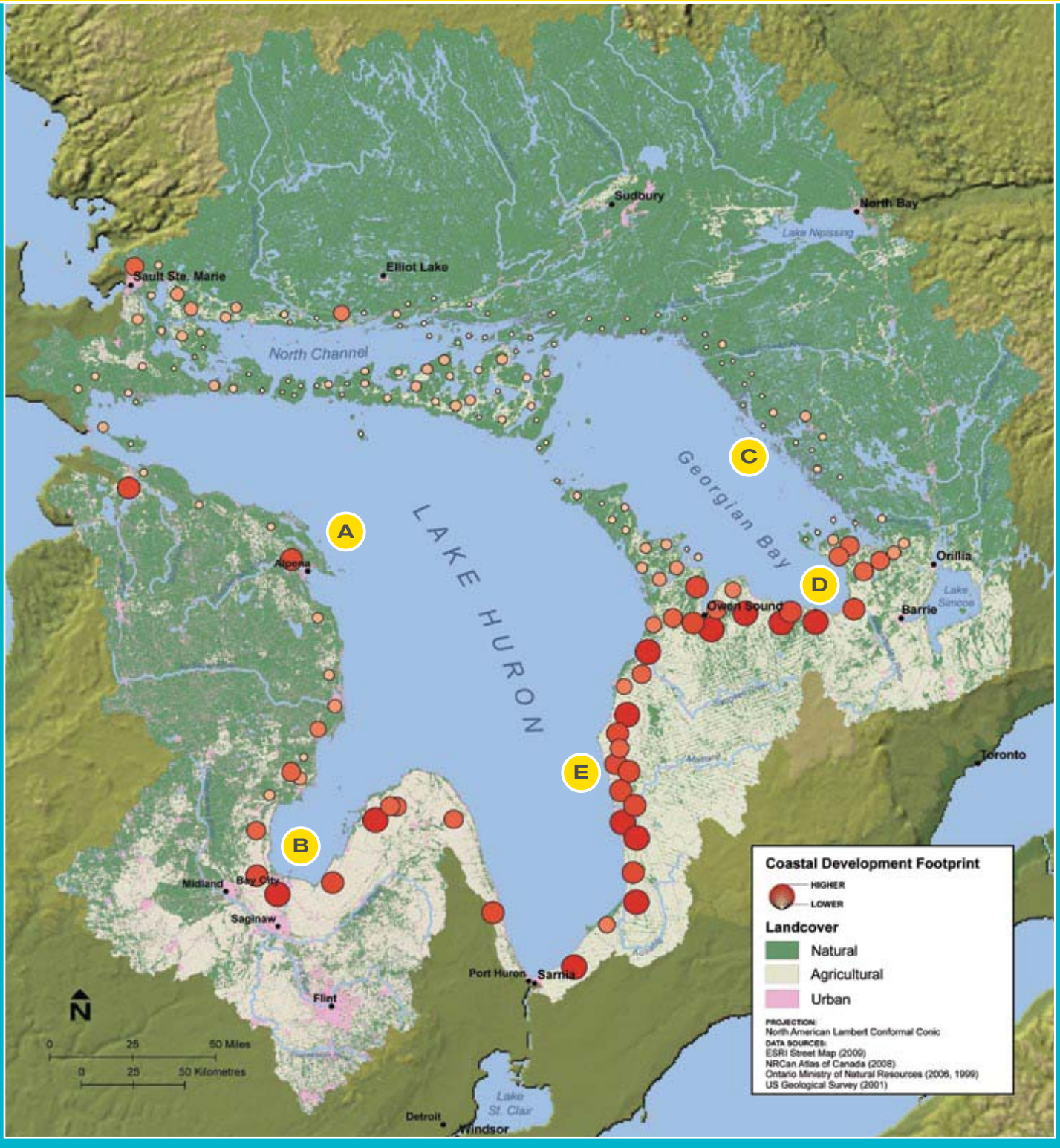
AERIAL MIGRANTS

Migrants that have high fidelity to Lake Huron, and for whose survival migratory corridors associated with the lake are crucial.
Status: FAIR – 18 indicators; 9 are at target, 9 are close to target
Image: birdwatching at Tawas Point

Lake Huron Coastal Development Footprint

Coastal Development Footprint is a cumulative index of indicators (building density, road density, artificial shoreline and land cover) that approximates the relative condition of the following biodiversity features: coastal wetlands, the coastal terrestrial ecosystem, islands and aerial migrants, and nearshore zone. This map displays the Coastal Development Footprint for coastal land units across the basin. Larger circles represent a higher coastal development footprint. These areas (e.g., Saginaw Bay) face more threats to biodiversity than those with smaller footprints (e.g., North Channel).

The areas highlighted below are examples of how some critical threats identified in the Conservation Action Planning process are impacting regional biodiversity. These are not comprehensive case studies, simply examples to place the critical threats into a geographical context. Note that regions across the basin face multiple critical threats.



WHAT ABOUT CLIMATE CHANGE?

Climate change will affect every biodiversity feature. For example:

- **Open Water Benthic and Pelagic Ecosystem:** Increased water temperature and longer stratified period will influence cold-water fish.
- **Nearshore Zone:** More intense storms may lead to failed stormwater and sewage infrastructure and to increased pollution as more runoff enters the watershed.
- **Islands:** Immobile, isolated species may be unable to adapt to rising temperatures.
- **Native Migratory Fish:** Changes to water volume, flow and temperatures can affect distribution and productivity.
- **Coastal Wetlands:** Changes in lake levels affect the area, distribution and abundance.
- **Coastal Terrestrial:** Under low water levels, newly exposed shoreline will be vulnerable to non-native invasive plants.
- **Aerial Migrants:** Vulnerable to loss of key habitats (especially wetlands) or food resources, and disparate changes in the timing of seasonal events.

NORTHEAST MICHIGAN

Shoreline development threatens significant coastal terrestrial habitat in Northeast Michigan. Dams and barriers are a critical threat to native migratory fish and also affect nearshore and coastal ecosystems by altering delivery of sediments and nutrients. The removal or strategic management of small dams is key to restoring stream, coastal, and nearshore ecology and populations of native migratory fish such as lake sturgeon.

SAGINAW BAY

Saginaw Bay is significant for its coastal wetlands and nearshore zone, which provide important habitat for native fish and wildlife species. Invasive species have replaced high-quality wetlands and may contribute to algal accumulation (muck) issues on shorelines. Agriculture contributes to non-point source pollution, and urban land uses lead to combined sewer overflows, both impacting water quality in the nearshore.

EASTERN GEORGIAN BAY

High-quality wetlands and sensitive island ecosystems are at risk due to the increasing desire to develop coastal areas with scenic beauty and recreation value for a variety of interests. Development pressures are highest in the southern part of this region.

SOUTHERN GEORGIAN BAY

Incompatible development and shoreline alterations have resulted in the degradation and fragmentation of nearshore and coastal ecosystems as well as the disruption of natural processes acting on the lakebed and shoreline that create and maintain important coastal and aquatic habitats.

SOUTHEAST SHORES OF LAKE HURON

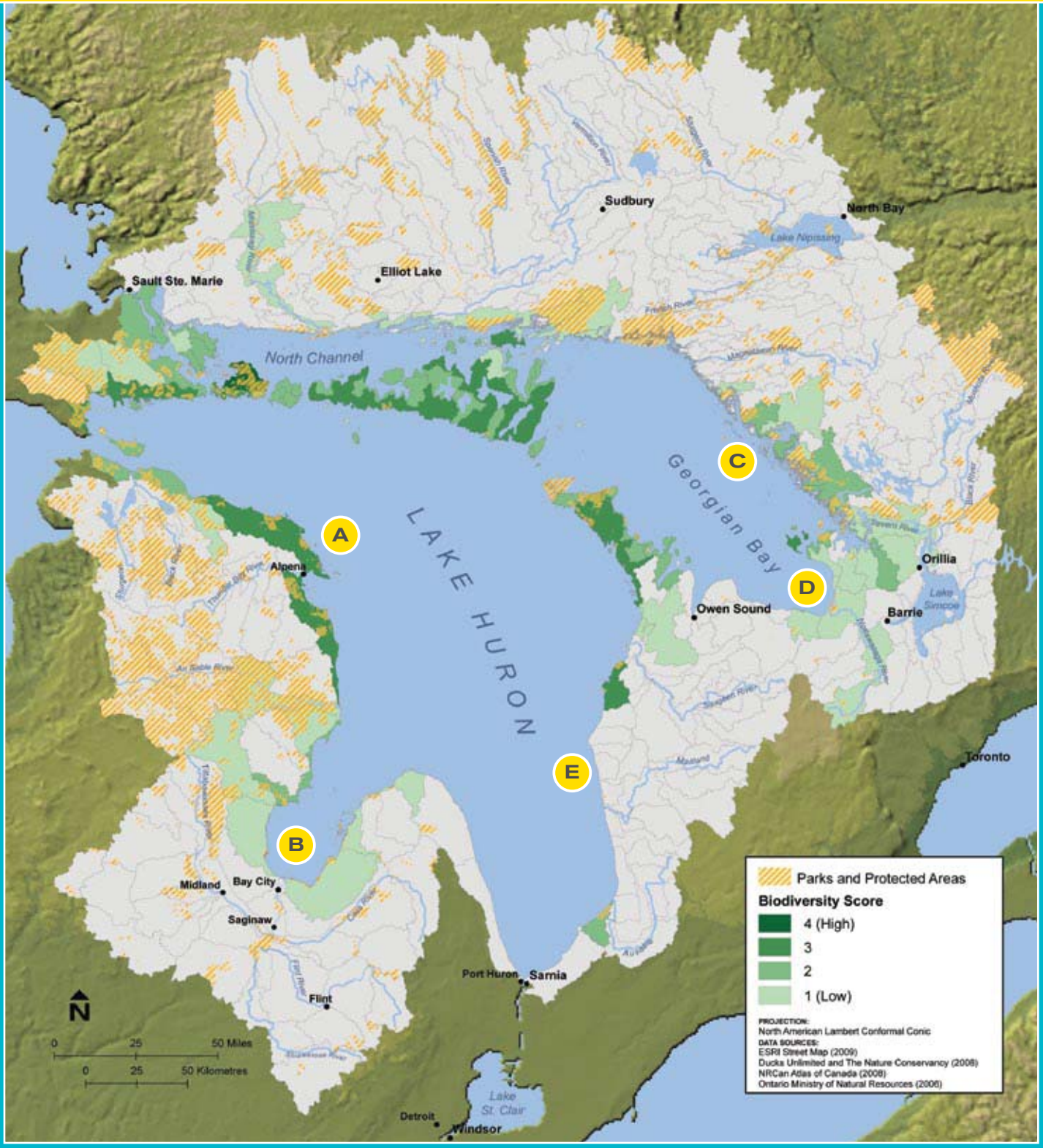
The biological diversity of shoreline between the Bruce Peninsula and Sarnia is at risk because of incompatible development, habitat fragmentation, the spread of phragmites and damage to sensitive coastal environments. Although it has enjoyed a long history of coastal recreational use, the region has been plagued by episodes of poor water quality, algal blooms and restricted use of public beaches due to non-point sources of bacteria and nutrients from surrounding agricultural, rural and urban land use activities.

Important Areas of Biodiversity for Protection or Restoration

This map highlights the coastal areas of Lake Huron that are most significant to basin-wide biodiversity because they contain the highest concentration of multiple features.

The Bruce Peninsula, Eastern Upper Peninsula, Manitoulin Island and Northeast Michigan clearly stand out. However, each region has pockets of significant biodiversity that are ideal for conservation strategies focused on protection.

What about areas that did not score highest for basin-wide significance? These areas still need conservation action! There may be locally or regionally significant areas of biodiversity that present ideal opportunities for restoration-based strategies.



There are many organizations across the basin that are implementing recommended strategies to protect and restore biodiversity, some of which are highlighted below. All of the examples illustrate the value of successful partnerships and coordinated regional efforts.

ABOUT THE MAP

Biodiversity score is an index of basin-wide significance for the following biodiversity features: coastal wetlands, coastal terrestrial, migratory bird stopover habitat and islands. The higher the score, the more significant the area for Lake Huron biodiversity.

Parks and protected areas represent existing land protection efforts and indicate capacity to implement further conservation strategies.

NORTHEAST MICHIGAN

The Huron Pines Small DAMS Program will inventory, assess and prioritize the removal of dams and barriers on streams in Northeast Michigan. Huron Pines has also developed a GIS database, conducted a literature review of dam management information and is developing a “better dams” guidebook. Partners include the Michigan Fly Fishing Club, Michigan Trout Unlimited and US Fish and Wildlife Service.

SAGINAW BAY

The Saginaw Bay Watershed Initiative Network (WIN) is a community-based, voluntary initiative made up of a network of foundations and corporations that support sustainability related projects, prioritizing those building connections and crossing governmental boundaries. WIN has funded multiple projects that support biodiversity conservation in the Saginaw Bay Watershed, including wetland restoration, dam removal, construction of fish passage ramps, stream restoration and rain garden installation and education.

EASTERN GEORGIAN BAY

The Georgian Bay Biosphere Reserve and its partners and supporters protect and enhance the natural and cultural resources of eastern Georgian Bay through stewardship, education, research and monitoring. McMaster University with support from Georgian Bay Forever have been instrumental in mapping and assessing the ecological health of many of the Bay’s coastal wetlands. Carling Township and local landowners recently supported evaluations so that high-quality wetlands can be protected under the Provincial Policy Statement. The Georgian Bay Land Trust has protected several key coastal and island properties.

SOUTHERN GEORGIAN BAY

The Southern Georgian Bay Coastal Initiative is a multi-agency and community-driven partnership that is coordinating a strategic, adaptive and integrated approach to protect and rehabilitate the coastal area between Tobermory and Port Severn. The Initiative has mapped the types and extent of shoreline alteration and coastal and nearshore habitats. This information and the evaluation of the threat of future disruptions can be used to inform and guide regional planning, permitting and sustainable shoreline development decisions in the future.

SOUTHEAST SHORES OF LAKE HURON

The Southeast Shores Working Group is a collaborative effort of federal and provincial agencies, health units, conservation authorities and non-government organizations to promote a science-based approach to identifying water quality issues and recommending remedial measures. Among its many partners, the Lake Huron Centre for Coastal Conservation is active in protecting and restoring Lake Huron’s coastal environment and promoting a healthy coastal ecosystem through education, research and community stewardship.

Lessons from the Maps

The maps depicting Biodiversity Features and Coastal Development Footprint can be viewed jointly to better understand areas with high biodiversity currently under threat or likely to have restoration needs, and areas with high significance that have relatively fewer factors that could threaten the biodiversity features.

WHAT THIS MEANS: Conservation of Lake Huron biodiversity will require both protection and restoration actions.

Comparing the Coastal Development Footprint map with the Important Areas of Biodiversity map, it is clear that the maps do not correlate. While many of the highest biodiversity areas are in areas with low coastal development footprints (e.g., parts of eastern Georgian Bay) there are also pockets of significant biodiversity amidst highly developed areas (e.g., southern Georgian Bay, Saginaw Bay).

WHAT THIS MEANS: Land protection strategies and plans must also consider pockets of biodiversity significance in very developed areas.

On the Important Areas of Biodiversity map, the parks and protected areas layer represents existing land protection efforts and indicates capacity to implement further conservation strategies. Parks and protected areas do not always overlap with areas with high biodiversity significance.

WHAT THIS MEANS: The conservation of Lake Huron's biodiversity is complex and challenging.

Developing Conservation Strategies

The strategies in this table were developed through broad consultation and based on importance and feasibility of implementation. Where possible, strategies were aligned with existing complementary plans to identify gaps and promote and reinforce existing efforts. The following table presents 21 Priority Conservation Strategies that are recommended for implementation within the next 5 years (2011-2015). This is an abbreviated list of all recommended strategies. See the technical report for a complete list of strategies, objectives and associated actions.

TO OUR COLLABORATORS IN THE LAKE HURON BINATIONAL PARTNERSHIP

Protecting and restoring biodiversity involves the coordination of many different professions and the pursuit of management actions by various partners. *The Sweetwater Sea: An International Biodiversity Conservation Strategy for Lake Huron – Technical Report* describes key threats to biodiversity, potential strategies to abate these threats, recommended priority action sites, and indicators that assess the health of Lake Huron's biodiversity. This report, developed through a two-year planning process involving more than 400 individuals from more than 100 agencies and organizations from around the Lake Huron basin, captures a broad range of professional and agency expertise. We ask that you consider this technical report and its recommendations in the development of your basin-wide and individual organization priorities. We look forward to pursuing collaborative efforts to protect and restore Lake Huron's biodiversity in the future.

– James Schardt, Environmental Protection Agency
– Janette Anderson, Environment Canada

STRATEGY	THREAT(S) ABATED	SCALE OF IMPLEMENTATION
1. **LAND AND WATER PROTECTION STRATEGIES** – Land and water protection by governmental and non-governmental organizations represents a key conservation approach. It has been highly successful, but will become more important over time as the threats to Lake Huron become more pervasive.		
1.1 Effectively conserve a system of public and private conservation lands for coastal terrestrial, nearshore zone and island features that are resilient to changes in land use and climate.	Climate Change; Housing and Urban Development and Shoreline Alteration	Regional/Local
2. **LAND AND WATER MANAGEMENT STRATEGIES** – Conservation goals cannot be achieved with direct land and water protection alone. Therefore, strategies that address conservation needs across all lands and waters, whether managed for biodiversity or resource extraction outcomes, are essential. This suite of strategies is directed at achieving conservation goals on managed lands and waters.		
2.1 Implement an integrative approach to barrier management that accounts for ecological and social values.	Dams and Other Barriers	Lake Huron Basin-wide
2.2 Implement improved septic technologies, including conversion of targeted septic systems to municipal or communal sewage systems.	Non-point Source Pollution	Lake Huron Basin-wide
2.3 Implement targeted agricultural best management practices (BMPs) to address non-point source pollution impacts to Lake Huron biodiversity.	Non-point Source Pollution	Regional/Local
2.4 Develop and implement an integrative, adaptive, and harmonized framework for coastal management within selected US and Canadian geographic regions.	Housing and Urban Development and Shoreline Alteration	Regional/Local
2.5 Restore priority coastal terrestrial, nearshore zone and island features.	Housing and Urban Development and Shoreline Alteration	Regional/Local
2.6 Develop and implement programs that identify and conserve priority coastal terrestrial, nearshore zone and island habitats.	Housing and Urban Development and Shoreline Alteration	Lake Huron Basin-wide
3. **SPECIES MANAGEMENT STRATEGIES** – A comprehensive biodiversity conservation strategy must not only address ecological systems and processes, but also species management, especially for species that contribute to ecosystem and human health.		
3.1 Restore native populations of Lake Huron's aquatic and terrestrial species.	Non-native Invasive Species and other threats	Regional/Local
4. **EDUCATION AND AWARENESS STRATEGIES** – Effective conservation frequently relies on strategies that involve awareness and education of agencies, organizations, communities, and individuals, all of whom directly and indirectly benefit from a healthy Lake Huron ecosystem. Here we propose a suite of strategies designed to incorporate biodiversity values into resource management decisions.		
4.1 Enhance knowledge, technical skills and information exchange to build capacity of local policy and land use planning authorities to include biodiversity values into their decisions.	Housing and Urban Development and Shoreline Alteration	Regional/Local
4.2 Better educate the public on climate change issues: by creating credibility and a sense of urgency for climate change mitigation strategies being implemented across the basin, and by providing information about observed and expected climate changes effects in Lake Huron that is easily understood.	Climate change	Great Lakes Basin-wide
4.3 Increase community engagement, awareness, understanding and commitment to coastal terrestrial, nearshore zone and island conservation.	Housing and Urban Development and Shoreline Alteration	Regional/Local
5. **LAW AND POLICY STRATEGIES** – Biodiversity related legal mechanisms include law and policy strategies that address widespread threats that cross political boundaries. Below we highlight one highly ranked strategy to address a pervasive threat across the entire Great Lakes basin.		
5.1 Eliminate ballast water as a vector for invasive species introductions.	Non-native Invasive Species	Great Lakes Basin-wide
6. **LIVELIHOOD, ECONOMIC AND OTHER INCENTIVES STRATEGIES** – Biodiversity conservation is frequently more successful when livelihood and economic incentives are linked with strategy development. Here we propose a strategy recognizing conservation activities that acknowledge ecosystem services.		
6.1 Develop programs to provide economic incentives for protection or restoration of ecosystem services.	Non-point Source Pollution	Lake Huron Basin-wide
7. **EXTERNAL CAPACITY BUILDING STRATEGIES** – Two highly ranked strategies that address external capacity building highlight the need to address information management and invasive species management.		
7.1 Develop and implement a data and knowledge management system designed to guide future conservation actions and effectively track implementation efforts.	All	Great Lakes Basin-wide
7.2 Form early detection / rapid response teams to eradicate new invasive species before they become established.	Non-native Invasive Species	Lake Huron Basin-wide
8. RESEARCH STRATEGIES – While the conservation community of the Lake Huron basin has achieved tremendous success over the past decades, there still remain gaps in our basic scientific knowledge that limit our ability to implement a comprehensive biodiversity conservation strategy. Here we highlight a suite of strategies designed to fill such gaps.		
8.1 Establish a system for monitoring biodiversity and climate change in sentinel watershed sites.	Climate Change	Great Lakes Basin-wide
8.2 Assess the value of ecological goods and services provided by Lake Huron, including how values are altered under climate change scenarios.	Housing and Urban Development and Shoreline Alteration; Non-point Source Pollution; Climate Change	Great Lakes Basin-wide
8.3 Develop a Lake Huron-wide risk assessment that informs strategies for the prevention of invasive species.	Non-native Invasive Species	Lake Huron Basin-wide
8.4 Conduct place-based research and development of control techniques for non-native invasive species.	Non-native Invasive Species	Regional/Local
8.5 Conduct a comprehensive watershed assessment of key action areas for mitigation of agriculture, urban and forest non-point source pollution, with special regard for areas important to biodiversity features and areas where climate change is expected to exacerbate current problems.	Non-point Source Pollution; Climate Change	Lake Huron Basin-wide
8.6 Enhance research and monitoring of the nearshore zone and coastal terrestrial margin.	Strategy Housing and Urban Development and Shoreline Alteration	Great Lakes Basin-wide

WANT TO LEARN MORE?

The complete Lake Huron Biodiversity Conservation Strategy process and results are detailed in *The Sweetwater Sea: An International Biodiversity Conservation Strategy for Lake Huron – Technical Report*, available at www.conserveonline.org/workspaces/lakehuron.bcs

PARTICIPATING ORGANIZATIONS

The Lake Huron Biodiversity Conservation Strategy reflects the input of nearly 400 individuals representing over 100 agencies, conservation authorities, universities and non-governmental organizations as well as additional input received at the local level. In particular, the authors acknowledge the guidance and support of the project Steering Committee members:

Janette Anderson (Co-Chair) / Greg Mayne, Environment Canada

Amy Derosier / Tammy Newcomb / Jim Bredin / Michelle Selzer, Michigan Department of Natural Resources and Environment

Ted Briggs, Ontario Ministry of the Environment

Pat Carr, Michigan Conservation Districts

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Mike Ripley, Chippewa/Ottawa Resource Authority

Peter Roberts, Ontario Ministry of Agriculture

Jamie Schardt (Co-Chair), U.S. Environmental Protection Agency

Brian Tucker, Metis Nation

EXISTING EFFORTS

The LHBCS aims to support, connect and advance the efforts of previous and ongoing conservation efforts across the basin. Strategies from the following plans, initiatives and agreements were integrated in the LHBCS:

- The Great Lakes Water Quality Agreement
- The Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem
- The Great Lakes Fishery Commission's Fish-Community and Environmental Objectives for Lake Huron
- Lake Huron-Georgian Bay Watershed Framework for Community Action
- The Michigan Great Lakes Plan: Our Path to Protect, Restore, and Sustain Michigan's Natural Treasures
- Partners in Flight Bird Conservation Plans
- The Michigan Wildlife Action Plan
- Lake Huron Binational Partnership Action Plans
- SOLEC Ecosystem Status and Trends: Draft Great Lakes Report – Lake Huron Chapter
- Great Lakes Regional Collaboration Strategy
- Biodiversity and Conservation Atlas of Great Lakes Islands

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