Section 6:Habitat

Photo: Scott Gillingwater

6.1 Introduction

The Lake Erie LaMP has identified habitat loss and degradation as one of the top three stressors that must be addressed to restore Lake Erie. The alteration of natural lands through the loss of forests, wetlands, grasslands, and changing hydrology has had marked effects on biotic processes and fish and wildlife populations in the Lake Erie basin.

The Lake Erie LaMP beneficial use impairment assessment found fish habitat in Lake Erie tributaries, coastal wetlands and nearshore areas to be impaired. Over 80% of historical coastal wetlands have been lost and most of those remaining are diked or have degraded physical or chemical properties. All 15 of the general habitat types representative of, and inextricably tied to, the aquatic components of the Lake Erie environment are impaired within at least one Lake Erie basin jurisdiction. Degradation of 14 of these habitat types are resulting in unmet wildlife population management objectives for particular wildlife species. Upland marsh, wet meadow, emergent macrophyte, bog/fen and interdunal wetlands are the five most commonly degraded habitats responsible for this problem. Benthic habitats in the lake have also been lost or disturbed. The loss of chironomid larvae and benthic invertebrate diversity in Lake Erie tributaries indicates that these habitats are also degraded.

In addition to loss of habitat, the beneficial use impairment assessments identified the loss of ecological function, or how efficiently the habitat supports the biological community that inhabits it. For example, dams prevent fish from swimming upstream to spawn; dredging and/or filling wetlands create avenues for non-native invasive species, such as purple loosestrife, to take hold and proliferate, greatly reducing the nutritional value provided by the wetland. Ecological function is impaired not only because of outright habitat destruction, but also because of anthropogenic activities that have increased sediment loads, raised soil and water temperatures, and altered river flows and hydrology. There is a direct connection between land use, nonpoint source runoff and habitat quality.

In order to address the key issue of habitat loss and alteration, the Lake Erie LaMP 2000 document sought to present a habitat action plan. With the emphasis on “action”, the LaMP 2000 report focused on identifying ongoing or planned projects that would preserve habitat or restore impairments and serve to meet the ecological objectives of the LaMP.

There are already a large number of habitat projects underway around the basin by a variety of agencies and local groups. Considerable review suggested there was a larger need for strategic planning rather than just listing and prioritizing projects for implementation. It is the LaMP's role to determine what it can best do, from a value added perspective, to tie existing efforts together and address gaps to see impacts/results on a lakewide basis. So LaMP efforts focused on developing a habitat strategy.

The habitat strategy developed for the Lake Erie LaMP provides a framework to guide and coordinate habitat protection and restoration efforts in the Lake Erie basin. The focus of the habitat strategy is on habitat preservation, restoration and improving the ecological function of habitats. It also considers the preservation, restoration and enhancement of the ecological processes that create and maintain habitats. The LaMP recognizes that implementation of the habitat strategy will be done largely through linkages with already existing programs. A number of these programs are referenced in the beneficial use impairment assessment reports addressing habitat and in the habitat section of the LaMP 2002 report. Others are mentioned at the end of this chapter. It is most important to remember that this habitat strategy was developed so LaMP partner agencies can incorporate these ideas into their own agency programs to better direct/redirect their programs to influence habitat quality around the Lake Erie basin and to be more in line with the goals of the Lake Erie LaMP.

The Habitat Strategy is presented below.

6.2 Lake Erie LaMP Habitat Strategy

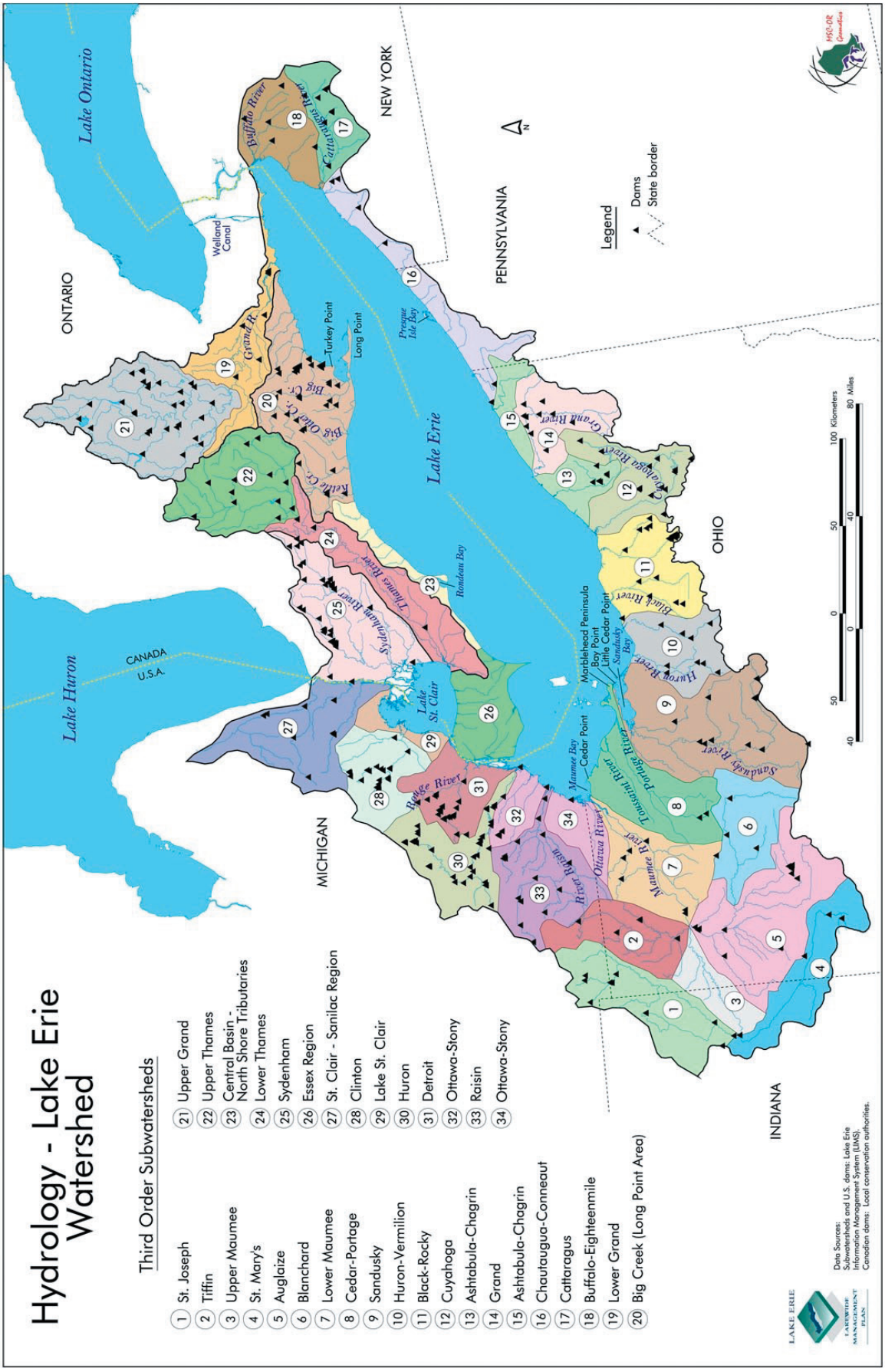
The loss and fragmentation of aquatic and terrestrial habitats is affecting ecosystem function in Lake Erie and its watersheds (Figure 6.1). The 1995 Lake Erie LaMP Concept Paper identified habitat loss and degradation as one of the three key stressors that must be addressed to restore Lake Erie. Several beneficial use impairment reports have also outlined impairments to terrestrial, tributary, shoreland/wetland, nearshore and offshore habitats that are affecting benthic invertebrate, fish and wildlife populations (Ciborowski in prep.; Halyk and Davies 1999; Lambert et al. 2001; Lake Erie LaMP 2000; Lake Erie LaMP 2002).

Recent results from a Lake Erie LaMP ecosystem objective modeling process have shown that land use is a key factor responsible for impairments to Lake Erie, along with nutrient loading, natural resource use (exploitation)/disturbance and contaminants. All of these factors need to be managed to protect, restore and rehabilitate habitats and their integrity in the Lake Erie basin. This strategy presents some key objectives that the Lake Erie LaMP partners are working toward over the next few years.

Guiding Principles

The habitat strategy for the Lake Erie LaMP must adopt a holistic program for conserving the biodiversity and ecological processes in both terrestrial and aquatic systems in the Lake Erie basin. Protection of natural habitats is the primary goal followed by habitat restoration and then habitat rehabilitation. Due to limited resources, funding efforts may focus on programs that will restore the integrity of aquatic systems in lake-effect habitat zones (e.g., lower reaches of tributaries) and Lake Erie proper. In moving forward with the habitat strategy and research on habitat issues, Lake Erie LaMP partners will adopt seven principles to conserve aquatic biodiversity adapted from Noss and Cooperrider (1994). LaMP agencies will use the guidelines and following objectives and actions in some priority (target) watersheds, monitor the success of this approach, and adapt the process if management actions are not having noticeable, positive impacts on Lake Erie habitats. The LaMP approach will build on existing habitat initiatives and seek to support areas where LaMP partner agencies have already directed habitat project funding. The hope is that the LaMP can show that these principles, if taken to heart by management agencies and management programs, can expedite positive change in Lake Erie basin habitats.

Figure 6.1: Hydrology of the Lake Erie Watershed



1. **Scale** - Address aquatic and terrestrial issues at the proper scale of resolution (ecoregions and ecodistricts, ecological drainage units, watershed/subwatershed, etc.). Watersheds or hierarchical classifications of watersheds (e.g., tertiary, quaternary) are generally regarded as the proper units for aquatic system management. Gene and species level research on plant and animal populations within the Lake Erie basin is another valuable component that could be used to define scale. For example, a genetically unique population of walleye in the Grand River (ON) is being considered for management options in the watershed.

2. **Baseline** - The baseline for management should be pre-European settlement vegetation communities in terrestrial landscapes and historical flow patterns for aquatic systems. In some cases, guiding principles clearly reflect the ideal scenario that may never be achievable in a heavily human-influenced system such as Lake Erie. Restoration and rehabilitation efforts need to approximate original flow patterns, natural seasonal cycles, and continuous (i.e., un-fragmented) landscapes, wherever possible, to restore ecosystem processes and habitat function.

3. **Integrated management of land and water** - Better integration of aquatic and terrestrial ecosystem planning will be key to the success of the Lake Erie LaMP. The Lake Erie ecosystem objective modeling process (Colavecchia et al. 2000) showed that lake conditions largely result from human activities on land.

4. **Protected areas** - A well-dispersed network of protected areas (reserves) or habitat refugia with natural ecosystem features is needed to restore and maintain biodiversity. Habitat fragmentation effects and corridors should be considered in the selection and management of new protected areas. Although pristine conditions will no longer occur in many areas of the Lake Erie basin, the aim should be to restore areas and include them in protected area systems, wherever possible. Place priority on protection of areas of high native species diversity, species endemism, number of species at risk or species of management concern, and areas of critical importance to aquatic systems. Areas adjacent to these high priority areas would then receive secondary priority.

5. **Restoration goals and priorities** - Restoration should focus on restoring underlying habitat structuring processes and solving root causes of environmental problems (e.g., restoring hydrological function, migratory pathways). Work toward removing existing problem areas that may cause extreme damage to watersheds now or in the future. Problems could include contaminated sites and sites with high nutrient inputs (either due to agricultural runoff or insufficient wastewater treatment). Set priorities on activities that accomplish the most good for the least investment. Ensure that cost-benefit analyses be done at a larger scale (landscape, watershed) than just simply on a project-by-project basis. Take into consideration the cumulative effects of protection and restoration activities.

Photo: Scott Gillingwater

6. **Key threats to aquatic systems -**
   Dams and diversions - Avoid construction of new dams and diversions unless these structures provide a net benefit to the Lake Erie fish community such as in the management of non-native invasive species, or unless appropriate measures to mitigate fish community effects are included in the construction. Barriers are an important component in the control of non-native invasive species such as sea lampreys. Removal projects should address the implications of range expansion of non-native invasive species, impacts of changed hydrology, potential impacts from disturbed sediments, biodiversity, and overall benefits to aquatic systems.

   Non-native invasive species - Work toward prevention of future introductions of non-native invasive species in the Lake Erie Basin. Control or eliminate established non-native invasive species wherever possible.

7. **Address key and emerging information needs** - Inventory, monitor and conduct research to continue to conserve and restore terrestrial and aquatic biodiversity in the Lake Erie basin. Policy is needed to accommodate shoreline habitat protection and private interests related to the impacts from fluctuating lake levels and climate change.

Goals

1. Protect and maintain high-quality habitats and the ecosystem processes that sustain them in the Lake Erie basin. To help accomplish this, guide development practices and land use practices such that they maintain or minimize impacts to ecological processes.

2. Restore, rehabilitate, enhance and reclaim degraded habitats and impaired hydrological function in the Lake Erie basin. Emphasis will be placed on habitats in the lake-effect zone of tributaries influencing Lake Erie.

3. Continue to promote the recognition that non-native invasive species have negative impacts on habitats in the Lake Erie ecosystem. Work toward prevention of further introductions of non-native invasive species into Lake Erie. Work towards controlling and reducing, where feasible, existing non-native invasive species.

4. Develop an integrated framework that will result in a consolidated vision of habitat for Lake Erie by adopting a common, basinwide standard for classifying, mapping, evaluating, tracking, and valuing habitats, their key attributes, and their regulating factors.

General Objectives

Objective 1: Expand and improve connectivity and habitat function of protected areas network in Lake Erie Basin

Short term actions:
- Network with other groups to identify existing protected areas and possibilities for expanding the protected areas network.
- Identify existing special management zones/protection measures for lake use (e.g., boating, hunting and dredging restrictions) designated by all government agencies (i.e., federal, provincial, regional and municipal).
- Support opportunities for the establishment of appropriate conservation areas (e.g., National Marine Conservation Areas) in Lake Erie.
- Encourage protection of more natural areas in the Lake Erie basin.
- Determine research needs, information gaps, and additional programs to further habitat protection/restoration and improve habitat function through the Lake Erie Millennium Network.

- Encourage better management practices in landscapes containing natural areas or in buffer zones surrounding natural areas. Implement measures to address erosion and runoff, reduce nutrient loadings, and pesticide use in the basin.
- Establish more functional linkages between protected areas throughout the watershed, particularly in priority watersheds.
- Characterize submerged moraines such as the Norfolk moraine.
- Establish an emergency response framework to protect key habitats in the Lake Erie basin from development pressures and emerging issues (e.g., West Nile virus and potential larvicide/adulticide spraying in wetland habitats).

Longer term actions:

- Incorporate lake objectives for benthic, fish and wildlife habitat into other initiatives.
- Encourage adoption/implementation of any relevant Lake Erie LaMP indicators by groups and agencies working in protected areas management.
- Characterize other submerged moraines and other lake bed features in Lake Erie.

Photo: Upper Thames River Conservation Authority

Objective 2: Restore, rehabilitate or reclaim functional habitats and ecosystems

Short term actions:

- Identify and focus efforts on some pilot watersheds and work to ensure that management plans adequately address lake-effect zones of tributaries along with headwater and upper tributary sections. Target efforts in reaches of tributaries that will have the most benefit to the health of Lake Erie. Identify key actions needed in tributaries to improve ecosystem function (e.g., dam removal, habitat protection/ restoration, modification of land use practices, etc.) and hold workshops to initiate action. Monitor before, during and after restoration.
- Prepare status reports for priority watersheds (if necessary) that outline the current status of the system, including headwater and upper reaches of the tributary. Encourage work in headwater areas if they are key contributors, although this will not be the focus of LaMP efforts.
- Identify and characterize the condition of priority habitats for restoration work. Determine where Lake Erie LaMP habitat priorities match or overlap with priorities and objectives of other habitat protection and restoration initiatives.
- Notify agency offices in the Lake Erie basin of LaMP habitat protection and rehabilitation priorities to encourage more funding for rehabilitation work. Review and evaluate grants, loans and other financial assistance programs to determine their current and potential impact on improving Lake Erie habitats.
- Identify any restoration and rehabilitation efforts already recommended or underway in the Lake Erie basin, particularly in priority watersheds. Provide input, from a Lake

Erie LaMP perspective, to habitat protection and restoration efforts in the 12 AOCs in the Lake Erie basin.
- Facilitate and encourage the adoption of sustainable land use practices in priority watersheds and throughout the basin. Hold local workshops to draw together communities and explain goals and targets of land use/habitat components of the Lake Erie LaMP. Network with individuals implementing federal, state/provincial agricultural improvement programs.
- Raise awareness of Lake Erie LaMP among member municipalities. Prepare a short (5-10 minute) presentation about the LaMP.

Longer term actions:
- Develop targets to work toward in terms of habitat and biodiversity protection in the Lake Erie basin through LaMP indicators process.
- Examine existing management strategies for tributaries in the Lake Erie basin, watershed/subwatershed management plans, and relevant policies and legislation for gaps that need to be addressed to meet Lake Erie LaMP habitat restoration objectives.
- Provide input to the RAP teams working on AOCs on the testing and outcomes of Lake Erie LaMP indicators.
- Protect habitats from further chemical contamination and encourage restoration of contaminated sites.

Objective 3: Prevent further introductions of aquatic and terrestrial non-native invasive species and reduce their impacts on habitat in the Lake Erie basin

Short term actions:
- Identify initiatives, policy/legislation, and remedial options available for aquatic and terrestrial non-native invasive species in the Lake Erie basin. Actively work toward development and implementation of legislation and policies protecting Lake Erie from further invasions.
- Publicize need for prevention of further non-native invasive species introductions by holding workshops and information sessions at key forums.
- Facilitate preparation of educational materials for the public and politicians.

Objective 4: Produce a binational map of the Lake Erie Basin

- Introduce an integrated, binational mapping system for the Lake Erie basin that identifies land use, habitat types, elements of species biodiversity, and key hydrological and physiographic features. This mapping system will harmonize existing spatial data in the Lake Erie basin and contribute information to setting restoration priorities for the Basin.
- Hold workshops to expedite the development of a binational map that can be used in setting priorities for habitat protection and restoration, monitoring change in habitat quantity and quality over time, and public education about the biodiversity of Lake Erie.
- Adopt habitat classification systems. Use standardized habitat zones and biologically defensible classifications that reflect functional use and interrelationships of each watershed and the Lake Erie basin as a whole.
- Incorporate biodiversity layers and physiographic layers and use to help in identifying areas for protection/restoration and monitoring change (ideally habitat improvements) over time.
- Attempt to classify Lake Erie and associated watersheds in terms of focal or refuge habitats, adjunct habitats, nodal habitats, source areas, and degraded habitats.
- Use elements of this map with information at the appropriate scale in land use zoning and setting restoration priorities across the Lake Erie basin.

Objective 5: Increase public awareness and involvement in protecting and restoring Lake Erie habitats

- Publicize information concerning habitat and biodiversity in the Lake Erie basin; protection, restoration and reclamation efforts; policies and regulations relating to biodiversity and key threats to biodiversity (e.g. non-native invasive species); and encourage public involvement in Lake Erie protection and restoration efforts.
- Develop and distribute brochures, CDs, and/or fact sheets for priority watersheds. Coordinate, where possible, with existing watershed, habitat stewardship or lake programs.
- Communicate habitat protection and restoration success stories in the Lake Erie basin. Link reporting with existing stewardship activities/programs first, wherever possible.
- Develop 4-6 page summary of broad-scale impacts of non-native invasive species on habitats in the Lake Erie basin.
- Catalogue existing habitat protection and restoration information, and put together a "habitat toolbox" for distribution.

Objective 6. Implement a monitoring strategy that tracks changes in habitat quality and quantity and measures the success of protective and restorative activities to improve our understanding of ecological function and, ultimately, the effectiveness of subsequent projects

Short term actions:

- Monitor progress in habitat protection and restoration on Lake Erie through existing programs and newly created programs.
- Use existing monitoring tools with relevance to Lake Erie habitat goals (e.g., habitat guidelines, documents setting conservation targets, etc.).
- Use combination of GIS-based tools and maps, decision-support systems, and selected indicators relevant to habitat and ecosystem function to evaluate progress in protecting habitats.
- Review adoption/implementation of habitat guidelines and natural heritage plans by municipalities in priority watersheds and elsewhere in the Lake Erie basin.

Longer term actions:

- Use indicators and targets developed by Lake Erie Millennium Network to monitor habitats and changing land use at the appropriate scale (e.g., watershed, subwatershed) and by various habitat zones and types.

Definitions

Habitat - The Lake Erie LaMP Habitat Strategy will use the following definition for habitat: "the dwelling place of an organism or community that provides the requisite conditions for its life processes" (SER 2002). Some attributes of habitat include:

- "The four basic necessities for wildlife (i.e., food, water, shelter, and space to survive) which are needed in sufficient supply and structural arrangement to meet an animal's life needs. Wildlife habitats vary over space, time and depending on the life cycle of individual species" (Lambert et al. 2001).
- "Specific locations where physical, chemical and biological factors provide life support conditions for a given species" (IJC 1989). This definition would include non-structural environmental factors such as light intensity, water temperature, dissolved oxygen concentrations, dissolved nutrients, turbidity, water mass movement or thermal regime.

Habitat structure and function - Structure and function can be examined from various perspectives, including productivity, efficiency, linked ecological processes, biodiversity and biological integrity (Halyk and Davies 1999).

Photo: Upper Thames River Conservation Authority

Ecological processes or **ecosystem functions** refer to the dynamic attributes of ecosystems, including interactions among organisms and interactions between organisms and their environment (SER 2002). **Ecosystem functions** can refer to those dynamic attributes that most directly affect metabolism, principally the sequestering and transformation of energy, nutrients and moisture (e.g., trophic interactions, mineral nutrient cycling, decomposition) while **ecosystem processes** refers to dynamic attributes such as substrate stabilization, microclimatic control, differentiation of habitat for specialized species, pollination, and seed dispersal (SER 2002).

Restoration - Process of working to return a habitat or ecosystem to its original (pre-settlement) state by removing the cause of degradation. Requires an understanding of the physical, chemical and biological processes within an area (e.g., watershed) while recognizing land uses that have caused structural and functional damage to the ecosystem. Goal is to re-establish the pre-existing biotic integrity in terms of species composition and community structure (SER 2002).

Rehabilitation - Process of working to recover natural functions, ecosystem processes, productivity and services within the context of the existing disturbance(s) (SER 2002).

Reclamation - Process to recreate the functions and processes of a naturally stable ecosystem with the understanding that it will be quite different from the condition prior to the disturbance. Main objectives of reclamation may include the stabilization of the terrain, assurance of public safety, aesthetic improvement, and usually a return of the land to a "useful purpose" (SER 2002). For example, a reclaimed area may be re-vegetated but this may involve the establishment of a limited number of only one or a few species (SER 2002).

Enhancement - Any manipulation of the physical, chemical, or biological characteristics of native habitat that improves its value and ability to meet specified requirements of one or more species. The manipulation changes the specific function(s) or the seral stage present. Examples include practices conducted to increase or decrease a specific function or functions for the purpose of benefitting species at risk and practices conducted for the purpose of shifting a native plant community successional stage. Enhancement does not encompass routine maintenance and management activities, such as annual mowing or spraying for unwanted vegetation (USFWS - http://southeast.fws.gov/partners/pfwdef.html).

Pilot or Target Watersheds (short term - next 5 years)

The LaMP approach for the habitat strategy is to target some key watersheds that are believed to have key linkages to habitat and biodiversity in Lake Erie, monitor and evaluate the success of this approach in these target watersheds, and determine whether this is a valid approach to use or whether another approach is needed. Factors influencing the selection of these watersheds include substantial impacts on habitat or biodiversity in Lake Erie proper; impacts that have been identified through LaMP beneficial use impairment assessment reports or other information collected through the Lake Erie LaMP process; a large drainage basin; efforts already underway in the watershed; funding and/or community support; and data availability.

1. Grand River, Ontario
2. Thames River, Ontario
3. Big Otter Creek, Ontario
4. Rondeau Bay, Ontario
5. Sydenham River, Ontario
6. Maumee River, Ohio
7. Cuyahoga River, Ohio
8. St. Clair River and Detroit River Corridor

(No ranking is implied in the listing above).

Criteria and Available Tools to Use to Select Other Target Watersheds (longer term - 5 years and beyond)

Other watersheds will be selected for protection and restoration efforts over the course of the Lake Erie LaMP. Criteria and tools that may be used to assist in the selection process of additional watersheds over the longer term will include, but not be limited to the following:

Criteria

- drainage area/volume, water flow (e.g., mean monthly flow)
- sediment input or loadings to Lake Erie (e.g., Rasul et al. 1999)
- destructive or habitat-altering adjacent land uses
- nutrient loads
- areas with habitat programs underway and community interest
- turbidity
- ecological sustainable water use
- biodiversity
- vulnerability of watershed to development, habitat degradation
- productivity

Tools

- Biodiversity Investment Areas (BIAs) - Nearshore Terrestrial Ecosystems (Mysz et al. 1998). This study selected Lake St. Clair/Detroit River, Western Lake Erie, Presque Isle and Long Point as shoreline BIAs based on ecological features and values.
- Biodiversity Investment Areas - Aquatic ecosystems (Koonce et al. 1998). This study selected 14 sites in Lake Erie and Detroit River as candidate BIAs; tributaries included Grand River, OH; Maumee River, OH; Old Women Creek estuary, OH; Sandusky River, OH; Spooner Creek, NY; St. Clair River delta, ON/MI; Sydenham River, ON; and Tonawanda Creek, NY. Criteria used included high productivity, high biodiversity and/or endemism, and significant contributions to the integrity of the whole ecosystem.
- Biodiversity Investment Areas - Coastal wetland ecosystems (Chow-Fraser and Albert 1998). This study selected BIAs based on wetland information; some of these were riverine wetlands such as Big Creek and Cedar Creek in Ontario.
- Great Lakes Shoreline Biodiversity Investment Areas (Reid et al. 2000). This study produced a composite ranking of shoreline units based on three key criteria: species

or communities of special interest; diversity of habitats, communities and species; and productivity and integrity.
- The Nature Conservancy - Great Lakes Ecoregional Plan/The Nature Conservancy of Canada - Conservation Blueprint.
- US 305(b)/303(e) lists and water quality reports listing impacted stream segments and causes.
- United States Environmental Protection Agency, Region 5, Critical Areas GIS project results.
- Decision support system for Lake Erie being prepared by the Great Lakes Basin Ecosystem Team. Designed to help select the most important areas for conservation.
- The Nature Conservancy's Ecologically Sustainable Water Management Framework (www.freshwaters.org/eswm/framework.shtml).
- Relevant indicators and thresholds produced from the Indicators Task Group for the Lake Erie LaMP.

6.3 An Integrated Habitat Classification System and Map of the Lake Erie Basin *(Prepared by: Dr. Scudder Mackey, University of Windsor)*

Funded by a grant from U.S.EPA-GLNPO to support the Lake Erie LaMP, this project will develop an integrated habitat classification system and binational map for the Lake Erie Basin. Specifically, the project will: 1) develop and implement a unified, consensus based classification of five Lake Erie habitat zones from data available in existing habitat mapping projects that are lakewide or Great Lakes basinwide in scale; and 2) develop a geospatial database that integrates classification systems at relevant scales into map layers and eventually into a single, integrated GIS habitat map. This project addresses the need for a unified, consensus based habitat classification system and inventory, which is a fundamental, necessary prerequisite to manage and conserve critical habitats and maintain ecological integrity within the Lake Erie basin. The integrated habitat map will be used to track improvements in fish and wildlife habitat quantity and quality resulting from preservation, conservation, and restoration efforts and to guard against further loss or degradation from land use alterations.

In early June 2005, an Experts' Workshop was held at the Franz Theodore Stone Laboratory on Gibraltar Island to identify existing geospatial datasets within the Lake Erie Basin and assess habitat classification schemes currently in use within the basin. Sub-groups were established to further identify geospatial datasets and explore classification schemes within five natural and semi natural habitat zones, including: terrestrial; inland aquatic; coastal wetland; coastal margin; and open water areas of the basin. These sub-groups reconvened in early 2006 to review and reach consensus on an integrated hierarchical habitat classification scheme based on recommendations from each of the habitat zone sub-groups. These experts will form the core of a Habitat Working Group that will continue to provide guidance to the project team during the testing and validation phase of the project where the classification scheme will be tested in two pilot watersheds – the Maumee River watershed in northwestern Ohio and the Grand River watershed in southern Ontario.

The project team will develop a strategy to revise and expand the classification scheme to the rest of the Lake Erie Basin and will also develop a binational habitat map data exchange website that will include links to geospatial metadata and habitat coverage in the basin. The Lake Erie habitat classification and mapping project will serve as a model for the development of a comprehensive basinwide habitat classification system and inventory for the entire Great Lakes Basin.

The project team is collaborating with other ongoing habitat assessment projects in the basin, including: a Great Lakes Fishery Commission-supported project through the University of Michigan's Institute for Fisheries Research to develop a comprehensive Lake Erie GIS to provide fisheries resource managers with comprehensive geospatial datasets; and, an ongoing U.S. Geological Survey Aquatic GAP project designed to evaluate the biological diversity of aquatic species and their habitats, and to identify gaps in the distribution and protection of these species and their habitats within the Great Lakes Basin.

6.4. Fisheries Related Habitat Projects *(Prepared by: Jeff Tyson, Ohio Department of Natural Resources and Elizabeth Wright, Ontario Ministry of Natural Resources)*

The Great Lakes Fishery Commission's (GLFC) Lake Committees and the Council of Lake Committees have recommended that fisheries habitat research, rehabilitation and restoration focus on four broad theme areas to effectively address achievement of each lake's fish community goals and objectives. Those broad themes identified include: 1) restoration of hydrological processes including flow regime and nearshore circulation patterns; 2) inventory and mapping of fish habitat conditions and reference environmental conditions; 3) restoration of suitable physical (substrate, temperature, submerged aquatic macrophytes), chemical (contaminants, pH, dissolved oxygen, total suspended solids), and biological (food web structure, trophic transfer) habitat; and 4) restoration of suitable connectivity. These broad theme areas complement the Lake Erie LaMP Habitat Strategy Objectives 2 (restore functional habitat), 4 (produce a binational map), and 6 (monitor changes in habitat quality and quantity). A total of 25 projects involving monitoring or evaluation of habitat, 9 projects that involve developing rehabilitation strategies, and 26 projects that involve habitat rehabilitation have been identified for Lakes Erie and St. Clair. All of these projects will impact fisheries habitat restoration either directly or indirectly. One project that directly addresses hydrological processes and fisheries habitat is the GLFC funded Huron-Erie Corridor (HEC) project, which is presented in Section 6.5.

Projects in progress or planned that address the LaMP Habitat Objectives 4 and 6 include an OMNR assessment of north shore coastal wetlands (Rondeau Bay) and a binational mapping initiative planned for Maumee River, Ohio and Grand River, Ontario. These initiatives seek to identify reference conditions in Lake Erie watersheds and lake effect zones, as well as coastal wetlands. These reference conditions will be used by agencies as a benchmark for habitat conditions and to track improvements in habitat quantity and quality resulting from preservation, conservation, and restoration efforts. The mapping initiative is presented in more detail in Section 6.3.

Projects that address LaMP Habitat Objective 2 – to restore functional habitats in the Lake Erie basin - include several implementation projects that are completed or are in the planning phase. Two projects completed by the Essex Region Conservation Authority and several partners, including Environment Canada, are the Fort Malden Shoreline Stabilization and Habitat Enhancement Project, and the McKee Park Habitat Enhancement Project. These projects created or enhanced shoreline habitat in the Detroit River AOC through soft engineering techniques. The Middle Harbor Fish Habitat Restoration Project in Ohio (ODNR, Division of Wildlife) is planned for 2006 and will target nearshore fish community restoration in a 400 acre connected coastal wetland. The project will restore lateral connectivity between Lake Erie and a coastal wetland, as well as promote the re-establishment of submerged aquatic vegetation using an island feature to reduce wind fetch and sediment resuspension.

Photo: Upper Thames River Conservation Authority

6.5 Huron-Erie Corridor System Habitat Assessment – Changing Water Levels and Effects of Global Climate Change *(Prepared by Dr. Scudder Mackey, University of Windsor)*

This project, funded by the Great Lakes Fishery Commission through the USFWS Restoration Act and sponsored by the Michigan Department of Natural Resources, will create a framework and design a process to systematically identify, coordinate, and implement binational aquatic and fish habitat restoration opportunities in the Lake Huron to Lake Erie Corridor (Huron-Erie Corridor, HEC). The project will be conducted within a context of long-term water-level regime changes resulting from direct anthropogenic hydromodification and/or potential effects of global climate change.

In 2005, the University of Windsor and the Ohio State University hosted three Lake Erie Millennium Network (LEMN) research needs workshops to provide guidance on current and future research needs and to develop a long-term strategy to identify and assess high-quality aquatic and fish habitats within the HEC. These Experts' Workshops brought together fishery biologists, aquatic ecologists, physical scientists (geologists, hydrologists), and resource managers to: 1) assess the adequacy of existing physical and biological datasets within the HEC system, identify gaps and prioritize additional habitat research/data collection needs (Workshop 3.01); 2) explore issues associated with developing and validating robust physical and ecological models to predict current and future locations of critical aquatic and fishery habitats within the HEC system (Workshop 3.02); and 3) apply existing data and models to a range of "transitional habitat" issues, including refinement of conceptual models of habitat succession, i.e. "step-stone" or transitional habitats and refugia (Saxon, 2003) associated with anticipated changing water-level regimes in the HEC (Workshop 3.03).

Three major environmental zones were identified based on hydrogeomorphic characteristics and dominant physical processes. These zones included: connecting channels and adjacent riparian areas; the St. Clair delta and adjacent wetland complexes; and nearshore, coastal margin, and open-water areas of Lake St. Clair. Critical data collection and research needs were identified, including the need for: 1) high-resolution bathymetry and substrate distribution data in nearshore/coastal areas of Lake St. Clair; 2) flow, circulation, and temperature distribution patterns - both daily and seasonal throughout the entire system; 3) the location and characteristics of active spawning habitats; 4) the seasonal distribution of larval fish, young-of-the-year, adult fish, benthic invertebrates, aquatic macrophytes, and species-at-risk; 5) the location, distribution, and stability of contaminated sediments; and 6) seasonal data on nutrient and contaminant loadings.

Workshop participants identified a critical need to develop an integrated 3-D hydrodynamic model that predicts flow and water levels in the connecting channels, the St. Clair delta, and circulation patterns and water levels in Lake St. Clair as a single hydrodynamic system. Also identified was the need to develop integrated ecological models for each of the three major environmental zones that predict changes in habitat distribution and response of aquatic/coastal margin vegetative communities and fish/benthic communities to altered flow and water-level regimes.

A long-term research strategy was developed that identifies the following critical research elements: 1) A historical comparison with current HEC system aquatic and fishery habitats, including habitat distribution, pattern and function; the degree of habitat alteration and the stressors that cause those alterations; and identification of potential habitat restoration and enhancement opportunities based on historical pattern and function. 2) The development of scenarios based on physical and ecological models that explore habitat impacts resulting from potential long-term changes in water-level regime, assess the potential degree of habitat alteration, and identify potential long-term management, protection, and restoration opportunities. 3) Development of tools and build capacity of key agencies, organizations, and institutions to identify and implement protection, restoration, and enhancement opportunities based on sound science as part of a long-term, binational fishery and aquatic habitat research and monitoring effort within the HEC system.

6.6 Ohio Aquatic GAP Update *(Prepared by Dan Button, U.S. Geological Survey)*

The Ohio Aquatic Gap Analysis Project was completed in 2005. The primary products are geospatial (GIS) databases depicting land stewardship, stream habitat types, and predicted distribution models for native fish, crayfish, and bivalves. An analysis of these data where then used to help identify potential high conservation-priority areas at the 14-digit hydrologic (HUC) sub-watershed level using species richness. Species richness is measured by enumerating the fish species rather than measuring their abundance. Seventy-five of the 504 (15%) sub-watersheds in the Lake Erie Basin were identified as having high potential for priority conservation. Thirty-seven of the 75 already have some conservation lands located within them. For both the Lake Erie and Ohio River Basins combined, results show that 22 fish species and two bivalve species have predicted distributions exclusive of GAP classified conservation lands. Surprisingly, nine of these fish species are considered rare, threatened or endangered in the State. A final report is in progress and expected to be published on the GAP Analyses Program web site in 2006 (http://www.gap.uidaho.edu).

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Some Management Objectives/Strategies in the Lake Erie Basin

(This list of objectives and strategies includes those identifed in Lake Erie LaMP Beneficial Use Impairment reports or by experts on the Habitat Strategy Task Group or expert reviewers; it is not a complete list)

Binational

- Restoration of Regional Shorebird Reserve (Western Hemisphere Shorebird Reserve Network) in western basin (Detroit, MI to Huron, OH) and protection of staging and breeding habitats in at key shorebird migration sites such as Long Point, ON and Presque Isle, PA.
- Support the North American Colonial Waterbird Conservation Plan objectives relating to habitat for the Upper Mississippi Basin/Great Lakes Colonial Waterbird Conservation Region which includes Lake Erie basin
- Partners in Flight and Important Bird Area programs in priority watersheds or habitat types for Lake Erie LaMP habitat protection and restoration activities
- Great Lakes Fishery Commission - Lake Erie Fish Community Goals and Objectives which recognize preservation and restoration of habitat as 1 of 8 guiding principles important for the identification of fish community objectives for Lake Erie (available March 2003)
- Great Lakes Fishery Commission - Lake Erie Committee - Draft Environmental Objectives
- Great Lakes Fisheries Commission Habitat Strategy
- Lake Erie LaMP ecosystem objectives (in development)

- The Nature Conservancy and Nature Conservancy of Canada Great Lakes Ecoregional Plan
- Regional Climate Change Guidelines for the Great Lakes prepared by Ecological Society of America Concerned Scientists
- Hartig, J.H. 1993. A survey of fish community and habitat goals/objectives/targets and status in Great Lakes areas of concern (http://www.glfc.org/pubs/SpecialPubs/Survey1993.pdf)
- Remedial Action Plans for Lake Erie Areas of Concern

Canada

- Great Lakes Wetlands Conservation Action Plan - strategy to protect area and function of 30,000 ha of wetlands in Great Lakes Basin by 2020.
- Policy for the Management of Fish Habitat
- Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat, Department of Fisheries and Oceans, Habitat Management Branch. 1998
- Strategic Plan for Ontario's Fisheries
- Ontario Ministry of Natural Resources Five Year Plan for Rehabilitation of Eastern Basin Fisheries 2000-2004
- Conservation Authority Fisheries Management Plans (e.g., Grand River Fisheries Management Plan)
- watershed plan objectives

United States of America

- Habitat acreage objectives for restoration/acquisition of upland marsh habitat in Lake Erie Marshes Focus Area of NAWMP (Lake Erie basin in Ohio). This plan calls for enhancement and restoration of 7,000 acres of existing protected wetland habitat and acquisition or protection of 11, 000 acres.
- United States Fish and Wildlife Service Conservation of Great Lakes islands and coastal near-shore habitats initiative
- Partners for Fish and Wildlife Ohio - http://midwest.fws.gov/Partners/ohio.html - habitat restoration on private lands
- Ecologically Sustainable Water Management Framework, Freshwater Institute, The Nature Conservancy - http://www.freshwaters.org/eswm/framework.html
- Aquatic Life Use Attainment Criteria for Surface Waters (Ohio)
- Ohio Lake Erie Qualitative Habitat Evaluation Index (QHEI)
- Ohio Lake Erie Quality Index
- Ohio Lake Erie Protection and Restoration Plan
- Ohio Environmental Protection Agency Headwater Streams
- Ohio Coastal Management Plan Nonpoint Source Program
- TMDLs around the US shoreline of Lake Erie