A Basin-wide Fish Habitat Strategic Plan for the Great Lakes

Prepared by
Great Lakes Basin Fish Habitat Partnership

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Preface

This Strategic Plan provides a five-year road map for the Great Lakes specifically addressing the impact of human induced threats on aquatic habitat and the response of fish communities to declines in the quality and quantity of that habitat. It is visionary and Basin-wide in scope. The goals and objectives in this living document provide the foundation for developing an Implementation Plan that identifies specific actions and geographic focus. It is our intent that any individual, group, or government in the Great Lakes Basin can use this document as a guide to focus aquatic habitat protection and restoration efforts in a manner that will yield the most effective long term Basin-wide improvements in fish populations.

The existence of several ongoing international partnerships in the Great Lakes has resulted in significant work to plan and restore fish, water quality and biodiversity (references 1, 3 – 14, 16 – 20, 22, 24, 27). The Great Lakes Basin Fish Habitat Partnership (GLBFHP) will build from those efforts focusing specifically on aquatic species habitats and setting priorities and targets based on fish community objectives already identified for each of the Great Lakes.

The governing body of the GLBFHP consists of entities that have jurisdictional authority over Great Lakes fisheries or have a Basin-wide interest in the protection and conservation of aquatic communities and habitats. It was initially formed under the Council of Great Lakes Fishery Agencies. Organizations involved in the Steering Committee are listed in Appendix 1. These partners welcome the involvement of numerous other local and regional partners in the Great Lakes who are protecting and restoring fish habitat.

National Fish Habitat Action Plan

Fish Habitat Partnerships have been identified as the working units of the National Fish Habitat Action Plan (NFHAP), providing the coordination, science, technology, and decision-making necessary to strategically identify and lead local partners in the on-the-ground protection and restoration of priority fish habitats. NFHAP is a business model for strategic conservation of aquatic habitats that will improve targeted fish communities. The work of the GLBFHP nests under this business model and directs its work within the broad goals and strategies of NFHAP.

Table of Contents

List of Tables

Introduction

The Great Lakes Basin is one of the largest surface freshwater aquatic ecosystems on the planet, containing nearly 20% of the world supply. This unique ecosystem includes groundwater, inland lakes, streams and wetlands, over 11,000 miles of coastline, the five Great Lakes - Superior, Michigan, Huron, Erie, and Ontario, and their connecting channels. The Great Lakes Basin is home to 10% and 31% of the human populations in the United States and Canada, respectively, with over 43 million people relying on it as a source of drinking water. More than 300 species of fish and other aquatic organisms inhabit the rivers, streams, coastal areas, and open water of the Basin, depending on its unique habitats during various vital life-history stages.

Protecting, restoring, and enhancing the aquatic biological diversity and habitats throughout the Basin will help in achieving not only healthy habitats, but healthy fish, healthy people and healthy economies. Binational economic activity in the Basin exceeds $200 billion a year, with the region generating more than 50% and 40% of the total US and Canadian manufacturing output, respectively. Recreation and tourism are also an important part of the Basin's economy with the annual value of just its commercial and sport fishery estimated at over $7 billion annually.

Unfortunately, many of the habitats that both the people and natural resources of the Basin rely on have been severely altered or degraded, Fortunately, protection and restoration of the Great Lakes has been a binational focus in its various forms since the early 1900s with the signing of the Boundary Waters Treaty of 1909. In 1955, in response to the introduction of sea lamprey and subsequent declines in lake trout fisheries, the Great Lakes Fishery Commission was formed and later in 1981, a Joint Strategic Plan for Management of Great Lakes Fisheries was signed by state, provincial, and tribal agencies from both countries. The importance of water quality and quantity within the Basin was solidified by the signing of the Great Lakes Water Quality Agreement in 1972, and reemphasized in 1978 and 1987, along with the Great Lakes Legacy Act in 2002. More recent efforts aimed at protecting and restoring the Great Lakes ecosystem include the Great Lakes Fishery and Ecosystem Restoration Program (2003), Great Lakes Regional Collaboration (2004), Great Lakes Habitat Initiative (2006), Great Lakes Fish and Wildlife Restoration Act (2006), Canada-Ontario Agreement (2007), and the Great Lakes Restoration Initiative (2010).

The Great Lakes Basin Fish Habitat Partnership (GLBFHP or Partnership) recognizes and values the past, current, and future binational commitments to protecting and restoring the Great Lakes Basin ecosystem, along with the institutional frameworks currently in place as a result. The GLBFHP looks to build upon these existing frameworks by providing an intellectual framework for advancing on-the-ground aquatic habitat restoration to benefit fish and other aquatic organisms. No other partnership effort is in place to do this specifically on a Great Lakes Basin-wide basis.

The GLBFHP looks to compliment existing and future Great Lakes Basin programs and initiatives by 1) drawing upon lessons learned from previous restoration efforts, 2) creating greater efficiency and synergy between ongoing and future restoration efforts, 3) including non-traditional partners, 4) assessing, inventorying, and strategically prioritizing aquatic habitat restoration needs, and 5) evaluating the success of our restoration efforts in achieving the goals and objectives identified in this strategic plan. To that end, the mission of the GLBFHP is *to protect, restore, and enhance fish habitat in the Great Lakes Basin by providing leadership, coordination, and collaboration with existing and future partners.*

Figure 1. Great Lakes Fish Habitat Partnership Geographic Coverage

Guiding Principles of the GLBFHP

1. Fish are among the Great Lakes most highly valued natural resources.
2. The terms fish and fish communities include associated aquatic communities.
3. Fish communities in the Great Lakes Basin should be sustained at objective levels across their natural ranges to provide both ecological and socioeconomic benefits.
4. Healthy fish communities require diverse, abundant and connected physical habitats, including clean water.
5. Habitat management will sustain scientifically managed harvests of renewable fishery resources.
6. Sustainable Great Lakes Basin fish communities and habitats require long-term planning and close cooperation and coordination of management activities across the Basin.
7. Partnerships among private organizations, individuals, and government agencies are the primary vehicles for accomplishing GLBFHP objectives.
8. Collaboration with other conservation and community efforts in the development of conservation, economic, and social policies and programs will sustain the ecological health of landscapes.
9. Implementation of our strategic plan is founded on sound science and guided by biologically based planning, both of which are, in turn, refined with increased knowledge gained through evaluation, monitoring, and research.
10. Habitat restoration and protection requires that root causes of habitat degradation, such as land management practices that affect hydrological flow and thermal regimes, be addressed at a watershed scale.
11. The Partnership will practice diligence in understanding the effects of any individual habitat action on non-targeted resources before recommending, endorsing or funding any project.
12. Global stressors, such as climate change, air borne contaminants and invasive species, must be addressed within and outside the Basin to protect and restore fish habitats.

Lake Huron – Contains some of the most extensive freshwater island archipelagos in the world, with estimates exceeding 36,000 islands, resulting in the longest shoreline of any lake in the world (3,227 miles). A significant threat to Lake Huron islands are development – homes, agriculture, shipping, industry, marinas, etc. continue to destroy shoreline habitat directly and disrupt shoreline replenishment processes.

Lake Superior – Lake Superior is a very cold, clear lake with average depth of clarity to 25 feet and average annual temperatures 40° F. Primary productivity is low in this Great Lake, making the coastal wetlands and estuaries critical for food production of many fish species. Numerous coastal wetlands are protected in Lake Superior, but sedimentation from streams continues to threaten their health. Upstream land use and land conversion affects stream flow and increases sedimentation downstream, eventually covering fish habitats in estuaries.

Regional and Local Challenges

Native people settled the Great Lakes region over 10,000 years ago and by the 16th century the population was estimated at 60 to 114 thousand. These settlers used copper from the south shore of Lake Superior and had established hunting and fishing communities throughout the Great Lakes (USEPA Great Lakes Atlas 2008). European settlement of the Great Lakes in the 1600's originated around ports where goods could be easily transported along various trade routes. Logging, mining and fishing were big draws for non-native cultures and settlements. These rapid changes resulted in drastic changes on the landscape and sometimes devastation of habitats. Changes in ecological communities and processes were also a result of subsequent development. Effects of these rapid landscape changes are still seen today in many areas. For example, more than 200

million tons of stamp sands and smelter slag wastes from copper mining operations were dumped into Torch Lake and on its shoreline in the 1800s and early 1900s. U.S. EPA began remedial activities in 1998 under the federal Superfund law and approximately 800 acres of stamp sand piles have been covered with soil and vegetation to prevent them from eroding into Torch Lake and Lake Superior, however significant sands remain exposed.

Agriculture followed logging and remains a significant economic driver for the Great Lakes Basin. With so much open land under production, overland flow of rain and snowmelt results in faster runoff and higher peak flood flows. Urban development results in even larger increases in runoff through concentrations of impervious surfaces. Additionally, tiling and ditching for both agriculture and urban development further increases runoff. These actions affect steam banks and beds, often creating entrenched streams that no longer overflow their banks and drop rich sediments onto floodplains, but instead carry these excess sediments downstream to lower reaches and estuaries, smothering aquatic habitats and the organisms that feed fish.

Lake Ontario – Zebra and quagga mussels have invaded nearshore habitats of Lake Ontario, disrupting nutrient flows, resulting in the growth of the nuisance algae, Cladophora, and affecting water quality. Where diverse fish communities once thrived with their food sources, exotic, invasive species dominate. More aliens result in less native fish.

Continued growth of human habitation, especially along shorelines and riparian areas, results in the largest direct loss of fish habitat, as well as alteration of ecological processes that degrade fish health and population resilience.

The Great Lakes have a relatively small contributing watershed when compared to the amount of water in the Great Lakes' proper - 94,000 square miles of water to about 201,500 square miles of land, a ratio of about 1 to 2. Actions on land can result in a quick response to aquatic habitats. Therefore, reversing or slowing locally generated impacts to aquatic habitat and species in portions of the Great Lakes is quite possible.

Lake Erie – Land use in watersheds has a significant impact on Lake Erie's tributaries and estuaries. The most significant water quality and habitat impacts are largely due to intensive row-crop agriculture, impervious soils, and rapidly developing urban and industrial landscapes. Urban and agriculture land uses have modified flow regimes and increased sediment and nutrient loading to virtually all Lake Erie tributaries. Along with direct channel modifications, such as channelization, many Lake Erie tributaries and estuaries are in poor condition for fish (Davies et al. 2005).

Lake Michigan –Dams and other barriers to fish migration have reduced nearly 30,000 km of available stream habitat to only 5,311 km). An estimated one-third of all Great Lakes fishes use tributaries as their principal spawning and nursery habitats.

Global Challenges

Aquatic habitats throughout the world will most likely be affected by climate change. Predicted effects of climate change on the Great Lakes vary, but models predict greater intensity of storm events, higher precipitation in some regions, higher air and water temperatures, and lowered lake levels from greater evaporation (Magnuson et al. 1997). These changes could significantly alter hydrologic flows in tributaries and result in the expansion of shoreline habitats. Atmospheric deposition of contaminants from both global and local sources threaten fish and human health. Mercury, dioxin, and acid rain are some of the contaminants entering the Great Lakes, creating long-term hazards in lakes such as Superior, which has a 190 year retention time.

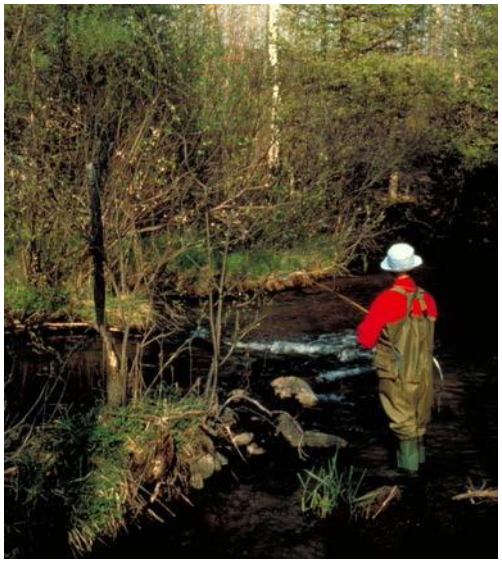
Aquatic invasive species became a global issue in the Great Lakes in the 1950's with the opening of the St. Lawrence Seaway and other canals that allowed ships to travel from the Atlantic Ocean into the Great Lakes. Numerous invasive species have since entered the Great Lakes resulting in major impacts on aquatic habitats and ecosystem health. An example is the sea lamprey, which prey on lake trout and lake sturgeon and have resulted in massive reductions of these valuable native fish.

Our greatest challenge is in managing the cumulative effects of multiple stressors acting on the system at multiple scales. We must address local threats to the Great Lakes to provide resilience to the fish communities so that they are more able to adjust to global threats such as climate change.

Great Lakes Successes

Lake Erie – Water quality has improved significantly in the Lake Erie basin, as evidenced by the Cayahoga River, which historically caught on fire from toxic conditions. The Cayahoga today has much improved water quality that sustains a significant sport and commercial fisheries for walleye and yellow perch.

Lake Michigan – Over-harvest, invasive species, poor water quality, and habitat degradation collapsed many fisheries in Lake Michigan in by the 1960s. Now Lake Michigan provides a word class and diverse sport fishery.



Lake Ontario – Naturally reproduced lake trout have been found in the lake for the past 14 consecutive years. Additionally self sustaining populations of lake sturgeon have been documented in both the Lower Niagara River and the Black River. Chaumont Bay (Eastern Lake Ontario), has had spawning runs of white fish and lake herring, with confirmation of successful white fish spawning by the capture of young on the year. New York State is looking to expand the range of these two species through future habitat work, artificial spawning and stocking efforts.

Lake Huron – The Lake Huron basin has retained high quality coastal habitat that supports an abundance of fish species, aquatic animals, and wetland plant species. There are self-sustaining populations of lake whitefish, walleye, and some naturally reproducing lake trout and lake sturgeon in the basin.

Lake Superior – The lake basin has transformed from deforestation and devastation 100 years ago to a largely forested landscape. The streams are healing and food webs are mostly intact. Self-sustaining populations of lake trout, whitefish, and some naturally reproducing lake sturgeon have returned. In addition, Lake Superior maintains the highest percentage of its native fish fauna of the Great Lakes.

Conservation Strategy

The GLBFHP's strategic direction is based on a foundation of existing, significant planning efforts to restore and protect Great Lakes fisheries and aquatic species habitats, including the Great Lakes Regional Collaboration, individual Lake Fish Community and Environmental Objectives, individual Lakewide Management Plans, and State Wildlife Action Plans (references 1, 3 – 14, 16 – 20, 22, 24, 25). This body of work was utilized to help the Partnership identify habitat types and threats, develop habitat goals and objectives, and compile a list of affected species. In addition, Steering Committee and Working Group members' collective knowledge and best professional judgment was utilized; many of these members were principle authors or participants in these previous planning efforts.

The process used to develop this Partnership's draft conservation strategy, as well as the outline followed below, is boiled down to three basic planning questions:

- Where are we? – Habitats were classified and human induced threats were identified and tied to habitats. This is also the stage that priorities were identified through a qualitative habitat/threats assessment.
- Where do we want to be? - Goals and objectives were drafted to provide targets for actions and benchmarks to measure progress.
- How do we get there? – A five-year implementation http://www.fws.gov/midwest/GLBFHP/plan for the Partnership was drafted.

The process used by the Partnership to develop this strategy was modified from The Nature Conservancy's Conservation Action Planning (CAP) process designed to develop work plans for conservation on a smaller geographic scale (The Nature Conservancy 2007). Full documentation of the methodologies used by the GLBHP is available in the Strategic Planning Meeting Documentation (GLBFHP 2009) and some of the results are provided in Appendices 2-4.

The Partnership's conservation strategy also falls within the National Fish Habitat Action Plan's goals and priority strategies.

National Fish Habitat Action Plan Final Interim Strategies*

Strategy 1 – Identify and protect intact and healthy waters
Strategy 2 - Restore natural variability in river and stream flows and water surface elevations in natural lakes and reservoirs.
Strategy 3 – Reconnect fragmented river, stream, reservoir, coastal, and lake habitat to allow access to historic spawning, nursery and rearing grounds.
Strategy 4 – Reduce and maintain sedimentation, phosphorus and nitrogen runoff to river, stream, reservoir, coastal, and lake habitats to a level within 25% of the expected natural variance in these factors or above numeric State Water Quality Criteria

* These are national strategies adopted by the NAFHAP Board in 2007. The GLBFHP goals and objectives fit within these strategies.

Aquatic Habitat Classification and Threats Assessment

Aquatic Habitat Classification

Habitat types identified by the GLBFHP include all aquatic habitats in the watershed, from headwater tributaries to open lake, necessary to support all life stages of affected species (Table 1). This classification will allow the Partnership to take a systems approach to conservation, from headwater tributary streams to nearshore and offshore spawning habitats. Fish species that use these habitats were identified from Fish Community Objectives and State Wildlife Action Plans and are listed in Appendix 3.

Table 1. Habitat Type Definitions

Habitat Type Definitions	
Habitat Type	Definition
Small Tributaries	Tributary streams with less than 40 acre catchment basins. These are streams that directly enter a lake or are headwaters to large tributary systems.
Large Tributaries	Tributary streams to a great lake that are larger than 40 acre catchment basins.
Shoreline	Within lake habitat that is generally 0 – 3 meters deep. Includes coastal wetlands, estuaries, embayments and islands.
Nearshore	Within lake habitat greater than 3 meters out to offshore habitat, based on lake specific definitions.
Offshore	Within lake habitat deeper than nearshore, based on lake specific definitions.
Connecting Channels	These specifically include: St. Mary's River, St. Clair River, Lake St. Clair, Detroit River, Niagra River, St. Lawrence River to the U.S. border where it flows into Canada.

Assessing Threats to Aquatic Habitat

The Partnership's planning team conducted extensive review of existing Great Lakes planning documents and State Wildlife Action Plans to identify human-induced stressors/threats and root causes of those threats. The result of this compilation is a threat matrix by habitat type (Appendix 2).

In June, 2009 the GLBFHP Steering Committee and invited guests underwent a facilitated process to assess the scope, severity, and reversibility to the threats identified. This meeting resulted in a qualitative threats assessment Basin-wide. The threats assessment was built at the individual lakeshed level and expanded to a Basin-wide assessment. It includes both the Canadian and American sides of the Basin. Tables (2 and 3) identify the severity (its direct impact), scope (the spatial extent of the impact across the Basin), and reversibility (our technological, scientific, and financial ability to mitigate, prevent, or eliminate the threat) of each threat by habitat type Basin-wide. The assessment process and definitions are provided in Appendix 4. Lake by lake assessments can be found in the meeting documentation (Great Lakes Basin Fish Habitat Partnership 2009). Lake assessments threat levels vary by lake; Tables 2 and 3 roll all lake assessment together to provide an overall Basin-wide picture of key threats.

Table 2. Scope and Severity Ranking for the Great Lakes by Habitat Type

Scope and Severity Ranking for the Great Lakes by Habitat Type						
	Small Tributaries	**Large Tributaries**	**Shoreline**	**Connecting Channels**	**Nearshore**	**Offshore**
Lack of access to various habitats	H = High	VH = Very High	M= Medium	H	VL= Very Low	NA
Loss of riparian habitat	VH	VH	L= Low	H	NA	NA
Loss of large woody debris	VH	VH	VL	L	L	NA
Entrenchment of streams causing loss of connectivity with floodplains	VH	H	NA	M	NA	NA
Alteration of sediment transport	H	M	NA	M	M	NA
Direct alterations of natural stream channels.	VH	VH	NA	M	NA	NA
Increased water temperatures	VH	VH	M	L	L	M
Alterations in natural stream flow	VH	VH	NA	L	NA	NA
Degradation and loss of wetland habitat	L	M	VH	VH	NA	NA
Loss of plant and animal diversity and abundance that results in altered food webs	L	L	VH	H	H	H
Degradation of water quality	M	M	M	M	M	M
Degradation and loss reef habitat	NA	NA	L	L	M	M
Degradation and loss of shoreline and coastal habitat	NA	NA	H	H	M	NA
Lack of inventory/information on various habitats	M	M	M	M	M	M

Table 3. Reversibility Ranking of Great Lakes Threats by Habitat Type

Reversibility Ranking of Great Lakes Threats by Habitat Type						
	Small Tributaries	**Large Tributaries**	**Shoreline**	**Connecting Channels**	**Nearshore**	**Offshore**
Lack of access to various habitats	M	M	M	M	M	NA
Loss of riparian habitat	M	M	M	M	NA	NA
Loss of large woody debris	VH	VH	VL	L	L	NA
Entrenchment of streams causing loss of connectivity with floodplains	VH	VH	NA	L	NA	NA
Alteration of sediment transport, especially resulting in stream aggradation.	VH	H	NA	M	M	NA
Direct alterations of natural stream channels.	M	VH	NA	M	NA	NA
Increased water temperatures	VH	VH	M	L	L	M
Alterations in natural stream flow	M	VH	NA	M	NA	NA
Degradation and loss of wetland habitat	M	M	H	M	NA	NA
Loss of plant and animal diversity and abundance that results in altered food webs	M	M	VH	H	VH	H
Degradation of water quality	M	M	M	M	M	M
Degradation and loss reef habitat	NA	NA	L	M	M	M
Degradation and loss of shoreline and coastal habitat	NA	NA	H	H	M	NA
Lack of inventory/information on various habitats	M	M	M	L	M	M

Setting Priorities

The qualitative threats assessment was used to develop fish habitat conservation priorities for the partnership by combining scope, severity, and reversibility relationships into habitat tiers (Table 4). Using the combined scope/severity and irreversibility ranks, each habitat type and threat is placed into the appropriate tier (See Appendix 4). Tier 1 habitat types and threats have the most effect on the Basin and have a relatively low cost in resources and time to restore, enhance, and/or protect. Tier 5 habitat types and threats have the least effect on the Basin and have high costs to restore, enhance, and/or protect.

A Basin-wide threats assessment is the first step in identifying priorities for this conservation strategy. Operationally these priorities can be stepped down to individual lakes and jurisdictions

for maximum strategic impact. The assessment to date is based on best professional judgment of the most knowledgeable scientists and fisheries managers working in the Basin using numerous assumptions with respect to the actual impact of the identified threats on certain habitat types. An imperative strategy and focus of the GLBFHP is to reduce the number of assumptions and drive future assessments with empirical data and modeling of the causal relationships between threats and habitat degradation.

The implementation plan recommends actions to complete the necessary quantitative habitat and threats analysis. The implementation plan also lists other information and research needs for moving this effort forward.

Until a quantitative threats assessment is completed, the GLBFHP will focus its efforts on reducing, preventing, and eliminating tier 1 and 2 threats. Priority will be given to actions that help meet objectives tied to tier 1 and 2 threats.

Priority will also be given to making entire systems (sub-basins) whole through habitat protection, restoration, and enhancement, which ultimately provides necessary spatial and temporal requirements for aquatic species.

Table 4. Results of Threat Ranks Combined into Tiers

Results of Threat Ranks Combined into Tiers		
Tiers	**Habitat Type**	**Threat**
1	Connecting Channels	Degradation and loss of wetland habitat
1	Large Tributaries	Lack of access to various habitats
1	Large Tributaries	Loss of large woody debris
1	Large Tributaries	Increased water temperatures
1	Large Tributaries	Loss of riparian habitat
1	Small Tributaries	Alterations in natural stream flow
1	Small Tributaries	Direct alterations of natural stream channels.
1	Small Tributaries	Increased water temperatures
1	Small Tributaries	Loss of riparian habitat
1	Small Tributaries	Loss of large woody debris
2	Connecting Channels	Lack of access to various habitats
2	Connecting Channels	Lack of inventory/information on various habitats
2	Connecting Channels	Loss of riparian habitat
2	Shoreline	Degradation and loss of wetland habitat
2	Small Tributaries	Degradation and loss of wetland habitat
2	Small Tributaries	Lack of access to various habitats
3	Connecting Channels	Alteration of sediment transport, especially resulting in stream aggradation.
3	Connecting Channels	Degradation of water quality
3	Connecting Channels	Degraded and loss of shoreline and coastal habitat
3	Connecting Channels	Direct alterations of natural stream channels.
3	Connecting Channels	Loss of plant and animal diversity and abundance that results in altered food webs
3	Large Tributaries	Lack of inventory/information on various habitats
3	Large Tributaries	Degradation and loss of wetland habitat
3	Large Tributaries	Degradation of water quality

Results of Threat Ranks Combined into Tiers		
Tiers	**Habitat Type**	**Threat**
3	Large Tributaries	Direct alterations of natural stream channels.
3	Large Tributaries	Alterations in natural stream flow
3	Large Tributaries	Entrenchment of streams causing loss of connectivity with floodplains
3	Nearshore	Alteration of sediment transport, especially resulting in stream aggradation.
3	Nearshore	Degradation and loss reef habitat
3	Nearshore	Degradation of water quality
3	Nearshore	Degraded and loss of shoreline and coastal habitat
3	Nearshore	Lack of inventory/information on various habitats
3	Nearshore	Loss of large woody debris
3	Nearshore	Loss of plant and animal diversity and abundance that results in altered food webs
3	Offshore	Degradation and loss reef habitat
3	Offshore	Degradation of water quality
3	Offshore	Lack of inventory/information on various habitats
3	Offshore	Loss of plant and animal diversity and abundance that results in altered food webs
3	Shoreline	Alteration of sediment transport, especially resulting in stream aggradation.
3	Shoreline	Degradation and loss reef habitat
3	Shoreline	Degradation of water quality
3	Shoreline	Degraded and loss of shoreline and coastal habitat
3	Shoreline	Increased water temperatures
3	Shoreline	Lack of access to various habitats
3	Shoreline	Lack of inventory/information on various habitats
3	Shoreline	Loss of plant and animal diversity and abundance that results in altered food webs
3	Small Tributaries	Alteration of sediment transport, especially resulting in stream aggradation.
3	Small Tributaries	Degradation of water quality
3	Small Tributaries	Entrenchment of streams causing loss of connectivity with floodplains
3	Small Tributaries	Lack of inventory/information on various habitats
4	Connecting Channels	Alterations in natural stream flow
4	Connecting Channels	Degradation and loss reef habitat
4	Connecting Channels	Entrenchment of streams causing loss of connectivity with floodplains
4	Connecting Channels	Increased water temperatures
4	Connecting Channels	Loss of large woody debris
4	Large Tributaries	Alteration of sediment transport, especially resulting in stream aggradation.
4	Large Tributaries	Loss of plant and animal diversity and abundance that results in altered food webs
4	Offshore	Increased water temperatures
4	Shoreline	Loss of riparian habitat
4	Small Tributaries	Loss of plant and animal diversity and abundance that results in altered food webs
5	Nearshore	Increased water temperatures
5	Nearshore	Lack of access to various habitats
5	Shoreline	Loss of large woody debris

Conservation Goals and Objectives

National Fish Habitat Action Plan Goals

1) Protect and maintain intact and healthy aquatic systems.
2) Prevent further degradation of fish habitats that have been adversely affected.
3) Reverse declines in the quality and quantity of aquatic habitats to improve the overall health of fish and other aquatic organisms.
4) Increase the quality and quantity of fish habitats that support a broad natural diversity of fish and other aquatic species.

Habitat Goals and Objectives[1]

All habitat objectives followed NFHAP goals by setting objectives to protect existing habitat, prevent further loss of habitat, enhance degraded habitat or restore lost habitats.

The GLBFHP is committed to a holistic approach to conservation; therefore we must address the root cause of habitat decline (Appendix 2), working with ecological processes. This requires that we address habitat threats on a spatial continuum from the headwaters of tributary streams to the open lake. Our habitat types represent the full continuum of habitats from headwater streams to open lake, and our goals and objectives reflect the need to act along that continuum to meet objectives for that specific habitat type as well as those downstream. Several objectives, however, are common for all or most habitat types and all lakes, so were combined as General Objectives and they are listed first.

Based on the current threats assessment and our collective knowledge of overall habitat loss and its affect on fish species, the GLBFHP has identified the following Basin-wide habitat goals and objectives. Further research and planning will be necessary to identify the exact locations of where conservation actions should be taken to meet the objectives in a manner that makes entire subsystems within the Basin whole, leading to a positive cumulative impact Basin-wide.

Objectives that tie to Tier 1 and 2 threats are highlighted in red.

General Objectives

Goal: Protect and Restore Ecological Functions:

Protect ecosystem functions by preventing the spread of existing and future aquatic invasive species by 2025.

Double the number of risk assessments conducted of future introductions of aquatic invasive species and their impact to Great Lakes aquatic communities by 2015.

Goal: Improve and Protect Water Quality:

Reduce point and non-point source inputs to target levels in all Great Lakes habitats (as established by the Great Lakes Water Quality Agreement) by 2025.

Enhance current environmental regulations to minimize air deposition and water quality impairments in the Great Lakes (consistent with State and Federal authorities) by 2025.

[1] Note: The objectives included in this draft plan, focus on the U.S. side of the Great Lakes. Objectives for the Canadian portion of the Great Lakes are in development and will be included in a subsequent draft.

Goal: Restore Surface and Groundwater Hydrological Functions:

Protect vital groundwater recharge and discharge areas in all habitats by 2030.

No net effect on water temperature increases by point source discharges in the Great Lakes Basin by 2030.

Goals: Protect and Restore Quality Spawning and Nursery Habitat; Protect and Restore Ecological Functions:

Support and assist the Great Lakes Regional Collaboration's goal to restore and protect one million acres of wetlands by 2015.

Enhance fishery benefits of diked and managed wetlands without compromising wetland management objectives. Improve fish access to 20 existing sites by 2025.

Protect all key extant wetlands by 2020.

Information Need Objectives:

Address wetland inventory, classification and significant site information needs by 2015.

Identify locations of key spawning reef habitats by 2015.

Increase information on how sediment transport affects fish/habitat along shorelines by 2025.

Increase information regarding the dynamics of shoreline sediment movement by 2025.

Identify various life stages of fish and aquatic organisms that use the reef habitats by 2025.

Pursue emerging technologies to control invasive species in tanker ballast water by 2020.

Table 5. Goals and Objectives for Small Tributaries

Goals and Objectives for Small Tributaries			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Improve connectivity	Maintain the 2009 level of connectivity in small tributaries in perpetuity.	Remove/replace 300 culverts in the Basin by 2015. Remove 50 "small dams" in the Basin by 2015.	

Goals and Objecti es for Small Tributaries			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Restore surface and groundwater hydrological functions	Maintain hydrology for all intermittent streams that provide spawning/nursery habitat for affected species in perpetuity. No net loss of wetlands in the Basin in perpetuity.	Modify 75% of existing water control structures and require newly designed water control structures on 100% of future projects to draw overflow from the bottom of impoundments in watersheds with coldwater communities by 2015. Develop regional hydrologic curves for 100% of watersheds at the 8 digit Hydrologic Unit Code (HUC) level in the Basin by 2015. Provide support/direction in watershed planning/education and implementation in 10% of small tributary watersheds in the Basin by 2015.	Restore 5,000 acres of wetlands associated with small tributaries by 2015 and an additional 5,000 acres by 2020. Remove 10 small tributaries from the EPA 303(d) list for sediment/nutrients by 2025. Remove 10 small tributaries from the EPA 305(b) list for contaminants by 2025.
Protect and restore quality spawning and nursery habitat	Maintain 100% of "natural" channel geomorphic processes in perpetuity (no net loss). Eliminate/prevent spread Aquatic Invasive Species (AIS) to 100% of currently unaffected wetlands associated with small tributaries in perpetuity.	Maintain 90% of existing riparian habitat and restore or enhance 1,000 miles of riparian habitat in small tributary streams in the Basin by 2015. Restore or enhance large woody debris (LWD) to 20 miles of small tributary streams and monitor effects on fish and sediment transport by 2015.	Restore 100 miles of "natural" channel geomorphic processes in the Basin by 2015.

Table 6. Goals and Objectives for Large Tributaries

Goals and Objectives for Large Tributaries			
Goals	**Objectives**		
	Protectin Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Improve connectivity	Maintain fish passage in all existing free-flowing systems in perpetuity. Prevent lack of fishery access in any new developments in perpetuity.	Remove or modify 5 dams to allow fish passage (one/lake) on U.S. side by 2015. Replace or modify 5 bridges/large culvert projects that block fish passage by 2015.	

Goals and Objectives for Large Tributaries			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Restore surface and groundwater hydrological functions	Maintain hydrology for all large tributary streams that provide spawning/nursery habitat in perpetuity. No net loss of wetlands in the Basin in perpetuity. Protect the base flow portion of the stream hydrographs coming from groundwater to ensure that existing hydrological thermal regimes remain intact by 2020.	Provide support/direction in watershed planning/education and implementation in 10% of large tributary watersheds in the Basin by 2015. Reduce artificial flow fluctuations from dam releases or water control structures in at least 5 river systems by 2020. Reduce artificially high peak flood flows in 2 major tributary watersheds by 2025.	Restore hydrological thermal regimes to balance base and flood flows in 10 watersheds by 2025. Remove 25 large tributaries from the EPA 303(d) list for sediment/nutrients by 2025. Remove 10 large tributaries from the EPA 305(b) list for contaminants by 2025. Remediate 2 Area of Concern (AOC)[2] type contaminated sediment sites to include restoration of aquatic habitats in 25 years.
Protect and restore quality spawning and nursery habitat	Identify and protect all existing high quality riparian habitats by 2015. Protect existing buffer zones that will provide woody debris into the system.	Restore or enhance large woody debris (LWD) to 10 miles of stream and monitor effects on fish and sediment deposition and transport by 2015.	Restore 5% of miles of lost riparian habitat in priority areas by 2020. Restore 5,000 acres of wetlands associated with large tributaries by 2015 and an additional 5,000 acres by 2020. Restore hydrological functions of large wetland complexes associated with large tributaries in each lake Basin by 2025.

[2] Great Lakes Areas of Concern (AOCs) are severely degraded geographic areas within the Great Lakes Basin. They are defined by the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life."

Table 7. Goals and Objectives for Shoreline

Goals and Objectives for Shoreline			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Improve connectivity	Protect all existing shoreline habitat that provides connectivity between nursery and spawning habitats by 2025.	Enhance connectivity of coastal habitat through improved management regimes (25% over existing levels).	Remove or install access points at 45 structures that are impediments to shoreline connectivity by 2025.
Protect and restore natural coastal systems and shoreline hydrological processes	Protect key habitat areas from any new development through 2025 and beyond.	Enhance management of shoreline habitats through beneficial use technologies that improve fisheries through 2025. Increase information on how sediment transport affects fish/habitat by 2025. Increase information regarding the dynamics of shoreline sediment movement by 2025. Ensure that impacts are minimized to fish habitat and natural shoreline by adopting Best Management Practices for all new and re-development projects by 2025.	
Protect and restore quality spawning and nursery habitat	Protect all intact coastal wetlands in the Great Lakes by 2020.	Enhance or restore 20% of identified coastal and connecting channel wetlands that have been lost or degraded by 2025. Enhance fishery benefits of diked and managed wetlands without compromising wetland management objectives. Improve fish access to 20 existing sites by 2025.	

Goals and Objectives for Shoreline			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Improve and protect water quality		Enhance shoreline water quality by eliminating Beneficial Use Impairments[3] in Areas of Concern.	

Table 8. Goals and Objectives for Nearshore

Goals and Objectives for Nearshore			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Improve connectivity	No new confined disposal facilities in nearshore areas[4].		
Protect and restore natural coastal systems and shoreline hydrological processes	Identify sensitive nearshore areas and protect them from future development, (e.g. structures for energy development) by 2015. Acquire key habitats that will protect nearshore hydrological processes by 2020. Protect all critical extant wetlands by 2020.	Enhance the fishery benefits of 20 existing diked wetlands that block fish for all applicable habitats by 2025. Work with local, state and federal units of government to encourage stronger coastal protection through regulatory systems.	
Protect and restore quality spawning and nursery habitat	Maintain large woody debris in Lake Superior. Maintain natural sediment transport processes (no net loss of sediment transport) by 2025.	Enhance nearshore sediment transport at 10% of existing structures (breakwalls, etc.) by 2025.	

[3] The Great Lakes Water Quality Agreement lists 14 beneficial use impairments against which the health of the Great Lakes are to be measured. Some of these impairments and associated criteria are: restrictions on fish and wildlife consumption, tainting of fish and wildlife flavor, degraded fish and wildlife populations, fish tumors or other deformities and loss of fish and wildlife habitat**.**

[4] A confined disposal facility, or CDF, is a structure planned and designed to receive sediments dredged from a navigation channel and safely contain the contaminants, preventing their reentry into the waterway or lake.

Goals and Objectives for Nearshore			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Protect and Restore Ecological Functions	Protect ecosystem functions by preventing the spread of existing and future aquatic invasive species by 2025.	Double the number of risk assessments conducted of future introductions of aquatic invasive species and their impact to Great Lakes aquatic communities by 2015. Reduce phosphorous input to target levels (as established by the Great Lakes Water Quality Agreement) by 2025.	
Improve and protect water quality		Assist the Lake Superior Binational Program meet its Zero Discharge Demonstration Program objectives.[5] Enhance current environmental regulations to minimize air deposition and water quality impairments in the Great Lakes (consistent with State and Federal authorities) by 2025.	Reduce point and non-point source inputs to target levels in all Great Lakes habitats (as established by the Great Lakes Water Quality Agreement) by 2025.
Protect and restore spawning reefs	Identify locations of key spawning reef habitats by 2020.	Identify various life stages of fish and aquatic organisms that use the reef habitats by 2020. Mechanically enhance existing reefs in targeted lake trout spawning areas by 2025. Minimize impacts to known spawning reefs by adopting Best Management Practices for all new and re-development projects by 2025.	

[5] The Zero Discharge Demonstration Program established Lake Superior as a demonstration project to achieve zero discharge and zero emission of nine toxic, persistent, and bioaccumulative chemicals: mercury; total polychlorinated biphenyls (PCBs); dieldrin/aldrin; chlordane; DDT; toxaphene; 2,3,7,8-TCDD (dioxin); hexachlorobenzene (HCB); and octachlorostyrene (OCS).

Table 9. Goals and Objectives for Offshore

Goals and Objectives for Offshore			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Protect and restore ecosystem functions	Protect ecosystem functions by preventing the spread of existing and future aquatic invasive species by 2025.	Double the number of risk assessments conducted of future introductions of aquatic invasive species and their impact to Great Lakes aquatic communities by 2015. Reduce phosphorous input to target levels (as established by the Great Lakes Water Quality Agreement) by 2025.	
Improve and protect water quality		Assist the Lake Superior Binational Program to meet its Zero Discharge Demonstration Program objectives.[6]	
Protect and restore spawning reefs	Identify locations of key spawning reef habitats by 2020.	Identify various life stages of fish and aquatic organisms that use the reef habitats by 2020. Minimize impacts to known spawning reefs by adopting Best Management Practices for all new and re-development projects by 2025. Mechanically enhance existing reefs in targeted lake trout spawning areas by 2025.	

[6] The Zero Discharge Demonstration Program established Lake Superior as a demonstration project to achieve zero discharge and zero emission of nine toxic, persistent, and bioaccumulative chemicals: mercury; total polychlorinated biphenyls (PCBs); dieldrin/aldrin; chlordane; DDT; toxaphene; 2,3,7,8-TCDD (dioxin); hexachlorobenzene (HCB); and octachlorostyrene (OCS).

Table 10. Goals and Objectives for Connecting Channels

Goals and Objectives for Connecting Channels[7]			
Goals	**Objectives**		
	Protecting Healthy Habitats	**Enhancing for Resiliency**	**Restoring Degraded Habitats**
Protect and restore natural coastal systems and nearshore hydrological processes		Enhance or restore 35% of identified coastal or undeveloped riparian lands by 2020. Enhance or restore 20% of identified coastal and connecting channel wetlands that have been lost or degraded by 2025.	
Protect and restore quality spawning and nursery habitat	No loss of existing wetlands by 2015. No further loss of connecting channel riparian habitat by 2020. Maintain current floodplain connectivity where it exists by 2030. No loss of unaltered channels outside of managed shipping channels by 2025.	Enhance or restore 35% of identified coastal or undeveloped riparian lands by 2020. Enhance or restore 20% of identified coastal and connecting channel wetlands that have been lost or degraded by 2025. Increase available spawning habitat by 25% by 2025.	
Protect and restore ecosystem functions	No further loss of existing connecting channel wetlands by 2015. No further loss of connecting channel riparian habitat by 2020.		
Improve and protect water quality		Eliminate pertinent beneficial use impairments[8] identified in connecting channels by 2025.	
Protect and restore spawning reefs	Protect all connecting channel spawning reefs by 2030.	Enhance and restore 25% of spawning reefs by 2030.	

[7] These specifically include: St. Mary's River, St. Clair River, Lake St. Clair, Detroit River, Niagra River, St. Lawence River to the U.S. border where it flows into Canada.

[8] The Great Lakes Water Quality Agreement lists 14 beneficial use impairments against which the health of the Great Lakes are to be measured. Some of these impairments and associated criteria are: restrictions on fish and wildlife consumption, tainting of fish and wildlife flavor, degraded fish and wildlife populations, fish tumors or other deformities and loss of fish and wildlife habitat**.**

Population Goals and Objectives

The GLBFHP has identified eight species, referred to as tracking species that will allow the partnership to link habitat conservation actions to species response. The following criteria were used in selecting the species listed in Table 11.

- The species is believed to be adversely impacted by degradation of that habitat type.
- The species is identified in one or more Lake Community Objectives (except for BKT and DAR)
- The species is currently and consistently monitored by one or more partners or current monitoring efforts could be easily modified to include the species.

Table 11. Tracking Species

Tracking Species	
Habitat Type	**Species**
Small Tributaries	Brook Trout, Darters (Johnny Darter)
Large Tributaries	Lake Sturgeon, Walleye
Shoreline	Smallmouth Bass, Lake Sturgeon, Yellow Perch, Northern Pike
Connecting Channels	Lake Sturgeon, Walleye, Northern Pike
Nearshore	Smallmouth Bass, Yellow Perch, Lake Sturgeon, Lake Trout, Walleye
Offshore	Lake Trout

The tracking species were cross referenced (where applicable) to the individual Lake Fish Community Objectives to develop population objectives (Table 12). These objectives reflect the best professional judgment of the GLBFHP Steering Committee with respect to the anticipated population response to habitat improvement. The Great Lakes system is highly complex with several other factors such as commercial fishing and angling regulations, and hatchery based augmentation; all play important roles in the fluctuation of many of these populations. The GLBFHP will focus research efforts in methodologies for identifying population response to habitat changes.

Table 12. Population Goals and Objectives by Species

Population Objectives by Species		
Species	**Goal**	**Objective**
Small Mouth Bass	Maintain and expand (where desired) existing population abundance of smallmouth bass in the Great Lakes Basin	Expand smallmouth bass populations into five priority nearshore waters by 2015. Increase smallmouth bass creel catch rates by 20% in the Great Lakes Basin by 2020 Reduce fish consumption advisories for smallmouth bass by 2030
Lake Sturgeon	Maintain and expand existing population abundance of lake sturgeon in the Great Lakes Basin	Protect lake sturgeon recruitment in self-sustaining rivers throughout the Basin. Restore the range (more rivers) by 20% of self-sustaining lake sturgeon populations by 2040. Restore self-sustaining population abundance of lake sturgeon by at least 10% in the Great Lakes Basin by 2040. Increase lake sturgeon recruitment by 20% through enhancement of spawning habitat by 2040. Delist lake sturgeon from endangered, threatened, or special concern status in all areas of the Great Lakes by 2060.
Lake Trout	Maintain and expand (where desired) existing population abundance of lake trout in GL Basin	Identify all locations of lake trout spawning reefs by 2015 for the Great Lakes Basin. Protect all known lake trout spawning reefs and shoals by 2025 Protect and enhance existing lake trout egg deposition and survival on offshore reefs. Mitigate for loss of lake trout spawning habitat by creating new spawning structures through opportunistic developments by 2025 (e.g., breakwall repairs, wind farm developments). Increase natural reproduction of wild lake trout to 25% of the Great Lakes Basin population by 2025. Increase lake trout egg survival by 20% within the Basin through reef habitat enhancement by 2030. Reduce fish consumption advisories for lake trout in the Great Lakes Basin by 2030.

Population Objectives by Species		
Species	**Goal**	**Objective**
Brook Trout	Maintain and expand (where desired) existing population abundance of brook trout in the Great Lakes Basin.	Increase range (river miles) of self-sustaining brook trout by 5% in Basin by 2020. Increase distribution (presence) of adfluvial brook trout by 15% in the Great Lakes by 2020. Increase brook trout electroshocking catch per unit effort Great Lakes Basin average by 15% by 2020.
Johnny Darter	Maintain and expand (where desired) existing population abundance of Johnny darters in the Great Lakes Basin.	Increase Johnny darter electroshocking catch per unit effort Great Lakes Basin average by 15% by 2020. Protect darters (no net loss) as an indicator of biodiversity in warm water streams through the prevention of Aquatic Invasive Species by 2025. Restore darters in at least 10 small warm water tributary 303 (d) sites after restoration by 2030.
Yellow Perch	Maintain and expand (where desired) existing population abundance of yellow perch in the Great Lakes Basin.	Expand yellow perch populations into five priority nearshore waters by 2015. Increase access to at least five previously accessible spawning habitats by 2015. Increase yellow perch creel catch rates by 20% in the Great Lakes Basin by 2030.
Northern Pike	Maintain and expand (where desired) existing population abundance of northern pike in the Great Lakes Basin.	Enhance access to five previously accessible spawning habitats by 2015 for northern pike. Reduce fish consumption advisories for northern pike by 2020. Increase the existing abundance of northern pike by 20% in the Great Lakes Basin by 2025.
Walleye	Maintain and expand (where desired) existing population abundance of walleye in the Great Lakes Basin.	Protect walleye recruitment in self-sustaining rivers throughout the Great Lakes Basin. Expand walleye populations in five priority nearshore waters by 2015. Increase the walleye population by 10% in the Great Lakes Basin through water quality and habitat enhancements by 2020. Reduce fish consumption advisories for walleye in the Great Lakes Basin by 2025. Expand the walleye distribution by 200 river miles through passage enhancement or restoration by 2040.

Five-Year Implementation Plan

The strategic goals and objectives drafted by this Partnership will guide its course of action and allow us to measure progress, but there are not sufficient resources to do it all. Therefore, the Partnership recognizes it must refine its priorities and narrow its focus to the most critical needs, strategically placing resources where they can be most effective. Priorities were identified (see Setting Priorities Section) to help the Partnership focus for the next few years. It is the intent of this partnership to conduct assessment, research, and information gathering at the Great Lakes level to allow us to refine and adapt our direction. It is also the Partnership's intent to assist local partners in successfully implementing on-the-ground actions through this plan. The following actions are our priorities to achieve our strategic vision.

- **Quantitative Habitat Assessment**

  The current priorities are based on a qualitative habitat assessment (Assessing Threats to Aquatic Habitat Section). A quantitative Basin-wide fish habitat assessment will be conducted based on the habitat types and threats identified through this initial planning process (Appendix 2). This assessment will allow decision makers to focus restoration or protection actions appropriately.

  Specific tasks are:

  - Combine applicable subset of data from the *Initial Assessment for the Status of Fish Habitat for the National Fish Habitat Action Plan* with existing data and landscape-based models developed by the Great Lakes Fishery Commission and the U.S. Geological Service's Great Lakes Aquatic Gap program.
  - Map threats/stressors (incompatible development, shoreline structures, dams, land use, etc.) that alter hydrology and therefore habitats, overlay fish communities, and create indexes of habitat condition.
  - Coordinate data collection and analysis with other Midwest fish habitat partnerships to facilitate communication and foster synergy between the FHPs and NFHAP national committees.

  Target completion date: December 2010.

- **International Participation**

  The Great Lakes are international and most fishery and water quality issues are addressed within international frameworks (e.g. Great Lakes Fishery Commission, Great Lakes Water Quality Agreement). Both the Ontario Ministry of Natural Resources (OMNR) and Department of Fisheries and Oceans Canada are partners on the Council of Great Lakes Fishery Agencies, which initiated candidacy for the Great Lakes to become a NFHAP Fish Habitat Partnership. Both were invited to serve on the Steering Committee and the Ontario Ministry of Natural Resources has been a strong participant. The current goals and objectives are written primarily for the U.S. side. The OMNR plans to review these objectives and add a Canadian component to them to help strengthen this effort overall. The Province of Quebec has not participated, but they will be invited to become a partner.

  The GLBFHP will also request the NFHAP Board to consider providing financial support for international programs and projects.

  Target completion date: December 2011.

❖ **Information Synthesis**

Several priority objectives identified data that should be obtained or compiled to adequately address a threat to allow the Partnership to track progress. Some of these tasks require compilation of existing data, some require the acquisition of new data and others will require the development of data management systems.

- Track GLBFHP projects –Develop or obtain a data management system that will track Great Lakes projects and tie them to GLBFHP and national fish habitat objectives. Target completion date: December 2010.

- Inventory specific fish habitats:
  - Address wetland inventory and classification needs – Update National Wetland Inventory maps where they are greater than 20 years old and convert Wisconsin Wetland Inventory maps to National Wetland Inventory. Work with the Habitat and Wetland Initiative (Great Lakes Regional Collaboration 2005) to compile data and track progress toward objectives of the Great Lakes Regional Collaboration, the Great Lakes Restoration Initiative and the GLBFHP. Incorporate this data into the quantitative habitat assessment and make it available for local decision making. Target completion date: December 2014.

  - Identify locations of key spawning reefs and other areas that nearshore and offshore developments should avoid – Classify habitats that are considered most important for fish habitat. Using the most effective and up-to-date technology (Riseng et al. 2008), acquire habitat data in nearshore zones first and offshore zones second. Target completion date: December 2014.

  - Identify groundwater recharge and discharge areas that are critical for fish habitat – Work with US Geological Service and Great Lakes hydrology experts to develop methods and models for initiating this work in high priority watershed.

  - Identify dams and culverts that impede fish passage – Utilize the Fish Passage Decision Support System in the U.S. Fish and Wildlife Service to upload existing information that is available from existing culvert and dam inventories. Upload dam locations and conditions from states and the Sea Lamprey Program. Identify areas that require on-the-ground inventories and complete them. Target completion date: December 2014.

  - Coordinate with State of the Lake Ecosystem Conference – SOLEC has identified numerous indicators of Basin-wide watershed health. Coordinate their data collection efforts with the Partnership's data collection needs to provide synergy in both efforts. This will include the extent and condition of coastal wetlands, and locations of shoreline structures that impede fish and sediment movement. Target Completion: Ongoing.

- Extent of Invasive Species – Cooperate with other Great Lakes invasive species initiatives to keep track of invasive species, especially those that directly affect fish habitat.
  Target Completion: Ongoing.

❖ **Research**

The Partnership will generally support fish habitat-related research needs identified in Great Lakes Fishery Commission plans and other habitat-related plans. It will actively pursue support of research that will help meet priority goals and objectives, specifically research that will:

- Identify habitat restoration techniques adaptable to climate change.
- Determine how sediment transport affects fish/habitat along shorelines and the dynamics of shoreline sediment movement.
- Identify various life stages of fish and aquatic organisms that use reef habitats.
- Improve aquatic species connectivity without advancing the spread of aquatic invasive species.
- Identify methodologies for identifying population response to habitat changes.

❖ **Adaptive Management and Monitoring**

This conservation strategy utilizes existing research, science, technology and best professional judgment to develop objectives and strategies. New information will become available over the next five years that will influence habitat objectives, this implementation plan, and on-the-ground conservation in the Great Lakes. The Partnership will make adjustments to this plan as needed. The following tasks will help guide monitoring needs that will likely adjust our approaches to habitat conservation in the Great Lakes.

<u>Overall fish habitat monitoring:</u>

- Institute long-term fishery monitoring that can be tied to habitat objectives. Utilize existing monitoring protocols of partner agencies for tracking species as much as possible. Make adjustments to protocols as needed to track progress toward population objectives.
  Target Implementation Date: Currently ongoing by partners.
- Evaluate the effects of on-the-ground conservation actions that the GLBFHP undertakes to ensure accountability, efficiency and effectiveness of implemented actions. Develop and provide a standard format for this evaluation. Identify actions that work and improve those that are ineffective.

Monitoring that is tied to specific habitat objectives:

- Develop long-term monitoring protocols and institute monitoring to track changes in stream sediment transport and hydrological flow within watersheds that are attempting to restore these functions.

- Evaluate the effects of Best Management Practices for building new shoreline structures (including levees, dams, hardened shorelines) on sediment transport and fish movement.

- Evaluate the effects of mechanically enhancing existing spawning reefs.

- Evaluate the effects of implementing Best Management Practices used for development near/on spawning reefs.

Cooperation with other Great Lakes monitoring efforts

Other Great Lakes programs have instituted monitoring efforts in the Great Lakes, including the Great Lakes Regional Collaboration, Great Lakes Fishery Commission, Great Lakes Cooperative Science and Monitoring Initiative and State of the Lakes Ecosystem Conference. Most organizations that are involved in the Steering Committee are also involved in these efforts. The GLBFHP will coordinate and communicate with these monitoring efforts to ensure there is no duplication and to develop joint plans that will help meet our needs.

❖ **Plan Updates**

As new information, research and monitoring redirects and refines the efforts of the Partnership, we will update the plan as needed. The GLBFHP will continue to feed information and plans back and forth between NFHAP, Great Lakes Fishery Commission, Great Lakes Binational Programs and other Great Lakes efforts to ensure the Partnership remains current and coordinated.

❖ **Outreach and Education**

Outreach plans are being developed by the GLBFHP Communications Committee to assist the Partnership in contacting and encompassing local governments, watershed coalitions, lake associations, anglers, and other stakeholders. With the addition of these groups the Partnership will be able to incorporate a wider, more encompassing, local knowledge pool in their decision making process. The addition of private sector and commercial entities will enable the Partnership to expand and increase its capability to leverage funding for priority projects. In addition, the Communications Committee will help coordinate media outreach regarding successes of the Fish Habitat Partnership and assist in pursuing funds and overseeing the development of complementary outreach tools (e.g. economic impact studies, website for public inquiry and input, etc.).

One initial outreach effort is to provide the draft strategic plan to interested parties and the public for review. The Partnership will utilize Great Lakes Information Network, other outreach mediums to advertise its availability and post the plan on the GLBFHP web site.

❖ **Promote Local Scale Conservation Actions**

The GLBFHP recognizes that most work to restore fish habitat will be done at the local level by local watershed associations, municipalities, states and non-governmental organizations. We will not attempt to specify local strategies in this plan for these groups; they are the best judge of identifying the strategies and actions to restore fish habitat in their watersheds and communities. However, there is value in providing assistance that will help local conservation efforts be successful. Therefore, the Partnership will work with organizations who are applying for GLBFHP funds, to encourage local conservation actions that fit within the following general criteria.

- Projects should link with priority objectives identified in this plan.
- Projects should consider watershed-scale ecological and hydrological processes that affect fish habitat and fish populations.
- Projects should monitor their actions on target habitat, ecosystem processes and fish populations over time.
- Projects should leverage resources from partners.
- Where applicable, projects should incorporate best management practices that:
    - Ensure they will not spread invasive species
    - Adapt to climate change
    - Use the most current science and technological knowledge for project design.

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Definitions of Ecological Terms

Ecosystem Processes or Ecosystem Functions - The dynamic attributes of ecosystems, including interactions among organisms and interactions between organisms and their environment. Ecological processes are the basis for self-maintenance in an ecosystem. Attributes include those that affect metabolism, principally the sequestering and transformation of energy, nutrients, and moisture; and physical attributes, such as substrate stabilization, microclimatic control, differentiation of habitat for specialized species, pollination and seed dispersal. Ecosystem functions and processes, along with the reproduction and growth of organisms, are what cause an ecosystem to be self-renewing. (From SER Restoration Primer: Society for Ecological Restoration, 2004).

Fish Community - Populations of species that comprise the biota are collectively identified as the **biotic community**. This community is frequently segregated on the basis of **taxonomic** status (e.g., fish community) or **life form** (e.g., tree community). Assemblages of organisms can also be recognized by their functional roles in the ecosystem (e.g. primary producers, predators, pollinators), in which case they are known as **functional groups**. (From SER Restoration Primer: Society for Ecological Restoration, 2004).

Hydrological Processes – In this plan, hydrological processes refers to parts of the hydrologic cycle related to groundwater and surface water flow.

Geomorphic Processes – Refers to the movement of water and sediment which creates the channel and bed of a stream or river. As water flows over a channel bed, it mobilizes sediment and transports it downstream, either as bedload, suspended load or dissolved load. The rate of sediment transport depends on the availability of sediment itself and on the river's discharge. Sediment is deposited within the stream, along the floodplain, or moved downstream to the river mouth and lake.

Appendices

Appendix 1: Steering Committee Organizations Involved in Partnership Development and Planning

Agency/Organization	Representative
Minnesota Department of Natural Resources (DNR)	Don Schreiner
Michigan DNR	Jay Wesley Randy Claramunt Steve Scott (Co-chair)
Pennsylvania Fish and Boat Commission	R. Scott Carney
Ohio DNR	Roger Knight
Illinois DNR	Steve Robillard
New York Department of Environmental Conservation	William Culligan
Wisconsin DNR	Bill Horns
Indiana DNR	Stuart Shipman
Chippewa Ottawa Resource Authority Tribes	Tom Gorenflo
Grand Portage Band of Chippewa Indians	Seth Moore
Great Lakes Indian Fish and Wildlife Commission Tribes	Neil Kmiecik
Trout Unlimited	Laura Hewitt
Ducks Unlimited	Dave Brakhage
Great Lakes Commission	Tim Eder
The Nature Conservancy	Richard Bowman
U.S. Bureau of Indian Affairs	Bob Jackson
U.S. Fish and Wildlife Service	Mark Brouder (Co-chair)
U.S. Environmental Protection Agency – Fish and Wildlife Service Liaison	Amy DeWeerd
U.S. Geological Survey	David Bornholdt
NOAA/NMFS	John Iliff
U.S. Forest Service	Nick Schmal
National Park Service	Jay Glase
U.S. Army Corps of Engineers	Jim Galloway
Ontario Ministry of Natural Resources	Eric Boysen Kevin Loftus
Great Lakes Fishery Commission	Gary Isbell
Great Lakes Sport Fishing Council	Tom Hamilton

Appendix 2: GLBFHP Habitat and Threat Matrix

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Small Tributaries (less than 40 square miles catchment) – **Improve connectivity**	Lack of access to spawning and nursery habitat and thermal refugia.	Dams, culverts, and sea walls that don't allow fish passage. Sedimentation Contaminants and invasive species (prevent	27 See Attachment A
Small Tributaries (less than 40 square mile catchment) – **Protect and restore quality spawning and nursery habitat.**	Loss of riparian habitat	Land Use Practices and Land Cover	27
	Loss of large woody debris	Land Use that converts land/habitat type: Forest to open Development	
	Entrenchment of streams causing a loss of connectivity with floodplains	Land Use that converts land/habitat type: Forest to open Development Forest to cropland Impervious surfaces	
	Alteration of sediment transport, especially resulting in stream aggradation	Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Dams Culverts that are not properly placed Bridges that are not large enough	

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
	Direct alteration of natural channel	Channelization Roads: Roads that impinge Culverts	
Small Tributaries (less than 40 square mile catchment) – **Restore surface and groundwater hydrological functions.**	Increased water temperatures	Land Use that converts land/habitat type: Forest to open/ag Development Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Water withdrawal Dams Climate change	27
	Alterations in natural stream flow	Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Land Use that converts land/habitat type: Forest to open Development Forest to cropland Impervious surfaces Dams Water withdrawal Climate change	

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Large Tributaries (greater than 40 sqaure miles catchment) – **Improve connectivity**	Lack of access to spawning and nursery habitats and thermal refugia.	Dams, culverts, and sea walls that don't allow fish passage. Sedimentation Contaminants and invasive species (prevent spread with Dams) Competition among species	51
Large Tributaries (greater than 40 square mile catchment) – **Protect and restore quality spawning and nursery habitat.**	Loss of riparian habitat	Land Use Practices and Land Cover Development Forest to open/agriculture	51
	Loss of large woody debris	Land Use that converts land/habitat type: Forest to open Development	
	Entrenchment of streams causing a loss of connectivity with floodplains	Land Use that converts land/habitat type: Forest to open Development Forest to cropland	
	Alteration of sediment transport, especially resulting in stream aggradation	Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Culverts that are not properly placed Dams	

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
	Direct alteration of natural channel	Channelization Roads: Roads that impinge Culverts	
Large Tributaries (greater than 40 square mile catchment) – **Restore surface and groundwater hydrological functions.**	Increased water temperatures	Land Use that converts land/habitat type: Forest to open/ag Development Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Water withdrawal Dams Climate change	51
	Alterations in natural stream flow	Land Use that alters hydrologic flow: Open lands Impervious surfaces Wetland drainage Poorly designed roads Land Use that converts land/habitat type: Forest to open Development Forest to cropland Impervious surfaces Dams Water withdrawal Climate change	

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Shoreline (generally 0-3 meters; includes coastal wetlands, estuaries, embayments, and islands) – **Protect and restore quality spawning and nursery habitats.**	Degradation and loss of wetland acres.	Development or navigation that leads to: Dredging Draining Filling Road building Hardened surfaces and shorelines Nutrient loading Contaminants Marine debris Excess sedimentation from tributaries Invasive species	38
Shoreline (generally 0-3 meters; includes coastal wetlands, estuaries, embayments, and islands) – **Protect and restore ecosystem functions.**	Loss of plant and animal diversity and abundance that result in altered food webs	Nutrient loading from land use Invasive species Increased boat traffic Nuisance native species	38
Shoreline (generally 0-3 meters; includes coastal wetlands, estuaries, embayments, and islands) - **Improve connectivity**	Lack of access to spawning and nursery habitat and thermal refugia.	Altered hydrologic flow Channelization Dikes Land Use practices that directly add sediment or nutrients: Cropland Urban yards Confined animal feeding operations Improper forestry practices Sea walls Sedimentation Lake level changes	38

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Shoreline (generally 0-3 meters; includes coastal wetlands, estuaries, embayments, and islands) – **Improve and protect water quality**	Degradation of water quality	Land Use practices that directly add sediment or nutrients: Cropland Urban yards Confined animal feeding operations Improper forestry practices Aerial deposition Contaminants Marine debris Invasive species Cage aquaculture Point discharges	38
Nearshore (area greater than 3 meters out to offshore based on lake specific definitions) – **Improve and protect water quality**	Degradation of water quality	Land Use practices that directly add sediment or nutrients: Cropland Urban yards Confined animal feeding operations Improper forestry practices Aerial deposition Contaminants Marine debris Invasive species Cage aquaculture	45
Nearshore (area greater than 3 meters out to offshore based on lake specific definitions) - **protect and restore spawning reefs**	Degradation and loss of reef habitat.	Ground water intrusion Lake level changes Navigation Channelization Sedimentation Zebra mussel growth Invasive species	45

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Offshore (area outside nearshore based on lake specific definitions) - **protect reefs**	Degradation and loss of reef habitat.	Oil and gas development Wind farm development offshore potential threat. Invasive species Zebra and quagga mussels	13
Offshore (area outside nearshore based on lake specific definitions) - **Improve and protect water quality**	Degradation of water quality	Land Use practices that directly add sediment or nutrients: Cropland Urban yards Confined animal feeding operations Improper forestry practices Aerial deposition Contaminants Marine debris Invasive species Point discharges	13
Shoreline (generally 0-3 meters; includes coastal wetlands, estuaries, embayments, and islands) – **Protect and restore natural coastal systems and shoreline hydrological processes.**	Degradation and loss of shoreline and coastal habitat	Development near and on shoreline Marinas Docks Roads Dredging for navigation Hardening to reduce erosion Lake level fluctuations Marine debris Invasive species Climate Change	38

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Nearshore (area greater than 3 meters out to offshore based on lake specific definitions) – **Protect and restore natural coastal systems and nearshore hydrological processes.**	Degradation and loss of shoreline and coastal habitat	Development near and on shoreline Marinas Docks Roads Dredging for navigation Hardening to reduce erosion Lake level fluctuations Marine debris Invasive species Climate Change	45
Connecting Channels (ie. St. Marys, St. Clair, Detroit, Niagara, St. Lawrence, etc.) - **Protect and restore natural coastal systems and nearshore hydrological processes.**	Degradation and loss of shoreline and coastal habitat	Development near and on shoreline Marinas Docks Roads Dredging for navigation Hardening to reduce erosion Lake level fluctuations Shipping traffic Invasive species Climate Change	Use shoreline and nearshore species for each Great Lake
Connecting Channels (ie. St. Marys, St. Clair, Detroit, Niagara, St. Lawrence, etc.) - **Improve and protect water quality**	Degradation of water quality	Land Use practices that directly add sediment or nutrients: Cropland Urban yards Confined animal feeding operations Improper forestry practices Aerial deposition Contaminants Marine debris Invasive species Point discharges	Use shoreline and nearshore species for each Great Lake

Habitat and Conservation Goal	Stressor or Threat	Root Cause of Stressor or Threat	Number of Fish Species of Interest
Connecting Channels (ie. St. Marys, St. Clair, Detroit, Niagara, St. Lawrence, etc.) – **Protect reefs**	Degradation and loss of reef habitat.	Oil and gas development Wind farm development offshore potential threat. Invasive species Zebra and quagga mussels	Use shoreline and nearshore species for each Great Lake
Connecting Channels (ie. St. Marys, St. Clair, Detroit, Niagara, St. Lawrence, etc.) – **Protect and restore ecosystem functions.**	Loss of plant and animal diversity and abundance that result in altered food webs	Nutrient loading from land use Invasive species Increased boat traffic Nuisance native species	Use shoreline and nearshore species for each Great Lake
Connecting Channels (ie. St. Marys, St. Clair, Detroit, Niagara, St. Lawrence, etc.) - **Improve connectivity**	Lack of access to spawning and nursery habitat and thermal refugia.	Altered hydrologic flow Channelization Dikes Sea walls Sedimentation Lake level changes Locks	Use shoreline and nearshore species for each Great Lake
All Habitats	Lack of Inventory/Information on key habitats.	Limited funding Difficult to inventory Limited technology Lack of understanding leads to lack of research and inventory.	Attachment A

This information was compiled from the following documents:

Lake Michigan Environmental Objectives
Environmental Objectives for Lake Huron
Lake Erie Environmental Objectives
Fish Community Objectives for Lake Superior
Fish Community Objectives for Lake Ontario
Lake Superior Lakewide Management Plan – Ecosystem Section
Lake Superior Binational Program Ecosystem Goals

Lake Ontario Lakewide Management Plan – Habitat Assessment and Restoration Section
Lake Erie Lakewide Management Plan – Habitat Section
Lake Huron Binational Partnership 2008-2010 Action Plan – Aquatic and Coastal Habitat Section
Lake Michigan Lakewide Management Plan 2008 – Habitat Section
Great Lakes Regional Collaboration – Habitat/Species Conservation
Great Lakes Regional Collaboration- Habitat and Wetlands Initiative

State Wildlife Action Plans

Appendix 3: Habitat Types and their Associated Species of Interest in the Great Lakes Basin

Habitat Types	Species	Great Lake[9]	Source Data[10]
Shoreline (0-3 meters)	Alewife	M, H, O	FCO
	Atlantic salmon	S, O	FCO
	Black buffalo	E,	WAP
	Bloater	M, S, H	FCO
	Brassy minnow	E,	WAP
	Brindled madtom	E,	WAP
	Brook trout	S	FCO
	Brown bullhead	O	FCO
	Brown trout	M, S, H, O	FCO
	Burbot	M, H, O	FCO
	Channel catfish	M, H	FCO
	Channel darter	E,	WAP
	Chinook salmon	M, S, H, O	FCO
	Cisco or lake herring	M, S, E, H,O	WAP, FCO
	Coho salmon	M, S, H, O	FCO
	Common white sucker	M	FCO
	Eastern sand darter	E, O	WAP
	Emerald shiner	M, H	FCO
	Grass pickerel	E,	WAP
	Lake sturgeon	M, S, E, H, O	WAP, FCO
	Lake whitefish	M, H, E	FCO
	Largemouth bass	H	FCO
	Longnose sucker	M	FCO
	Mooneye	E, O	WAP
	Muskellunge	E, O, H, E	WAP, FCO
	Ninespine stickle back	O, S	WAP, FCO
	Northern pike	M, H, E	FCO
	Pink salmon	S, H	FCO
	Rainbow smelt	M, S, H, O, E	FCO
	River darter	E, H	WAP
	River redhorse	M, E	WAP
	Round whitefish	M, S, H, O, E	FCO
	Sauger	M, S, E, H, O	WAP
	Silver chub	E,	WAP
	Slimy sculpin	M, S, E, H,O	WAP, FCO
	Smallmouth bass	M, S, H, O, E	FCO

[9] Great Lakes within the basin: Superior (S), Michigan (M), Huron (H), Erie (E), Ontario (O).

[10] Information was compiled from State Wildlife Action Plans (WAP) and Fish Community Objectives (FCO) from each Great Lake

Habitat Types	Species	Great Lake[9]	Source Data[10]
	Spoonhead sculpin	M, S	WAP
	Spottail shiner	H	FCO
	Spotted sucker	E,	WAP
	Steelhead	E, M, S, H, O	FCO
	Stonecat	E, H	WAP
	Tadpole madtom	E, H	WAP
	Walleye	M, H, O	FCO
	White bass	E	FCO
	Yellow perch	M, H, O	FCO
Nearshore (3-30 meters)	Alewife	M, H, S, O	FCO
	Atlantic salmon	S, O	FCO
	Black buffalo	E,	WAP
	Bloater	M	FCO
	Brassy minnow	E,	WAP
	Brindled madtom	E,	WAP
	Brook trout	S	FCO
	Brown bullhead	M, S, O	WAP, FCO
	Brown trout	M, S, H, O	FCO
	Burbot	M, H, O	FCO
	Channel catfish	M, H	FCO
	Channel darter	E,	WAP
	Chinook salmon	M, S, H, O	FCO
	Cisco or lake herring	O, M, S, E, H	WAP, FCO
	Coho salmon	M, S, H, O	FCO
	Common white sucker	M	FCO
	Eastern sand darter	E, O	WAP
	Emerald shiner	M	FCO
	Lake Sturgeon	M, S, E, H, O	WAP, FCO
	Lake trout	O, H, M, S	WAP, FCO
	Lake whitefish	E, M, S, H, O	FCO
	Largemouth bass	H	FCO
	Longnose sucker	M	FCO
	Mooneye	M, E, H, O	WAP
	Muskellunge	E, O	WAP, FCO
	Northern pike	M, H, E	FCO
	Pink salmon	S, H	FCO
	Pygmy whitefish	S,	WAP
	Rainbow smelt	M, H, S, O, E	FCO
	River darter	E, H	WAP
	River redhorse	M,	WAP
	Round whitefish	M	FCO
	Sauger	M, S, E, H	WAP
	Shortjaw cisco	M, S, H, O	WAP, FCO
	Silver chub	E,	WAP
	Slimy sculpin	M, S, H, O	WAP, FCO
	Smallmouth bass	M, H, E	FCO

Habitat Types	Species	Great Lake[9]	Source Data[10]
	Spoonhead sculpin	M, S, H, O	WAP, FCO
	Spotted gar	M, E	WAP
	Spotted sucker	E,	WAP
	Steelhead	M, S, H, O, E	FCO
	Stonecat	E, H	WAP
	Tadpole madtom	E, H	WAP
	Walleye	M, S, H, E	FCO
	White bass	E	FCO
	Yellow perch	M, H, O, E	FCO
Offshore (30 meters and Greater)	Burbot	M, H	FCO
	Cisco or lake herring	M, S, H, O	WAP, FCO
	Deepwater sculpin	M, S, H, O	WAP, FCO
	Kiyi	M, S, H, O	WAP
	Lake trout	M, S, H, O	WAP, FCO
	Lake whitefish	O, M, S, H	FCO
	Pigmy whitefish	S,	WAP
	Round whitefish	O, M, S, H	FCO
	Sauger	H	WAP
	Shortjaw cisco	M, S, H, O	WAP, FCO
	Slimy sculpin	M, S, H, O	WAP, FCO
	Spoonhead sculpin	M, S, H, O	WAP, FCO
	Stonecat	H	WAP
Small Tributaries (less than 40 square miles catchment)	Banded darter	M,	WAP
	Bigmouth shiner	M, S,	WAP
	Black redhorse	M, E,	WAP
	Brassy minnow	M, S, H	WAP
	Brook trout	E, O, S	WAP, FCO
	Channel darter	H	WAP
	Eastern sand darter	E, O	WAP
	Faintail darter	M, E, H	WAP
	Finescale dace	M, S, E, H	WAP
	Golden redhorse	E,	WAP
	Grass pickerel	E, H	WAP
	Iowa darter	O	WAP
	Least darter	M, S, E, H	WAP
	Longear sunfish	M, E, O	WAP
	Pugnose shiner	M, E, H, O	WAP
	Rainbow smelt	M, H, S, O, E	FCO
	Redfine shiner	M, O	WAP
	Redside dace	M, S, E,	WAP
	Slimy sculpin	M, S, H	WAP
	Southern redbelly dace	E,	WAP
	Spoonhead sculpin	S, H	WAP

Habitat Types	Species	Great Lake[9]	Source Data[10]
	Spotted sucker	H	WAP
	Striped shiner	M, E, H	WAP
	Western creek chubsucker	E,	WAP
	Western sand darter	M	WAP
Large Tributaries (greater than 40 square mile catchment)	Atlantic salmon	S, O	FCO
	Banded darter	M, E,	WAP
	Bigeye chub	E, O	WAP
	Bigmouth shiner	M, S, E,	WAP
	Black buffalo	M, E, H	WAP
	Black redhorse	M, E, H, O	WAP
	Blackchin shiner	O,	WAP
	Brassy minnow	M, S, H	WAP
	Brook trout	S	FCO
	Brown bullhead	M, S, E, H, O	WAP, FCO
	Brown trout	M, S, H, O	FCO
	Burbot	M, O, H	FCO
	Channel catfish	M, H	FCO
	Channel darter	E, H	WAP
	Chinook salmon	M, S, H, O	FCO
	Cisco or lake herring	M, E, H, S, O	WAP, FCO
	Coho salmon	M, S, H, O	FCO
	Common whitesucker	M	FCO
	Eastern sand darter	E, O	WAP
	Fantail darter	M, E, H	WAP
	Finscale dace	M,	WAP
	Golden redhorse	M, E, H	WAP
	Grass pickerel	M, E,	WAP
	Greater redhorse	M, E	WAP
	Lake chubsucker	M, E, H	WAP
	Lake sturgeon	M, S, E, H, O	WAP, FCO
	Least darter	M, S, E, H	WAP
	Longear sunfish	M,	WAP
	Longnose sucker	M	FCO
	Mooneye	M, E, H	WAP
	Muskellunge	E, O, H, E	WAP, FCO
	Northern brook lamprey	E,	WAP
	Northern pike	M, H, E	FCO
	Pink salmon	S, H	FCO
	Pirate perch	M, E, H, O	WAP
	Pugnose minnow	E,	WAP
	Pugnose shiner	M, E, H, O	WAP
	Rainbow smelt	M, S, H, O, E	FCO

Habitat Types	Species	Great Lake[9]	Source Data[10]
	River chub	M, E, H	WAP
	River darter	E, H	WAP
	River redhorse	M, E,	WAP
	Sauger	M, S, E, H	WAP
	Silver chub	E,	WAP
	Silver lamprey	E,	WAP
	Silver shiner	E,	WAP
	Slimy sculpin	M, S, H, O	WAP, FCO
	Smallmouth bass	M, H, E	FCO
	Spoonhead sculpin	S, H	WAP
	Spotted gar	M, E	WAP
	Spotted sucker	M, E,	WAP
	Starhead topminnow	M,	WAP
	Steelhead	M, S, H, O	FCO
	Stonecat	M, E, H	WAP
	Striped shiner	M, E, H	WAP
	Tadpole madtom	M, E, H	WAP
	Walleye	M, S, H, E	FCO
	Western creek chubsucker	M, E,	WAP
	Western sand darter	M,	WAP
	Yellow perch	M, H, O, E	FCO

Appendix 4: GLBFHP Habitat Type Threat and Tier Ranking

Threats Rankings
Threats are scored as: Very High, High, Medium, Low, or Very Low for their scope (extent), severity, and irreversibility based on a modified Conservation Action Planning (CAP) process developed by The Nature Conservancy.

Meanings of these ratings are:

Scope - Most commonly defined spatially as the geographic scope of impact on the habitat type within the Great Lakes that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

Very High: The threat is likely to be widespread or pervasive in its scope and affect the habitat type throughout the habitat's occurrences in the Great Lakes.
High: The threat is likely to be widespread in its scope and affect the habitat type at many of its locations within the Great Lakes.
Medium: The threat is likely to be localized in its scope and affect the habitat type at some of the habitat's locations within the Great Lakes.
Low: The threat is likely to be very localized in its scope and affect the habitat type at a limited portion of the habitat's locations within the Great Lakes.
Very Low: The threat is likely to be extremely localized in its scope and affect the habitat type at a very limited portion of the habitat's locations within the Great Lakes.

Severity - The level of damage to the habitat type that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

Very High: The threat is likely to destroy or eliminate this habitat type over some portion of the habitat's occurrence within the Great Lakes.
High: The threat is likely to seriously degrade the habitat type over some portion of the habitat's occurrence within the Great Lakes.
Medium: The threat is likely to moderately degrade the habitat type over some portion of the habitat's occurrence within the Great Lakes.
Low: The threat is likely to slightly degrade the habitat type over some portion of the habitat's occurrence within the Great Lakes.
Very Low: The threat is likely to slightly impair the habitat type over some portion of the habitat's occurrence within the Great Lakes.

Irreversibility – The degree to which the effects of a source of stress can be restored.

Very High: The source produces a stress that is not reversible (e.g., wetlands converted to a shopping center).
High: The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
Medium: The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining wetland).
Low: The source produces a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland).

Very Low: The source produces a stress that is completely reversible at very low cost (e.g., foot traffic through a wetland).

Combining Scope and Severity for each Threat

		Scope				
		Very High	High	Medium	Low	Very Low
Severity	Very High	Very High	High	Medium	Low	Very Low
	High	High	High	Medium	Low	Very Low
	Medium	Medium	Medium	Medium	Low	Very Low
	Low	Low	Low	Low	Low	Very Low
	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low

Using the above table, the Scope and Severity ranks for each threat are combined to create an overall threat rank for the basin.

Multiple threats to habitat types and multiple habitat threat scores are summed together using the 3-5-7-9 rule:

3 High ranked threats are equivalent to 1 Very High-ranked threat;
5 Medium ranked threats are equivalent to 1 High-ranked threat;
7 Low ranked threats are equivalent to 1 Medium-ranked threat;
9 Very Low ranked threats are equivalent to 1 Low-ranked threat;

Once multiple threats scores are summed together, the overall threat status for a single habitat type, for a threat, and the overall threat status for the whole Great Lakes is calculated using the 2-prime rule. This rule requires the equivalent of two Very High rankings (e.g., one Very High and at least three High rankings) for the overall ranking to be Very High and the equivalent of two High rankings for the overall ranking to be High.

This process will be conducted for each Great Lake and then combined for an overall Great Lakes Basin ranking.

Habitat Type and Threat Tiers (grouping)

Using the combined scope/severity and reversibility ranks, each habitat type and threat is placed into the appropriate tier (see summaries below). Tier 1 habitat types and threats have the most effect on the Basin and have a relatively low cost in resources and time to restore, enhance, and/or protect. Tier 5 habitat types and threats have the least effect on the Basin and have high costs to restore, enhance, and/or protect.

Generally, these tiers provided a timeframe for habitat objectives as follows:
Tier 1 – 5 year completion
Tier 2 – 10 year completion
Tier 3 – 15 year completion

Tier 4 – 20 year completion
Tier 5 – 25 year completion

Tier Summaries:

Tier	Scope/Severity Rank	Reversibility Rank
1 Highest Effect at Lowest Cost	Very High	Very Low
	Very High	Low
	High	Very Low
	High	Low
	Very High	Medium
2	Medium	Very Low
	High	Medium
	Medium	Low
	Very High	High
	Low	Very Low
3	High	High
	Very High	Very High
	Medium	Medium
	High	Very High
	Low	Low
4	Very Low	Very Low
	Medium	High
	Low	Medium
	Very Low	Low
	Medium	Very High
5 Lowest Effect at Highest Cost	Low	High
	Very Low	Medium
	Low	Very High
	Very Low	High
	Very Low	Very High