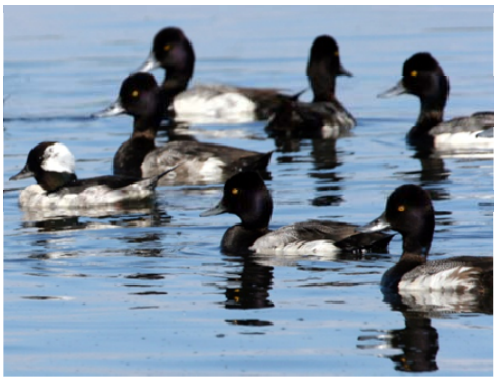
Report to Congress



Great Lakes Fish and Wildlife Restoration Act of 2006

Progress 1990 - 2010

U.S. Fish and Wildlife Service
Department of the Interior

CONSERVING AMERICA'S fisheries
U.S. FISH AND WILDLIFE SERVICE

Prepared by
U.S. Fish and Wildlife Service
Region 3 Fisheries Program

Executive Summary

About the Great Lakes Fish and Wildlife Restoration Act

The Great Lakes Fish and Wildlife Restoration Act (Act) became Public Law 101-646 on November 29, 1990, with the purpose "to carry out a comprehensive study of the status, and the assessment, management, and restoration needs, of the fishery resources of the Great Lakes Basin; to develop proposals to implement recommendations resulting from that study; and to provide assistance to the Great Lakes Fishery Commission, states, Native American tribes, and other interested entities to encourage cooperative conservation, restoration and management of fish and wildlife resources and their habitat." It was reauthorized in 1998 and 2006; the current authorization schedule extends through fiscal year 2012.

Why the Service prepared this report

When the Act was reauthorized in 1998 and again in 2006, Congress included a requirement that the U.S. Fish and Wildlife Service (Service) submit a report that describes actions taken to solicit and review proposals to restore fish and wildlife in the Great Lakes, the results of proposals implemented, and progress toward accomplishment of the goals Congress provided for the Service's activities in the Great Lakes. This report documents the progress that the Service and our Great Lakes partners have made through 2010 and highlights many (74 completed projects and 36 projects in progress) of the fish and wildlife restoration success stories made possible through the Act.

Our principal findings

The Service finds that the fish and wildlife restoration proposal program authorized under Section 1005 (16 U.S.C. 941c) has become a tremendous success during 1998-2010, with 110 projects funded at a total value of more than $21.3 million, including $10.4 million in federal funds awarded. In total, efforts to reach the Service's Great Lake Goals have brought 265 state, tribal, federal, university, non-governmental, and Canadian organizations together under unified interagency processes. The Service has been able to focus efforts via Act funded projects toward 21 of the 32 recommendations identified in the Great Lakes Fishery Resources Restoration Study and other Great Lakes management plans.

Additionally, the Service finds that significant progress has been made in addressing the six Great Lakes Restoration Goals specified in Section 1006 (16 U.S.C. 941d). Highlights include: control of sea lamprey populations across the Great Lakes; improved management of lake trout, lake whitefish, lake sturgeon, and other native fishes; delisting of gray wolves in the Western Great Lakes area from the Federal List of Endangered and Threatened Wildlife; increasing populations of Kirtland's warbler, Great Lakes piping plover, Karner blue butterfly and other listed species; restoration of wildlife habitat on over 15,500 acres of coastal wetlands; protection, enhancement and restoration of over 107,000 acres of migratory bird habitat; identification of contaminant impacts and restoration activities for the St. Lawrence River, Niagara River, West Branch Grand Calumet River, Saginaw River, and lower Fox River River/Green Bay; and many successful law enforcement operations.

Status of Great Lakes fish and wildlife resources and the Act

Fish and wildlife restoration needs in the Great Lakes present a management challenge which is staggering in scope and complexity. The Great Lakes drainage basin encompasses an area of approximately 200,000 square miles, is home to more than 35,000,000 people, several large metropolitan areas, and supports a recreational fishery worth over seven billion dollars. This report illustrates that significant progress has been made in addressing fish and wildlife restoration needs. However, the scale of resource restoration issues advances continuously, with new challenges (e.g. invasive Asian carps and other potential invasive species) arising each day. The Great Lakes Fish and Wildlife Restoration Act has become a central rallying point around which many Great Lakes agencies and organizations can address these challenges together.

The Act provides critical support allowing for implementation of key research and restoration efforts in an incredibly diverse and dynamic ecosystem. The Act has complemented and leveraged the legacy of strong cooperation and collaboration between Great Lakes states and provinces, tribes, federal agencies (both U.S. and Canadian), and non-governmental organizations. The Act promotes actions that "move the needle," and are completed in a strategic and efficient manner. Additionally, the Act promotes innovation, communication, and accountability. Key projects have allowed for the restoration of important Great lakes habitats in novel, cutting edge ways; results of the work were documented for both the natural resource community and the public, and the degree of success has been documented through scientifically measurable and repeatable criteria. The administrators of the Act are committed to maintaining extremely high standards, and to maximizing net resource outcomes for every dollar appropriated, and ultimately yielding the greatest related economic benefit for the American people.

More recently, changes in demographics and the economic structure within the Great Lakes have greatly elevated the importance of healthy aquatic systems to sustain recreational fishing, boating, and related tourism in communities that once relied upon heavily upon manufacturing and industry. Act funding has made an important and meaningful contribution to supporting a way of life for these communities, and is more critical than ever in light of challenges such as climate change and new invasive species (including Asian carp). Resource managers and constituents from the eight Great Lakes states recognize the important role the Act has played and can play in the future in realizing critical successes in the conservation and restoration of ecologically and economically valuable species and their habitats.

About the Service

U.S. Fish and Wildlife Service Great Lakes Programs

The mission of the U.S. Fish and Wildlife Service is to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. Service programs in the Great Lakes are implemented by 63 field stations (see map below). These offices conduct fish and wildlife restoration activities throughout the basin, including coastal and near-shore habitats, under numerous federal authorities that generally relate to nationally significant migratory species, federally listed threatened and endangered species, and interjurisdictional species and their habitats. The Service manages approximately 140,000 acres in the basin as part of twenty-two Refuges under the National Wildlife Refuge System, maintain over 11,000 acres in waterfowl production areas and produce millions of fish each year for interagency restoration programs from seven National Fish Hatcheries. Four Fish and Wildlife Conservation Offices conduct population assessment and cooperative management of native species and habitats- including efforts to improve fish passage and help prevent and control aquatic invasive species. The Great Lakes Coordination Office, two Fish Health Centers, two Sea Lamprey Control Stations, and one Fish Technology Center also perform important work in support of managing healthy populations of native aquatic species. Agents at thirteen Law Enforcement offices enforce federal wildlife laws, such as the Lacey Act. At twelve Ecological Services offices the Service provides consultation and technical assistance services to federal, state, tribal and local authorities, and a variety of non-governmental organizations, toward conserving fish and wildlife, as well as providing expertise toward the identification, restoration and prevention of contaminant, invasive species, and other negative impacts. The Service also works directly with private land owners to restore fish and wildlife habitat on their properties through the Partners for Fish and Wildlife Program.

For further information about Service programs and activities in the Great Lakes Basin, visit the Midwest Region website at http://midwest.fws.gov or the Northeast Region at http://northeast.fws.gov.

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Acknowledgements

The Service gratefully acknowledges the many contributions of our partners in implementing the Great Lakes Fish and Wildlife Restoration Act. The Service conducts virtually all of its activities in the Great Lakes in collaboration with other agencies, organizations, and individuals.

In particular, the Service acknowledges the state and tribal agencies that provide staff to serve on the Proposal Review Committee. Through their dedication and contribution of their expertise they ensure that only the highest quality projects that address the greatest conservation needs are funded. The Service also acknowledges the Secretariat of the Great Lakes Fishery Commission for managing the request for proposal process from 1998 through 2006 and administering many of our cooperative agreements for fish and wildlife restoration activities during that time.

The Service acknowledges the extensive involvement of our partners in this effort, who continue to provide funding, in-kind contributions and expertise in implementing fish and wildlife restoration projects. The Service would also like to recognize the many partners who worked with us in support of the six Great Lakes Goals. These participating organizations are listed in Appendix I by specific Act funded project, a complete list of partners can be found in Appendix II. The Service would also like to acknowledge the many peer reviewers who have volunteered their time to score and rank proposals, their involvement adds a level of scientific rigor which is invaluable to the overall process.

Introduction

Purpose

The Great Lakes Fish and Wildlife Restoration Act (16 U.S.C. 941) (Act) was enacted on November 29, 1990, with the purpose "to carry out a comprehensive study of the status, and the assessment, management, and restoration needs, of the fishery resources of the Great Lakes Basin; to develop proposals to implement recommendations resulting from that study; and to provide assistance to the Great Lakes Fishery Commission, states, Indian tribes, and other interested entities to encourage cooperative conservation, restoration and management of fish and wildlife resources and their habitat."

The U.S. Fish and Wildlife Service (Service) completed the Great Lakes Fishery Resources Restoration Study (Study) in 1995. The Study focused on the status of fishery resources and habitat in the Great Lakes basin, including effectiveness of present management plans and analysis of the impacts and management alternatives for recently introduced non-indigenous species. The Study developed 32 recommendations for actions to restore the fishery resources of the Great Lakes basin to sustainable levels (Appendix III).

The Act was reauthorized in 1998, and Congress created a Proposal Review Committee authorized to assist the Service to identify, review, and implement proposals for the restoration of fish and wildlife resources based on the results of the Study. In addition proposals were to be consistent with the goals of the Great Lake Water Quality agreement, the 1954 Great Lakes Fisheries Convention, the 1980 Joint Strategic Plan for the Management of Great Lakes fishery resources, the Nonindigenous Aquatic Nuisance Prevention and Control act of 1990, and the North American Waterfowl Management Plan and joint ventures established under the plan.

The Act was reauthorized again in 2006 and further expanded the scope of the Act to comprehensively include both fish and wildlife restoration goals. The Proposal Review Committee was expanded to include one fish and one wildlife appointee from each State Director or Tribe Chair. Proposals were also suggested to be consistent with the strategies outlined in the Great Lakes Regional Collaboration authorized by Executive Order 13340. The authorized appropriation was also increased from $8 million to $16 million.

Congress required the Director of the Service to submit a report to the Committee on Resources of the House of Representatives and the Committee on Environment and Public Works of the Senate that describes: 1) actions taken to solicit and review proposals; 2) the results of proposals implemented; and 3) progress toward accomplishment of the Service's Great Lakes goals. Based on the 2006 re-authorization, this report is due December 31, 2011. Currently, the Act legislation is set to expire at the end of fiscal year 2012.

In an effort to fully summarize the Act, this report documents the progress that the Service and our partners have made between 1990 and 2010. It also highlights many of the fish and wildlife restoration success stories made possible through the Act.

Great Lakes fish and wildlife resources

The Great Lakes basin stretches across more than 750 miles from West to East, covers a surface area of over 94,000 square miles, includes more than 10,000 miles of shoreline, and is the largest system of fresh surface water on earth, containing 18 % (5,500 cubic miles) of the world supply. The basin supports a wide diversity of fish and wildlife and habitats, is home to 142 fish species, and is used by more than 500 species of migratory birds. At least 180 nonnative species have become established in the Great Lakes Basin and pose varied threats to native species.

The Great Lakes contain almost all of North America's unique alvar ecosystems, supporting many globally imperiled species of plants, insects, and land snails. Great Lakes coastal wetlands include sites, such as Long Point, Lake Erie, which are recognized internationally for their outstanding biological significance.

Fish and wildlife habitats and water quality have undergone tremendous change from human impacts as the population of the basin grew from about 100,000 in the 16th century to more than 35,000,000 today. More than 10% of the population of the United States, and 25% of the population of Canada, live in the basin, and some of the world's largest concentrations of industry as well as extensive agricultural lands occur in this region. Over two-thirds of all Great Lakes wetlands have been lost since European settlement began, having an enormous impact on fish and wildlife populations. One example of these alterations to the Great Lakes Ecosystem occurred when the Welland Canal was opened in 1829, bypassing Niagara Falls, joining Lakes Erie and Ontario, and allowing the parasitic sea lamprey to colonize the entire basin.

Act Coordination

The effectiveness of the Act as an overarching strategy has increased steadily since 1990, by fueling the existing fish and wildlife resource management partnerships and by highlighting the activities of the Service under six common Great Lakes restoration goals. The Act has also opened up new possibilities for international coordination, such as the potential to combine activities under the Fish and Wildlife Restoration Proposal program with those funded under the Canada-Ontario Agreement (COA). Since 1971, the Canada-Ontario Agreements have guided the Parties in their work to improve the environmental quality of the basin by reducing the amount of pollution entering the basin, improving and protecting fish and wildlife habitat, working toward the goal of water that is safe to swim in and drink, and fostering a sense of environmental stewardship throughout the region.

This report provides many details and examples of fish and wildlife restoration activities, accomplishments and partnerships realized through 2010. The Service views the Act as a vibrant conservation program with unlimited future potential to enhance fish and wildlife conservation in coordination with other environmental restoration programs in the Great Lakes region.

It is our goal in this report to accurately communicate the status of the Act and its many programs to the reader.

Actions Taken to Solicit and Review Proposals Under Section 1005 of the Act

Reauthorized in 2006, the Great Lakes Fish and Wildlife Restoration Act of 1998 created a new program to facilitate the identification, review, and implementation of state, tribal, and partner proposals for the restoration of fish and wildlife resources.

The Act also required that fish and wildlife restoration proposals be consistent with the goals of the Great Lakes Water Quality Agreement, as amended, the 1954 Great Lakes Fisheries Convention, the 1980 Strategic Plan for the Management of Great Lakes Fisheries, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, the North American Waterfowl Management Plan, and the strategies outlined through the Great Lakes Regional Collaboration authorized under Executive Order 13340.

The Act created the Great Lakes Fish and Wildlife Restoration Proposal Review Committee (PRC) with the authority to review proposals submitted and recommend to the Director which proposals should be implemented. From 1998-2005 the PRC operated under the guidance of the Council of Lake Committees of the Great Lakes Fishery Commission. Following the 2006 reauthorization, the PRC was expanded to include wildlife representation and has been coordinated by the Service.

Milestones and achievements from the Act granting program from 1998-2010 include:

- The first formal Request for Proposals (RFP) under the Act was announced in February 1999.
- The first proposals were funded under the Act in August 1998, with the signing of a cooperative agreement between the Great Lakes Fishery Commission and the Fish and Wildlife Service;
- The PRC was established in April 1999 and members are appointed by each State Director or Tribal Chair;
- In 2006 the PRC was expanded to ensure the inclusion of both fisheries and wildlife representatives. The Service maintains active involvement with the Committee and helps oversee the proposal review process;
- The PRC
- Recommendations for projects have been transmitted by the PRC to the Service each year since 1999, including lists of alternate proposals to be considered in the event that additional funding should become available.
- The Act website was created in 2011 and is now a great source of information relating to Act requests for proposals and the results of past projects.
- The inclusion of additional funding through the Great Lakes restoration Initiative (GLRI) (Page 5) for fiscal year 2010 helped to expand the scale of projects and make a larger impact on the landscape.

During the first twelve years of the program, proposals have been submitted requesting more than $70 million in federal funds for fish and wildlife restoration. These 473 proposals included the promise of leveraging more than $42 million in non-federal matching funds, representing a potential investment of over $112 million in Great Lakes fish and wildlife restoration (Table 1).

Table 1. Number of proposals received and the funding levels requested by year.

Year	# of Proposals	Federal Funds	Matching Funds	Total Cost
1998	5	$89,000	$58,000	$147,000
1999	7	$150,000	$50,000	$200,000
2000	20	$3,027,000	$2,230,000	$5,257,000
2001	19	$1,742,000	$1,892,000	$3,634,000
2002	22	$1,892,000	$912,000	$2,804,000
2003	27	$2,062,213	$930,308	$2,992,521
2004	24	$2,044,291	$815,000	$2,859,291
2005	25	$2,500,000	$999,021	$3,499,021
2006	13	$1,235,411	$550,009	$3,985,972
2007	36	$2,270,218	$1,715,754	$2,270,218
2008	59	$4,492,096	$2,124,280	$6,616,376
2009	49	$4,173,300	$2,055,238	$6,228,538
2010	167	$44,477,953	$28,109,623	$72,587,576
	473	$70,155,482	$42,441,233	$112,596,715

In addition to the 473 proposals submitted to date, the Service has received hundreds of letters, phone calls, and e-mail messages of support from partners, the Council of Lake Committees, and from the PRC in the course of implementing Section 1005 of the Act. The number of proposals submitted has grown from five in 1998 to 167 in 2010. These communications and the sheer number of proposals received effectively demonstrate the importance of key issues that have shaped the heightened interest and need for restoration throughout the Great Lakes basin. In the end, much restoration work has been accomplished but more remains, as does partner interest in funding this work.

Resources available

The Act has authorized appropriations for the creation and support of offices, completion of conducting studies outlined in the original legislation, and supporting fish and wildlife restoration proposals. Authorized appropriations have varied slightly over the years, but it is clear that appropriations have historically been less than authorized levels (Figure 1). For example, the Act (1998) authorized appropriations up to $4.5 million per year for the implementation of fish and wildlife restoration proposals, or $31.5 million from 2000-2006, of which Congress appropriated a total of $8.29 million, an average of $1.18 million per year. The Act of 2006 authorized appropriations up to $14 million per year from 2007-2012 for the implementation of fish and wildlife restoration proposals, or $56 million from 2007-2010, of which Congress has appropriated a total of $6.68 million, an average of $1.67 million per year. Additionally, $8 million in federal funding was made available in fiscal year 2010 through the GLRI (page 5). With GLRI, the total available federal funding for fiscal year 2010 was $9.47 million and made it possible to fund regional projects for the first time under the Act.

The Service, the PRC and our partners have contributed to the highly effective request for proposals and selection process. The PRC also includes many anonymous peer reviewers from academia, the community of resource managers and biologists, and other respected professionals within the field to ensure that the highest priority and best designed work is selected for funding.

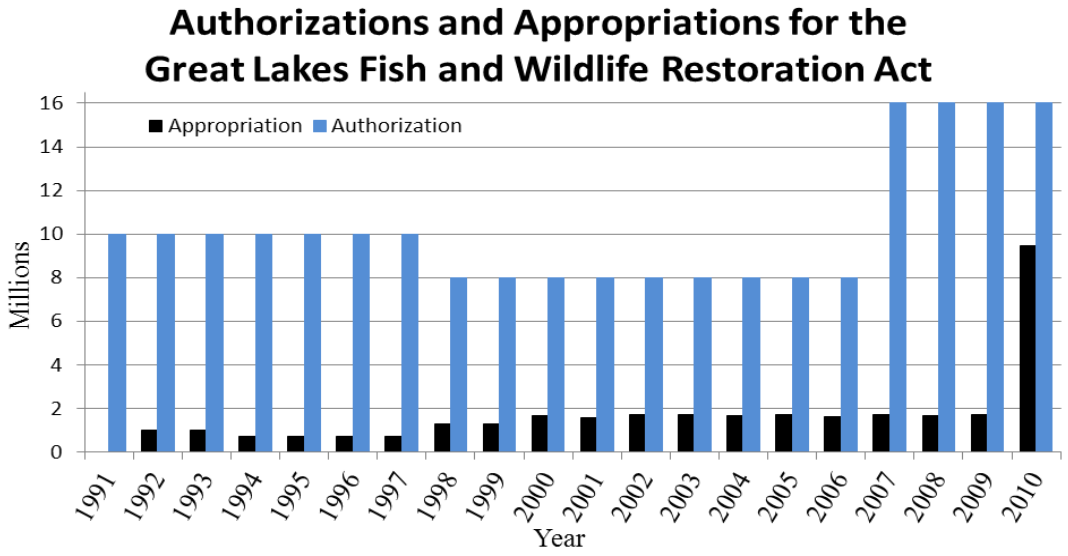

Figure 1. Authorizations and the respective appropriation levels for each respective year of the Act.

Demand for proposal funding has greatly exceeded appropriations

After the proposal review process is complete, in addition to submitting recommended projects to the Service, the PRC on many occasions provided the Service with a list of highly-ranked alternate proposals that would have made valuable contributions to Great Lakes fish and wildlife restoration had additional funding been available. Looking back, this is a practice that provides valuable insight into the quantity and quality of projects that seek funds through the Act each year. Although the number of these proposals varies from year to year, out of 41 full proposals submitted in fiscal year 2010, there were 10 recommended for funding and 17 provided as highly ranked alternates. If ample funding had been available, 41% of the full proposals submitted would have been recommended by the PRC. Over the past decade, some unfunded proposals were resubmitted and funded in subsequent years, although many deserving and valuable projects await funding.

Great Lakes Restoration Initiative supports the Act through increased funding

In FY 2010, Congress appropriated $475 million to the Environmental Protection Agency's (EPA) budget for a new interagency Great Lakes Restoration Initiative (GLRI), which targeted the most significant problems in the region. In FY10, $8 million of Service designated funds was used to fund Act projects. GLRI funding support, in addition to annual appropriations for

the Act, allowed the PRC to recommend a series of large-scale projects including two regional projects, as well as a large-scale dam removal, and 8 other important projects.

The option to recommend and select regional scale projects has been in place since the 1998 reauthorization. Specifically, it stipulates that "not more than the lesser of 33 1/3 percent or $4,600,000 may be allocated to implement regional projects…," Due to the administrations GLRI, 2010 was the first year sufficient funds existed to utilize this portion of the Act. These projects included the purchase of conservation easements in the Lake Erie watershed and the purchase of two automated "mass marking" trailers to be used throughout the basin in support of fish stocking in the Great Lakes (Appendix 1; Pages: 45-46).

The Act is a key tool for implementing the GLRI Action Plan for fish and wildlife restoration and protection. With the Act framework and PRC already in place and operating efficiently, GLRI funding support provided the Service and our partners with an opportunity to demonstrate the efficient and highly successful process in place through the Act.

Trends in Project Proposals

Most of the proposals submitted for review, and most of those recommended for funding by the PRC, represent investigations intended to assess the status of fish and wildlife populations and identify the factors impacting those resources. This was particularly true in the beginning years of the Act, but has changed recently as more and more habitat restoration proposals have been submitted and recommended.

Both habitat restoration and scientific research play important roles in Great Lakes conservation and recovery. A key component to an effective Great Lakes ecosystem management and restoration program is an understanding of species interactions and dynamics for the mix of native and non-native species inhabiting this ecosystem. Without a well-funded research program, management decisions are inevitably based on inadequate and outdated information. The complex issues of the Great Lakes require study approaches that are multi-disciplinary, inter-jurisdictional, and large in scope. Studies that use this approach are extremely insightful in developing linkages between natural resources and management actions, and accordingly demand sufficient funding. The Act has been very effective in funding this kind of applied research in a manner that was not possible before its reauthorization in 1998, and continued post reauthorization in 2006.

There is strong support for restoration projects and the proposal process

The Act has proven to be extremely efficient and effective in supporting interagency fish and wildlife restoration actions and collaborative decision-making. This is in part because the process draws upon the proven framework of the Joint Strategic Plan for Management of Great Lakes Fisheries, under which state, tribal, federal and provincial management agencies have chosen to work. The Service has received positive comments on the process in a number of letters from our partners; support for the Act funded grants program has never been stronger.

Results of Proposals Implemented Under Section 1005 of the Act

Since 1998, over $6.1 million has been appropriated through the Act for research and restoration activities as approved by the Director following recommendations from the PRC. In addition, GLRI supported the Act further by providing $8,000,000 in fiscal year 2010, bringing the total amount of funding available for these projects to over $14.1 million. Matching non-federal dollars tied to the 110 funded projects total more than $7.7 million. When combined with the federal monies, total on-the-ground investment is more than $21.3 million to date through the Act (Table 2). Summaries for each of the research and restoration projects supported through the Act during 1998 - 2010 are presented in Appendix I at the end report. The summaries provide basic information including project title, Great Lakes basin focus area, year funded, partners involved, and cost, as well as the project highlights and background. The volume and diversity of Act funded restoration projects is impressive.

Table 2. Projects funded by year through the Great Lakes Fish and Wildlife Restoration Act; note the additional funding in 2010 from the Great Lakes Restoration Initiative.

Year	Number of Projects	Federal Funding	Partner Match	Total
1998	3	$61,800	$52,100	$113,900
1999	3	$63,300	$25,900	$89,200
2000	9	$486,887	$597,791	$1,084,678
2001	12	$486,001	$346,939	$832,940
2002	12	$575,000	$769,420	$1,344,420
2003	10	$571,750	$272,793	$844,543
2004	9	$566,256	$201,034	$767,290
2005	7	$566,978	$261,830	$828,808
2006	6	$484,093	$181,046	$665,139
2007	7	$578,013	$311,876	$889,890
2008	10	$593,089	$279,239	$872,328
2009	10	$590,190	$314,702	$904,892
2010	1	$489,838	$163,279	$653,117
Act Total	99	$6,113,196	$3,777,949	$9,891,146
GLRI Funding				
2010	11	$8,000,000	$3,951,442	$11,951,442
Act **and** GLRI Total	110	$14,113,196	$7,729,391	$21,842,588

Act funded projects have taken place at locations throughout the entire basin. Although most projects focused on issues within a single Great Lake basin, 35% have had broader reaching objectives involving multiple basins or Great Lakes wide (Figure 2). This is also mirrored when looking at the amount of funds expended through projects within the watershed of each

individual lake. The largest portion, 43%, has been spent on projects involving multiple basins or Great Lakes wide (Figure 3). Note that the relative amount of project dollars expended appears to show a bias towards Lake Erie, 34% of the total. This is due to a single large scale dam removal project funded in 2010 with GLRI funds (for a project summary see Appendix I, Page: 47).

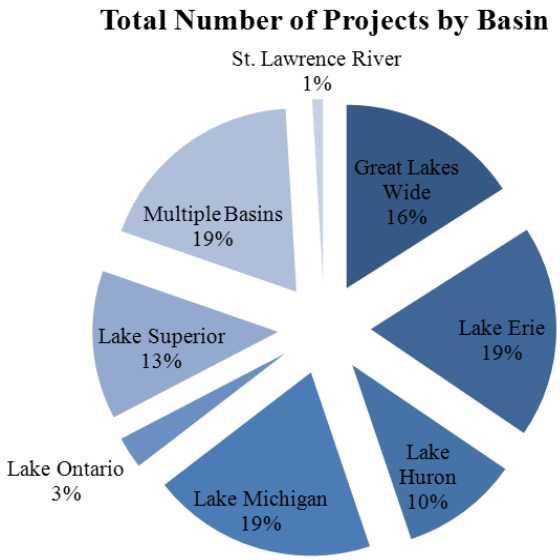

Figure 2. The number of projects funded through the Great Lakes Fish and Wildlife Restoration Act by geographical area of interest, 1998-2010.

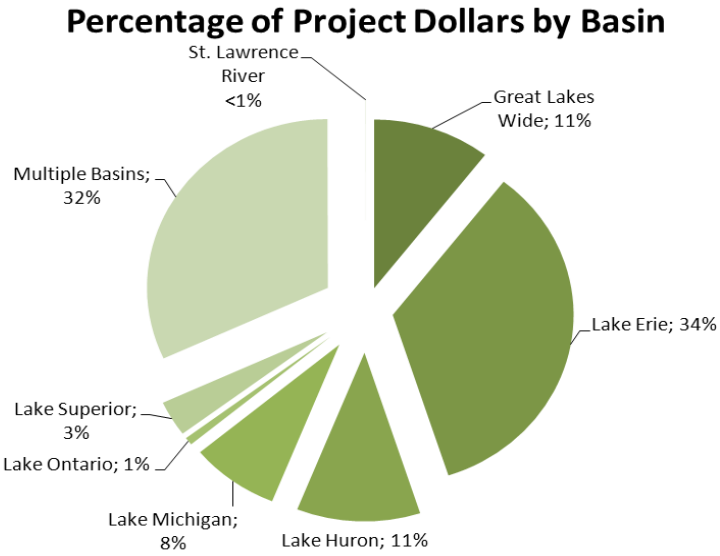

Figure 3. The percentage of total funds, including partner matching dollars, expended through the Great Lakes Fish and Wildlife Restoration Act on projects by geographical area of interest, 1998-2010.

Results of Regional Projects Implemented Under Section 1005 of the Act

Regional projects, submitted by tribal entities or State Department of Natural Resources Directorate give us an opportunity to work on projects which cover larger geographical areas and benefit multiple states or tribes. Regional projects are defined by the Act as "authorized activities of the United States Fish and Wildlife Service related to fish and wildlife resource protection, restoration, maintenance, and enhancement impacting the resources of multiple States or Indian Tribes with fish and wildlife management authority in the Great Lakes basin." The Service is responsible for accomplishing regional projects on behalf of the State and/or Tribal agencies as well as providing a project manager to oversee the progress of the project. However, language in the Act dictates that regional projects can only be funded with up to 33 1/3% of annual Act funding or a maximum of $4.6 million per fiscal year. Due to this stipulation, the first solicitation for Regional Projects did not occur until 2010, when the GLRI substantially increased funding levels for the Act restoration proposals. In 2010, two projects were selected, "Building Capacity for Fisheries Management on the Great Lakes: Implementation of Mass Marking Technology" and "State and Federal Refuge Protection Buffers in the Southwest Lake Erie Watershed Phase II." The ongoing results of these regional projects have been an invaluable resource to the Service and our partners as an opportunity to fund and work on large-scale priorities in the Great Lakes Basin.

Progress Toward Addressing the Great Lakes Fishery Resource Restoration Study Recommendations

Scope and scale of work needed

The Great Lakes Fishery Resources Restoration Study Report to Congress (1995) presented 32 recommendations (Appendix III) which, except where specifically indicated, address issues common to all five of the Great Lakes and their watersheds. When these recommendations were originally developed, there were some informal discussions about the funding levels required to address them; however, no formal estimates were produced or included in the Report.

Progress toward the 32 Recommendations

From 1998-2010, projects funded through the Act have worked towards addressing many of the 32 recommendations set out by the 1995 Great Lakes Fishery Resources Restoration Study (Appendix III).

Those 32 recommendations can be identified within 10 focus areas which we have used to categorize the projects funded to date through the Act (Figure 4; Figure 5). These represent a quick and easy way to investigate where projects accomplished through Act appropriations have

focused. Although progress has been made towards specific goals, it is also clear that many recommendations remain largely unaddressed (Table 2). However, many of the 32 recommendations are complex and require long term effort, in terms of data collection, implementation of activities, and time to gauge the response of natural systems to our actions. The process of establishing interagency databases, creating geographic information systems and initiating cooperative monitoring programs has in many ways just begun, and will take many more years to be fully established.

Each project funded through the Act identifies the specific Great Lakes Fishery Resources Restoration Study recommendations that have been addressed by the project. Most projects reference several recommendations due to the fact that many recommendations are overlapping and inter-related.

In addition to progress via Act funded projects, progress has also been made toward these recommendations via Service restoration activities with its partners to achieve the Service's Great Lakes goals as listed on pages #13 of this report. Service Fish and Wildlife Conservation Offices and National Fish Hatcheries have also been key partners in delivering Great Lakes Basin restoration activities.

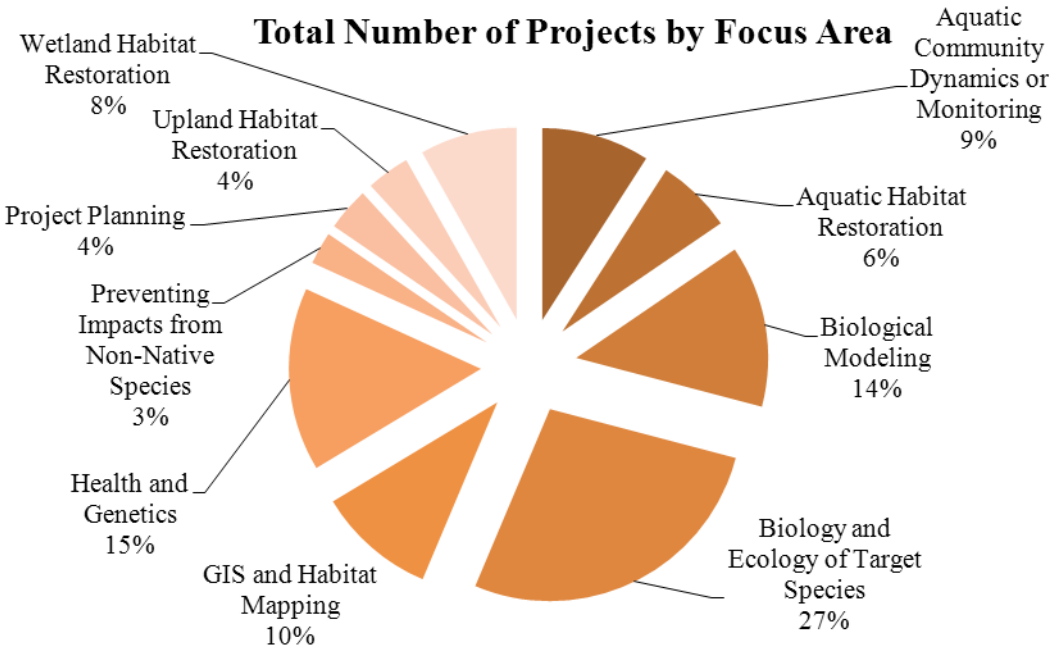

Figure 4. The total number of projects funded through the Great Lakes Fish and Wildlife Restoration Act by Focus Area, 1998-2010.

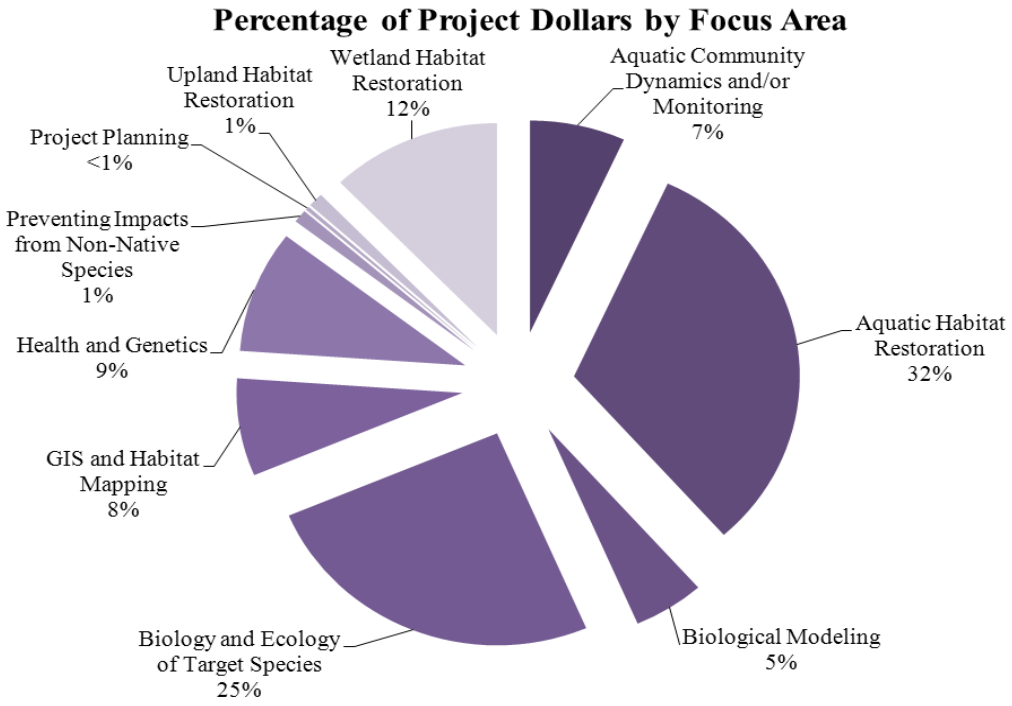

Figure 5. The percentage of total funds, including partner matching dollars, expended through the Great Lakes Fish and Wildlife Restoration Act by Focus Area, 1998-2010.

Table 3. The number of projects completed or in progress contributing to each of the 32 recommendations from the Great Lakes Fishery Resources Restoration Study Report to Congress (1995).

	Recommendation	1998-2002	2003-2010	ALL*
1	Develop and Adopt Aquatic Community and Habitat Goals and Objectives to Support Ecosystem Management.	5	1	6
2	Fully Implement the Strategic Plan for Management of Great Lakes Fisheries.	0	0	0
3	Conduct Comprehensive and Standardized Ecological Monitoring.	5	1	6
4	Standardize Fish Community Assessment Data and Establish Comprehensive Fishery Databases.	4	3	7
5	Develop Offshore Capabilities.	1	1	2
6	Fish Community Assessment Program.	12	5	17
7	Fish Community Modeling.	12	10	22
8	Coordinate State and Native American Tribal Harvest Monitoring and Management: Measure Commercial and Recreational Fish Catches.	2	2	4
9	Evaluate Ecological Effects of Stocking and Revise Stocking Strategies, as Necessary, to be Consistent with Proposed Aquatic Community and Habitat Goals and Objectives.	4	5	9

10	Ecological Information Clearinghouse/Geographic Information System.	2	6	8
11	Identify, Inventory, Protect and Rehabilitate Significant Habitats.	10	40	50
12	Develop and Implement Action, Restoration and/or Enhancement Plans for Exploited and/or Declining Indigenous Aquatic Species.	23	44	67
13	Develop and Implement Action/Restoration Plans for Forage Fish.	2	9	11
14	"Close the Door" on Nonindigenous Species Introductions.	0	2	2
15	Implement and Expand Effective Sea Lamprey Control.	2	0	2
16	Great Lakes Fishery Commission Line Item Funding for Sea Lamprey Control Efforts in the St. Mary's River.	0	0	0
17	Fund Implementation of the Great Lakes Fishery Commission's Basin-wide Sea Lamprey Barrier Plan.	0	0	0
18	Prevent or Delay the Spread of Ruffe.	0	0	0
19	Determine the Impacts of Hydroelectric Facilities and Dam Operations on Fishery Resources.	3	1	4
20	Increase Involvement in the Bi-national Program to Restore and Protect Lake Superior and Expand this Mechanism to Lakes Huron, Erie, and Ontario.	0	0	0
21	Establish Uniform Tissue and Sediment Contaminant Levels Used by Various Agencies for Ecosystem Health.	0	0	0
22	Broaden the Scope of Current State Anti-degradation Policies.	0	0	0
23	Develop and Implement an Action Plan to Analyze Contaminant Level Effects on Aquatic Resources.	0	0	0
24	Participate in Remedial Action Plans, Lake-wide Management Plans, and the Environmental Monitoring and Assessment Program.	0	0	0
25	Salmonine Egg Viability.	1	1	2
26	Establish an Isolation or Quarantine Facility.	0	0	0
27	Develop an Epizootic Epitheliotrophic Disease (EEDV) Diagnostic Test.	0	0	0
28	Fish Health.	4	3	7
29	Fish Genetics.	6	9	15
30	Lethality of Sea Lamprey Attacks.	1	0	1
31	Develop Aquatic Resource Education Programs.	3	0	3
32	Conduct a Cormorant Fishery Predation Study.	1	0	1

*In most cases, funded projects have worked towards multiple recommendations

**The reader might be tempted to relate the number of projects implemented under each recommendation as a way to view the rate of our progress toward achieving restoration. The number of proposals addressing each study recommendation is useful information for tracking where Great Lakes states and tribes have chosen to focus restoration work; however, this does not necessarily allow us to chart how far along we are in fulfilling each recommendation.

Progress Toward the Goals Specified in Section 1006 of the Act

Introduction to Goals I-VI under Section 1006

The Great Lakes Fish and Wildlife Restoration Act states that "In administering programs of the Fish and Wildlife Service related to the Great Lakes Basin, the Director shall seek to achieve the following goals."

Goal I:

Restore and maintain self-sustaining fishery resource populations.

Goal II:

Minimize the impacts of contaminants on fishery and wildlife resources.

Goal III:

Protect, maintain, and, where degraded and destroyed, restore fish and wildlife habitat, including the enhancement and creation of wetlands that result in a net gain in the amount of those habitats.

Goal IV:

Stop illegal activities adversely impacting fishery and wildlife resources.

Goal V:

Restore threatened and endangered species to viable, self-sustaining levels.

Goal VI:

Protect, manage, and conserve migratory birds.

Through this mandate, Congress has tied together activities authorized under the Act and Service resource management operations funded via a number of other laws, treaties, agreements, codes and guiding documents.

The Service's mission requires a coordinated effort among our various programmatic offices and our many partners and stakeholders. This coordination is achieved through commissions, councils, committees, trusts and other organizations operating within the Great Lakes as well as through our own internal programmatic and cross programmatic teams.

The Service has achieved many accomplishments under the six Great Lakes Restoration Goals from 1990-2010. The following sections provide summaries of how the Service has addressed the stated goals and describe progress made, outcomes achieved, and future priorities. Although

some funds are provided by the Act outside of the grant program, the majority of the accomplishments presented in the following section were implemented with funds appropriated under authorities other than the Act or in conjunction with contributions from partners. In addition, many of the Act funded projects (1998-2010) also worked towards these goals, focusing most heavily on goals I and III (Figure 6, Appendix I).

Although the accomplishments included in this report are significant, and substantial progress can be found under each goal, the amount of restoration work that remains is enormous. The Great Lakes Basin is the largest surface freshwater system on earth and contains a great variety of fish and wildlife resources and habitats. More than 35,000,000 people live within the Basin and the impact of their activities on these resources and habitats is immense. Even as agencies achieve desired outcomes at many locations, the scale of current restoration issues advances and new challenges arise. Accordingly, the list of restoration needs is extremely dynamic and great in both scope and complexity, much work still remains.

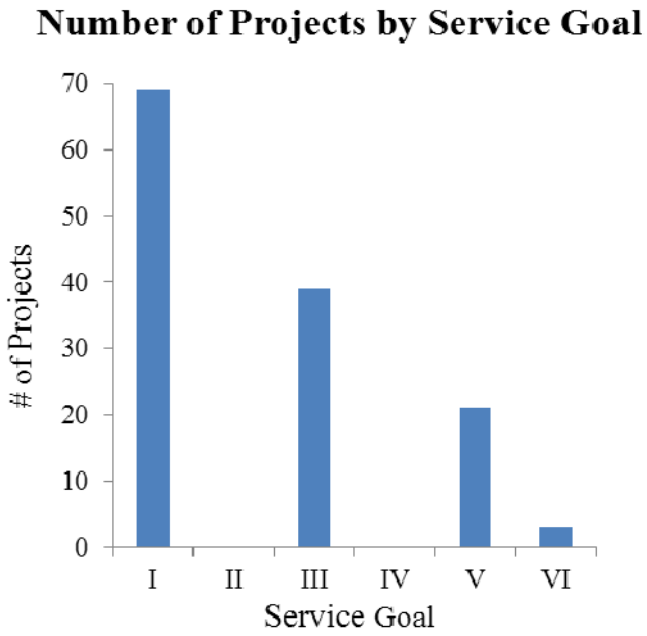

Figure 6. The number of Great Lakes Fish and Wildlife Restoration Act funded projects that work toward acheivng each of the six Service Great Lakes goals, 1998-2010. Note that projects can apply to more than one goal.

The Service's Great Lakes restoration goals and progress

Many of the accomplishments presented under the Service's six Great Lakes goals in this section of the report also represent progress toward addressing the 32 recommendations of the Great Lakes Fishery Resources Restoration Study (Appendix III). The 32 Study recommendations align with and can be considered a subset of the Service's goals for the Great Lakes. This is because the Study recommendations are focused on aquatic resources, while the Service's six

Great Lakes goals address conservation of migratory bird populations, terrestrial habitat, endangered species, and many other resources in addition to fisheries.

Most of the overlap between the Service's goals and the Study recommendations occurs under goals I and III, and this is where most of the progress in addressing the recommendations can be seen. Other agencies and organizations, including the Great Lakes states and tribal authorities, U.S. Geological Survey, EPA, and the Great Lakes Fishery Commission, are also making progress in addressing these and other Study recommendations. With the exception of the fish and wildlife restoration projects funded directly through the Act, and reported in the previous section, those accomplishments are not covered in this report.

Funds authorized and appropriated through the Act from 1998-2010 contributed over $9.8 million, with an additional $11.9 million from the GLRI to accomplish work of the recommendations and the six goals reported in this section. These monies were used to fund 110 specific projects that aided our fish and wildlife resources in the Great Lakes. However, the majority of the activities and accomplishments presented here were supported by Service resource management funds. These funds were provided via other U. S. and Canadian federal sources and by a wide range of state, provincial, tribal, local government, and private sector funds and contributions.

Additionally, in 2010 the Upper Midwest/Great Lakes Landscape Conservation Cooperative (UMGL LCC) joined several others across the continent to help expand a landscape scale perspective to our conservation work in the Great Lakes and beyond. With an initial allocation of Great Lakes Restoration Initiative funds, UMGL LCC is beginning to provide products and services that will help inform an interconnected network of land, water, wildlife, and cultural resource interests that share a common need for scientific information to better inform conservation action. The concept of landscape conservation and sustaining landscapes for natural resources requires sharing conservation goals and objectives, and working interdependently among conservation stakeholders, a role the UMGL LCC was expressly created to take on.

Service aquatic restoration activities in pursuit of the Great Lakes restoration goals are closely coordinated with the fish and wildlife projects funded under the Act. This is ensured by active Service participation in the Act PRC, and numerous other entities (e.g. the Great Lakes Fishery Commission, Great Lakes Council, etc.) in the Great Lakes basin. The essential linkages embodied in the Act have resulted in continuously improving interagency coordination and therefore continued benefits to the watershed. Service and its partners working tightly in unison regarding Great Lakes restoration efforts.

Goal I: Restore and maintain self-sustaining fishery resource populations.

Primary Operational Authority and Guidance

- Great Lakes Fish and Wildlife Restoration Act of 2006
- Nonindigenous Aquatic Nuisance Species Prevention and Control Act of 1990
- U. S. District Court Great Lakes Consent Decree of 2000, 1836 Treaty waters
- U.S. District Court Inland Consent Decree, Treaty of 1836
- U.S. - Canada Convention on Great Lakes Fisheries, 1955
- Great Lakes Fishery Act of 1956
- Joint Strategic Plan for Management of Great Lakes Fisheries
- Federal Power Act
- Fish and Wildlife Act of 1956
- Fish and Wildlife Coordination Act
- Endangered Species Act of 1973
- Great Lakes Restoration Initiative (GLRI)

Service Programs

- Fish and Wildlife Conservation Offices provide fish & wildlife management technical assistance to federal agencies, state agencies, tribal governments, and non-governmental organizations
- National Fish Hatchery propagation to support native fish rehabilitation in accordance with interagency Fish Community Objectives established under the Joint Strategic Plan for Management of Great Lakes Fisheries
- Fish health diagnostics and assessments of hatchery products and wild fish health surveys
- Conservation of natives fishes and mussels to avoid Endangered Species Act listing
- Aquatic Invasive Species risk assessment, surveillance, control; interagency technical assistance and coordination; support of State, Tribal, and nongovernmental grants
- Biological Stations conduct sea lamprey assessment and control operations to suppress Great Lakes populations while supporting native fish restoration and fish community objectives.
- Fish passage restoration to improve migration and improve access to habitat for aquatic organisms
- Coordination and consultation with federal and state regulatory agencies
- Mass Marking Program to ensure all salmonids stocked in the Great Lakes receive a tag prior to their release to improve our ability to manage the fishery
- Habitat Restoration under the National Fish Habitat Action Plan recognized partnerships

Progress 1990-2010

Working closely with our partners, the Service has made substantial progress toward improving the status and management of native species using a variety of tools and expertise. Lake trout, brook trout, lake sturgeon, and Atlantic salmon are prime examples of species whose populations have progressively increased within the Great Lakes fish community.

Improving the management of Great Lakes fisheries depends on better understanding the dynamics of a large and complex ecosystem and how native species react to habitat changes and to other pressures on their populations. The Service's Fish and Wildlife Conservation Offices continue to work with partners, developing fish community goals and objectives and to assess, monitor, and research fishery resources to characterize how to best manage and restore native fish species. Sometimes changes in fisheries management are called for, such as reducing mortality of lake trout through measures identified in the 2000 Great Lakes Consent Decree. Service biologists are conducting fishery assessments in the 1836 Treaty waters of lakes Superior, Huron and Michigan to help tribal fishery managers minimize the bi-catch of lake trout in their whitefish fisheries. Until adequate reproduction is documented, stocking of fish is required to maintain populations; the Service's National Fish Hatchery system plays a key role in providing species such as lake trout and brook trout for recovery efforts in the Great Lakes. The Service's Fish Health Center helps assess the relative health of stocked and wild fish populations in the Great Lakes. Through the new Mass Marking program, the Service will gain important information (e.g. movement patterns, natural mortality ratios, etc.) about the stocked fish and better hone the Great Lakes stocking strategy.

Often, the key to restoring populations is improved access to habitat, habitat restoration, or otherwise countering the impacts of human activities in the basin. Service habitat based programs restore fish passage, improve stream corridor habitat, and help implement best management practices in headwaters and riparian areas (see also Goal III, Page: 24).

The Service also continues to address the impacts of Aquatic Invasive Species that impede progress toward restoring self-sustaining fish populations. The Service works to: 1) identify species at risk to invade the Great Lakes, so that actions are taken to interdict those invasions, 2) conduct, and support activities conducted by others, to minimize the spread of invasive species within the Great Lakes, and spread from the Great Lakes to inland ecosystems, and 3) develop and implement (and support those activities conducted by others) integrated management programs to minimize impacts of species that have invaded the Great Lakes.

The Service's highly successful Sea Lamprey Control Program, under the administration of the Great Lakes Fishery Commission, is among the most important factors in maintaining and restoring Great Lakes fisheries. Intensive control operations in the St. Mary's River and northern Lake Huron beginning in 1999 resulted in a significant reduction of sea lamprey induced mortality on lake trout stocks, and was an important factor contributing to rebounding wild lake

trout recruitment observed over the past six years. Recently expanded control operations in other locations have resulted in suppression of sea lamprey populations to near target levels in Lake Superior and Lake Ontario, and significant reductions in Lake Michigan.

Finally, the Service has focused efforts on fish health surveys using the latest technology to monitor wild fish populations and fish in state, tribal and federal fish hatcheries. Thousands of fish are screened for health status and progeny from 9 native lake trout stocks and 2 native brook trout stocks were certified and brought into the National Fish Hatchery System to provide fish for interagency restoration programs.

Selected Outcomes

- Progress towards suppressing sea lamprey populations to target levels established for each of the lakes, working with Fisheries and Oceans Canada, the U.S. Geological Survey, and the Great Lakes Fishery Commission.
- Improved the status of lake trout populations by stocking more than 4 million lake trout yearlings annually in lakes Huron, Michigan, Erie, and Ontario.
- Improved management of lake trout and lake whitefish in the 1836 Treaty waters in partnership with 5 tribes, Michigan, and the Chippewa-Ottawa Resource Authority.
- Improved the status of Coaster brook trout in Lake Superior by stocking 230,000 fish annually.
- Worked with state and tribal partners to restore lake sturgeon populations on tribal lands and in Great Lakes tributaries. Stock 50,000 juvenile lake sturgeon annually.
- Improved information for fisheries management by creating a Great Lakes Fish Stocking database to house information from all management agencies.
- Improved information for management of the health of wild fish populations and hatchery stocks through assessment of more than 16,500 fish from 31 species.
- Improved information on genetic diversity, abundance, and habitat conditions for lake sturgeon by coordinating projects and workshops basin-wide.
- Improved information on invasive ruffe and round goby populations and led efforts toward limiting their spread into additional Great Lakes habitats.
- Operated two isolation facilities to verify the health of lake trout and brook trout, and brought progeny from 30 collections from wild stocks into National Fish Hatcheries.
- Provided information on movement of big-head and silver carp up the Illinois River toward Lake Michigan and contributed towards the initiative to construct fish barriers near Chicago.
- Actively participated in Asian Carp monitoring near Chicago and assisted with rotenone events both above and below the electric barrier.
- Removed 56 barriers to fish passage at Great Lakes Basin tributary sites through the replacement of undersized culverts at road crossings and removal of other obstructions.

- Improved instream flow and habitat conditions and provided fish protective measures at non-federal hydroelectric projects in Great Lakes tributaries.
- Worked with partners to establish an Upper Great Lakes Fish Habitat Partnership to implement aquatic habitat improvement projects.

Priorities for the Future

- Improve information on priority species, habitat, and threats to restoration.
- Identify effective restoration techniques, activities, and locations.
- Monitor fish health status and trends in wild and hatchery stocks.
- Restore self-sustaining lake trout populations across the Great Lakes.
- Restore self-sustaining brook trout populations in Lake Superior.
- Restore lake sturgeon populations across the Great Lakes.
- Restore yellow perch populations in Lake Michigan.
- Restore walleye populations in Lake Huron.
- Restore Atlantic salmon populations in Lake Ontario.
- Restore American eel populations in Lake Ontario.
- Improve management of fisheries for lake whitefish and walleye.
- Maintain Great Lakes sea lamprey populations below target levels.
- Control the spread of ruffe and round goby populations.
- Block bighead and silver carp access from the Illinois River, and other pathways, into the Great Lakes.
- Improve and maintain hatchery facility infrastructure including the offshore stocking and research vessel MV/Spencer F. Baird.
- Restore native corgonid species in the Great Lakes.

Goal II: Minimize the impacts of contaminants on fishery and wildlife resources.

Primary Operational Authority and Guidance

- Clean Water Act
- Fish and Wildlife Coordination Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Oil Pollution Act
- Endangered Species Act of 1973

Service Programs

- Technical Assistance to federal, state, and tribal partners on ecotoxicology and ecological risk assessment
- Realty Pre-acquisition Surveys to prevent contaminant impacts to National Wildlife Refuge System lands
- Pesticide Use Proposal Program to minimize use of pesticides on lands of the National Wildlife Refuge System and to apply Integrated Pest Management practices wherever possible
- Participation on U.S. EPA-sponsored Biological Technical Assistance Teams
- Clean Water Act coordination through technical assistance to U.S. EPA and states
- Natural Resource Damage Assessment (NRDA) and restoration
- Scientific investigations and surveillance
- Endangered Species Act consultation
- Spill contingency planning and spill response to protect natural resources and assist U.S. EPA and U.S. Coast Guard
- Contaminant Assessment Program to identify contaminant threats to Refuges and technical assistance to Refuges in preventing future contamination and cleaning up existing contaminant problems.

Progress 1990-2010

Working closely with our partners, the Service works to prevent contaminant and pollution impacts to fish, wildlife, plants, and their habitats, and restores those resources which have been impacted. Using its unique expertise in wildlife and aquatic toxicology, the Service develops resource management actions which would prevent adverse effects of contamination. Where contamination already occurs, the Service performs scientific investigations to identify the effects and then develops management actions to eliminate contaminant-related injuries.

The Service has reduced or minimized the effects of contaminants on threatened or endangered species by consulting with state and federal agencies on contaminant effects under the auspices of the Endangered Species Act. The Service consults with state and federal agencies on water quality to ensure that criteria and standards are protective.

The Service has identified injuries to resources caused by contamination and has implemented activities to restore those resources. Using authorities as trustees for natural resources under the Comprehensive Environmental Response, Compensation, and Liability Act (the "Superfund" law), where injuries have occurred in the past, or are not preventable, the Service identifies injuries, pathways to exposure, and parties responsible for such injuries to enlist their cooperation to restore both the injured resources and their associated public benefits.

The Service minimizes or reduces the effects of oil and hazardous material spills through technical assistance in contingency planning and during spill response to minimize the adverse effects of spills. The Service has restored resources lost due to spills by performing natural resource damage assessments and implementing restoration projects.

The Service minimizes or eliminates contaminant effects by integrating consideration of contaminant effects into all other Service activities, including management of refuge lands, conservation of endangered species, fish hatcheries and fishery management activities, habitat restoration, and law enforcement. The Service's contaminants specialists work in partnership with other agencies and organizations, which have come to rely on our expertise.

The Service contributes to other agency's efforts to minimize contaminants by offering expertise and assistance in the areas of ecotoxicology and ecological risk assessment. The Service identifies contaminant sources, pathways, and effects of exposure. The Service coordinates and cooperate with, and provide technical assistance to, virtually every other state and federal agency which may deal with or consider contaminant effects.

The Service contributes to the goal of virtual elimination of persistent toxic substances in the Great Lakes Basin through participation in the Great Lakes Bi-National Toxics Strategy. Also, the Service directly contributes to several indicators of environmental quality including, among others, natural lake trout populations, sea lampreys, and bald eagle reproduction. The Service contributes to these indicators under the auspices of The State of the Lakes Ecosystem Conferences (SOLEC).

Selected Outcomes

- Determined the effects of contamination and habitat limitations on the Great Lakes bald eagle population through analysis of tissue samples collected over 25 years. *[1130 base funding, some NRDA settlement funds]*

- Responded to oil spills when wildlife and their habitats were significantly impacted, including the Mistersky Spill (Detroit River) in 1995, Rouge River/Detroit River Mystery Spill in 2002, Tug Seneca Grounding (Lake Superior) in 2006, Enbridge Line 6B Pipeline Release (Kalamazoo River) in 2010, Enbridge Line 6A Pipeline Release (Romeoville, IL) in 2010, Duncan Bay Spill (Lake Huron) in 2010, West Shore Pipeline Co. and Buckeye Partners Pipeline Release (Lockport, IL) in 2010. *[1130 base funds, Oil Spill Liability Trust Fund, funds from responsible parties]*
- Restored and protected over 1,600 acres of Great Lakes coastal wetlands and lake plain prairie, removed over 342,000 cubic yards of contaminated sediment, and enhanced recreational and environmental education opportunities in the Saginaw River and Bay system through a Natural Resource Damage Assessment settlement with General Motors for their releases of contaminants. *[DOI's NRDAR Fund and General Motors]*
- Made progress toward restoration of wetland, stream, littoral, riverine and upland habitats that have been adversely affected by contaminant releases through Natural Resource Damage Assessments on Great Lakes tributaries including the Kalamazoo River, Rouge River/Detroit River, and the Tittabawassee River. *[DOI's NRDAR Fund and potentially responsible parties]*
- Continued consultation (under Section 7 of the ESA) on national water quality criteria to ensure that U.S. EPA's criteria are protective of listed species, and working with U.S. EPA, Region 5, to implement the terms and conditions of our 1995 Biological Opinion on the Great Lakes Water Quality Guidance to ensure that the Guidance is protective of listed species. *[1130 base funding]*
- Completed an ecological risk assessment and geotechnical investigation of Grassy Island, formerly used for dredge material disposal and now part of the Detroit River International Wildlife Refuge, to help determine remedial measures needed to protect fish and wildlife using the island and adjacent waters. *[Line item appropriation, 1130 base funds, and Great Lakes Restoration Initiative funds]*
- Investigated the ongoing effects of contaminants on terns, gulls, and other colonial water birds at Great Lakes Areas of Concern (AOCs) and reference areas to determine progress toward recovery of beneficial use impairments and delisting of AOCs. *[NRDA funds, 1130 base funds, Great Lakes Restoration Initiative]*
- Began surveillance for exposure and effects of contaminants of emerging concern in the Great Lakes and connecting channels by investigating fish health in areas receiving large releases from wastewater treatment plants. *[Great Lakes Restoration Initiative]*
- Continued assistance to the Service's National Wildlife Refuge System to investigate and eliminate contaminant effects on Great Lakes coastal influenced Refuges. *[1130 base funds]*
- Made progress toward restoration of wetland, stream, littoral, riverine, and upland habitats that have been adversely affected by contaminant releases to the Fox River (WI) via the Fox River Natural Resource Damage Assessment *(NRDA)*.

- Conducted consultation (under Section 7 of the ESA) with U.S. EPA on changes to water quality criteria at several Wisconsin sites to ensure that the criteria are protective of listed species.
- Continue to work with partners on efforts to study and improve water quality in Wisconsin's Areas of Concerns *(ES/GLRI)*
- Continue to work on NRDA project across the Great Lakes to protect, and restore resource damages.

Priorities for the Future

- Continue scientific investigations of the effects of contaminants at Great Lakes Areas of Concern (AOCs) and pursue natural resource damage assessment (NRDA) to identify management actions and restoration projects which would restore a fully functioning ecosystem.
- Improve monitoring of biological effects of contaminants of emerging concern in the Great Lakes to identify the need for corrective management actions before remediation becomes necessary.
- Improve our spill response capacity and spill planning efforts to address increasing risks from aging pipeline infrastructures, potential releases from hydro fracturing operations and other energy developments, and expected increasing intensity of severe weather events.
- Continue to assist with recovery efforts of Great Lakes endangered species by identifying and eliminating ecological stressors caused by contaminants.
- Continue to assist the National Wildlife Refuge System, the Fisheries Program and the Landscape Conservation Cooperatives to identify and eliminate contaminants as a limiting factor to natural resource conservation and management goals.
- Continue and increase technical assistance to partners by providing expertise on fish and wildlife toxicology and ecological risk assessment.
- With continued funding provided through the Great Lakes Restoration Initiative, continue to work with partners to identify and implement projects that contribute to delisting of Beneficial Use Impairments in AOCs and to detect, identify, and evaluate the toxicity and potential impacts of emerging contaminants on fish and wildlife resources in the Basin.

Goal III: Protect, maintain, and, where degraded and destroyed, restore fish and wildlife habitat, including the enhancement and creation of wetlands that result in a net gain in the amount of those habitats.

Primary Operational Authority and Guidance

- National Wildlife Refuge System Improvement Act of 1997
- Fish and Wildlife Coordination Act
- National Wildlife Refuge System Administration Act
- Executive Order 12996
- Refuge Recreation Act
- Endangered Species Act of 1973
- Clean Water Act
- Federal Power Act

Service Programs

- National Wildlife Refuges and Wetland Management Districts
- Restoration assistance on private lands
- Partners for Fish and Wildlife and Coastal Program restoration activities
- Coordination and Consultation with Federal and State regulatory agencies
- Wetland and grassland restorations on Service lands
- National Fish Passage Program
- National Fish Habitat Action Plan
- Migratory bird banding
- Invasive species control
- Natural resource research
- Law enforcement
- Prescribed burning
- Hunting and fishing
- Environmental education and interpretation
- Wildlife observation and photography
- National Wetland Inventory

Progress 1990-2010

Working closely with our partners, the Service implemented fish and wildlife protection and restoration projects on federal, state, tribal and private lands. Each Service office in the basin serves as a cornerstone in researching, evaluating, scoping, and implementing habitat improvement projects. The Service is often a leader of projects and initiatives, lending expertise, staffing, and resources to high-priority Basin-wide habitat projects such as the Costal Program-

Great Lakes. With the expertise of Service biologists and the flexibility and initiative of this community based program, the Coastal Program has initiated efforts that focus on: 1) Coastline, estuary wetlands, and stream corridor restoration, 2) Identification and application of Best Management Practices to avoid fish and wildlife habitat loss, 3) Invasive species prevention and control, 4) Applied research, and 5) Education.

The Coastal Program has, since fiscal year 2000, restored or protected more than 15,500 acres of coastal habitat, enhanced more than 125 stream and shoreline miles, and removed at least 11 fish passage barriers. The Service also serves as the lead federal agency in implementing on-the-ground habitat projects which benefit at-risk, threatened and endangered species in the Basin, such as completing over 350 habitat restoration projects to benefit the federally endangered karner blue butterfly.

The cumulative efforts of these stations and staff have resulted in hundreds of accomplishments during this period. The protection and restoration of thousands of acres have benefited dozens of fish and wildlife species throughout the Basin - game and non-game, migratory and resident, endangered and non-endangered. Many of these same projects have yielded increased educational and recreational opportunities for Great Lakes area residents.

In addition to our own work, the Service helped other government agencies plan projects such as roads, flood control, renewable energy (hydroelectric, wind power, etc.), and navigation projects to avoid harming fish, wildlife, and their habitats in a cost-effective way while still meeting project purposes. Through authority of the Clean Water Act, the Service reviews proposed projects that may affect wetlands and provides assistance in designing projects to avoid impacts to fish, wildlife, and sensitive natural areas. The Service also pursues habitat restoration through settlements under authority of the Comprehensive Environmental Response, Compensation, and Liability Act and Oil Pollution Act to address injuries to fish and wildlife resources resulting from contamination. Settlements have led and will lead to habitat restoration at various locations throughout the Great Lakes Basin.

Selected Outcomes

- The Coastal Program has, since fiscal year 2000, restored or protected more than 15,500 acres of coastal habitat, enhanced more than 125 stream and shoreline miles, and removed at least 11 fish passage barriers.
- Through fish passage and stream restoration projects, provided fish access to over 530 miles of aquatic spawning, rearing and feeding habitat.
- Working in partnership with others, completed nearly 637 Challenge Cost-Share Program habitat projects valued at more than $8.4 million dollars. These projects on federal, state, tribal and private lands protected or restored migratory bird habitat in wetland, upland, and riparian areas while also increasing public recreational opportunities.

- R3 Refuges restored 888 acres of upland habit, 321 acres of wetlands and 65 acres of coastal wetlands in close proximity to the Great Lakes. In addition 5,416 acres infested with non-native invasive plants were treated.
- Detroit River International Wildlife Refuge (established 2001) increased in size from 300 acres to 5,700 acres through active and generous partnership projects. Notable contributions included 358 acres of wetlands from the Waste Management Company, 242 acres of unique coastal wetlands from Ford Motor Company and 126 acres of critical spawning habitat in Plum Creek Bay donated by Monroe County, MI.
- Established the Ohio Great Lakes Cooperative Weed Management Area (CWMA) headquartered at Ottawa County Soil and Water Conservation District *[GLRI funding]*.
- In cooperation with USGS and Ducks Unlimited, restored the coastal wetland function of the highly productive 75 acre Crane Creek estuary (OH GLRI project). The project included installation of specialized fish passage structures to improve spawning and rearing habitat for Lake Erie fish and provided benefits to fresh water mussel species that are being devastated by Zebra Mussel invasion.
- Completed acquisition of Sugar Island in Thunder Bay of Lake Huron. This 143 acre island is one of the few remaining pristine islands in that portion of the lake *[GLRI funding]*.
- Partnered with DTE Energy Corporation, The Conservation Fund, Ducks Unlimited, and the North American Wetlands Conservation Council to acquire 119 acres of critical habitat along the Cass River (OH).
- Created two, three acre nesting islands at Patoka River NWR in an effort to create and maintain additional, optimum breeding sites for the endangered interior least tern (*Sterna antillarum*).
- Restored wetland values to 141 acres of formerly farmed land in the Flint River Flood Plain. Other partners in this Michigan GLRI project included the Saginaw Bay Initiative Network, EPA, and Ducks Unlimited.
- Wetland inventory work resulting in geospatial maps and reports provide a picture of where our wetland and habitat resources are and where they are changing to support a wide range of fisheries and wildlife management actions and activities.
- Built several reefs in the Huron-Erie Corridor intending to benefit focal species like lake sturgeon.
- Protected critical fish spawning and nursery shoals and colonial bird habitat through the acquisition of Little Charity and a portion of Big Charity Island in Lake Huron's Saginaw Bay.
- Enhanced the health of the Bear River through restoration and community involvement, including cleanup activities and volunteer biological monitoring.
- Removed the Antrim Creek Dam.
- Completed the Lake Sturgeon Assessment in partnership with Bad River band.

- Controlled invasive Phragmites on Muskegon Lake/and Rudiman Creek through a Habitat restoration partnership.
- Rehabilitated Stover, a community's creek in northern Michigan, with cleanups and erosion control practices.
- Restoration of habitat for rare marsh birds at Chicago's Hegewisch Marsh. The project site represents a rare coastal wetland located in an otherwise highly industrialized setting, and will help provide resource benefits, outdoor recreation, and education opportunities for a very under-served urban community.
- Invasive species removal within 240 acres of coastal habitats at Illinois Beach State park, and Spring Bluff Nature Preserve, in Lake County, Illinois. The complex represents Illinois' largest remaining continuous block of high-quality Lake Michigan coastal communities.
- Restored and created over 30 acres of wetland habitat as part of the 143 acre Forest Beach Migratory Preserve, a bird stopover preserve/habitat development project in Wisconsin. *[American Recovery and Reinvestment Act, PFW]*
- Removed 56 barriers to fish passage at Great Lakes Basin tributary sites through the replacement of undersized culverts at road crossings and removal of other obstructions.
- Improved instream flow and habitat conditions and provided fish protective measures at non-federal hydroelectric projects in Great Lakes tributaries.
- Worked with partners to establish an Upper Great Lakes Fish Habitat Partnership to implement aquatic habitat improvement projects.

Priorities for the Future

These significant accomplishments address regional and national program priorities and goals. For example, in the Wildlife Action Plans for the Great Lakes states, threats from invasive species are consistently ranked at or near the top. Many of these accomplishments address those threats within the Wildlife Action Plans that we incorporate within our strategic planning. Program activities support Regional priorities and the activities related to the strategic planning process at the regional level.

The various program goals within our strategic plan are designed to lead to our intended Program outcome: maintaining and increasing federal trust resource populations. The Service will initially measure progress by an outcome indicator that represents a percentage of sustained or increasing target species populations, with an eye toward improvement. This indicator is derived from information assessed by the Coastal Program, by other Service species-oriented programs, or by our partners.

- Continue to work in partnership with private landowners to conduct voluntary habitat protection and restoration projects on their property.

- Strengthen and expand our partnerships with states, tribes, and industry to continue our habitat protection and restoration work, both on and off Service lands.
- Continue to support watershed health through active participation in aquatic and terrestrial invasive species control projects throughout the basin.
- In combination with habitat projects, optimize the educational and recreational benefits available to local residents, especially youth, through programs at the Detroit River International Wildlife Refuge and other refuges in the basin.
- Provide more public use and interpretation opportunities through National Wildlife Refuge and National Fish Hatchery visitor services programs.
- Leverage our scientific capabilities and those of our partners to develop complementary short and long-term resource management strategies which will improve and sustain the biological health of the basin.
- Continue to review federally authorized or funded projects that may substantively affect high priority fish and wildlife habitat to ensure project impacts are identified and addressed.
- Work in cooperation with a number of conservation organizations to enhance hundreds of acres of wetland habitat through the removal of invasive plant species in northern Door County, WI. (PFW)

Goal IV: Stop illegal activities adversely impacting fishery and wildlife resources.

Primary Operational Authority and Guidance

- Lacey Act
- Endangered Species Act of 1973
- Convention on International Trade in Endangered and Threatened Species (CITES)
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- National Wildlife Refuge System Administration Act

Service Programs

- Special Agent Program
- Wildlife Inspection Program
- National Wildlife Forensics Laboratory

Progress 1990 - 2010

Working closely with our partners, the Service strives to stop illegal activities adversely impacting fish and wildlife resources. Efforts include: detecting and deterring crimes involving the illegal take, trade, and trafficking of protected species; investigating activities involving habitat destruction and environmental contaminants; and preventing the introduction of invasive species via international trade and travelers. The Service's Great Lakes Region Office of Law Enforcement takes primary responsibility for the protection and conservation of fish and wildlife through the enforcement of federal wildlife laws and treaties and, as such, is an integral part of the overall management effort of all Service programs within the Great Lakes Basin.

The Office of Law Enforcement is comprised of special agents, wildlife inspectors, regional and field support, and supervisory personnel. The Special Agent Program is made up of a force of plainclothes criminal investigators who target the most severe cases of illegal activity. Wildlife Inspection Program personnel are positioned at strategic locations within the Midwest and are the first line of defense in stemming illegal international shipments of wildlife in the Great Lakes Basin. Service personnel work hand in hand with the Customs and Border Protection officers to insure that fish and wildlife traveling into or out of the country is shipped in compliance with appropriate laws. Wildlife inspectors are becoming increasingly vigilant in detecting the entry of injurious fish or wildlife (e.g. Asian carps) into the Great Lakes Basin.

Although a number of federal statutes provide the authority to protect wildlife in the Great Lakes Basin, three principal laws are most extensively used. Non-game migratory birds as well as game birds and waterfowl are protected by the Migratory Bird Treaty Act and its regulations. The Lacey Act allows for the apprehension of illegal imports of injurious live wildlife, and the

Lacey Act Amendments provide strong federal protection to wildlife and extends federal assistance to the states and foreign governments for the enforcement of wildlife laws. The Endangered Species Act not only protects endangered and threatened species, but includes CITES enforcement authority as well as the framework for the Service's Wildlife Inspection Program.

Over the last 5 years through investigations, prosecutions, and outreach efforts (see Appendix II for list of accomplishments), the Service has made progress toward ensuring a sustainable harvest of game species, ensuring that the United States meets species specific international obligations, preventing introduction of invasive species, and maintaining habitat conditions necessary for healthy aquatic communities.

Selected Outcomes

- The Office of Law Enforcement has been successful in strategically placing both special agents and wildlife inspectors at duty stations near the Great Lakes in an effort to better protect native species from exploitation, and work at stopping the import of invasive species. Ports of Chicago and Detroit are fully staffed with wildlife inspectors, and Port Huron is home to a wildlife inspector position. In addition special agent duty stations have been filled in Duluth, MN; Marquette, MI; and the duty stations in Green Bay, WI; Bay City, MI; Ann Arbor, MI; and Chicago, IL remain fully staffed.
- Service special agents are working closely with state counterparts to investigate illegal activity on the Great Lakes involving the illegal commercialization of wildlife resources, and/or the introduction of interstate transport of federally listed injurious species. This is being accomplished by increased coordination, and cooperation between states, tribes, and federal law enforcement.
- Service wildlife inspectors are working closely with Federal inspection partners such as Customs and Border protection and USDA Agriculture, to interdict illegal wildlife shipments in and around the Great Lakes. In addition, wildlife inspectors are focusing on detecting and interdicting injurious species.
- Conducted various waterfowl hunting enforcement activities each Fall in the basins of lakes Ontario, Erie, and Huron, Michigan, often in collaboration with state conservation officers, as part of joint waterfowl task force operations.
- Invested in new technologies (mobile X-ray unit) to allow for more thorough inspection of shipments.

Priorities for the Future

- Continue building the Service law enforcement program and maintain an effective presence in the Regions by regularly hiring new agents as needed. Focus on working in coordination State and Tribal partners in an effort to fully enforce all wildlife related laws.
- Focus enforcement efforts on potentially devastating threats to wildlife resources such as;

illegal trade, unlawful commercial exploitation, habitat destruction, introduction of invasive species and environmental contaminants.

- Continue and strengthen border inspection efforts to control illegal import and export of wildlife and injurious species at the five main border crossings and two international airports in the Great Lakes Basin.
- As part of the Service's national program, utilize improved intelligence gathering and analysis of the illegal wildlife trade to support wildlife law enforcement and resource protection in the Great Lakes Basin.

Goal V: Restore threatened and endangered species to viable, self-sustaining levels.

Primary Operational Authority and Guidance

Endangered Species Act of 1973

Service Programs

- Listing and candidate recovery - Identify species that are or could become endangered and protect them under the Endangered Species Act; work with government and private partners to find ways to preclude the need to list species.
- Consultation - provide expertise to other Federal agencies to adapt projects so they can be carried out successfully without harming listed species or their habitat.
- Recovery - Develop plans to recover listed species and work with partners to implement needed recovery actions.
- Grants to states and Private Stewardship provide grants to states to work on federally listed species; assist private landowners to implement conservation actions.

Progress 1990-2010

Threatened and endangered species often forewarn of threats to the ecological health of an area, and the Great Lakes are no different. In close coordination with a multitude of partners, including the basin's sportsmen and women, private landowners, local, state, and tribal governments, industry, and nongovernmental organizations, the Service identifies threats to listed species and those in decline but not yet listed, implements conservation actions to address these threats and needs, and assists other Federal agencies in their consultation and species recovery responsibilities. As the lead agency for federally listed threatened and endangered species, the Service has made tremendous progress in recovering listed species and preventing future listings through flexible and innovative programs and techniques to restore the more than 30 species listed under the Endangered Species Act (ESA) that occur within the basin.

Initiating and implementing actions to help preclude the need to list species in decline represents an important component of the Service's Listing program. The Service and a multitude of agencies and institutions have made progress in pursuing restoration of the lake sturgeon, the only sturgeon species endemic to the Great Lakes basin. These interagency efforts have determined the size of some spawning populations, as well as reproductive success, genetic identity, and use and suitability of existing habitat to facilitate development and implementation of management actions. A number of dams have been removed to provide passage for sturgeon, and flows have been improved downstream of dams resulting in increased spawning success. The Service and state agencies are formulating Candidate Conservation Agreements to protect the Eastern massasauga rattlesnake on publicly owned land. The massasauga, a Candidate species since 1999, is declining throughout its range.

The Service has also made substantial progress in restoring listed species. The gray wolf has

been restored as a top predator in the north woods ecosystem of Minnesota, Wisconsin, and Michigan. The Service initiated a program in 2001 to reestablish a migratory flock of the endangered whooping crane in the eastern United States using captive-reared cranes led from Necedah National Wildlife Refuge in Wisconsin to wintering grounds in the Gulf coastal marshes of Chassahowitzka National Wildlife Refuge in Florida. Coordinated efforts to manage habitat that mimic the effects of wildfire, and efforts to control cowbird parasitism, have resulted in an increase in the number of singing male Kirtland's warblers. A variety of efforts to restore Great Lakes piping plover (once numbering only 12 breeding pair) were conducted with many partners and volunteers to protect nesting birds and track movements throughout their migrations. The Service is working closely with private landowners to protect beach habitat for plover, while enabling them to proceed with their development plans. Although numbers of the plover remain low, recovery has progressed due to intensive conservation programs. Portions of oak savanna and pine barrens ecosystems that support the threatened Karner blue butterfly are gradually being restored, and full recovery of the species is on the horizon. Finally, the threatened Eastern prairie fringed orchid inhabits wet prairies, bogs, and fens, habitats that were once abundant but are now rare due to drainage and conversion to agriculture. The Service, State partners, and volunteers continued efforts to protect and restore these important habitats and to hand-pollinate this species.

The ESA provides opportunities to assist and, at times, fund activities of others. ESA funding sources include the Cooperative Endangered Species Conservation Fund, through which the Service has provided many grants to Great Lakes states, and the Private Stewardship Program that provides funding to partners for voluntary conservation projects involving candidate, proposed, and listed species. Other tools and voluntary programs include Habitat Conservation Plans, Safe Harbor Agreements, and the Service's own habitat-based programs (e.g. National Fish Habitat Action Plan, National Fish Passage Program, Partners for Fish and Wildlife, etc.) that lend site-specific technical and funding assistance.

Selected Outcomes

- Developed agreements with private landowners and performed thousands of informal consultations with partners to benefit and/or avoid harm to listed species.
- Worked on projects with partners to restore lake sturgeon, the only sturgeon species endemic to the Great Lakes basin.
- Midwest Region and the Chicago Field Office funded a process to create a range wide extinction risk model for the eastern massasauga rattlesnake, a candidate for federal listing.
- The Service coordinated development of the Eastern Massasauga Rattlesnake Candidate Conservation Agreement
- Reclassified the gray wolf from endangered to threatened in the eastern United States, providing flexibility to States and tribes to manage wolves.
- Completed the Final Karner Blue Butterfly Recovery Plan (2003). *[ES]*
- Restored and maintained a significant amount of savanna and barrens habitat for the Karner blue butterfly which has contributed to recovery of the butterfly across its range

including sites within the Great Lakes watershed (Wisconsin and Indiana). *[ES/GLRI/ESA Section 6/Indiana Dunes NLS/TNC/Wisconsin DNR]*

- Renewed the permit for one of the largest statewide Habitat Conservation Plans (HCP) in the nation; the Wisconsin Statewide Karner Blue Butterfly HCP, which has 41 partners responsible for about 241,000 acres of habitat in Wisconsin.
- Assisted with the development and completion of a captive propagation handbook for the Karner blue butterfly to help guide captive rearing programs.
- Increased numbers of the threatened Lake Erie water snake through habitat management and education programs
- Improved coordination and shared information on management strategies under an International Framework to manage cross-border species with Canada.
- The Coastal Program partnered with a network of researchers in 2010 to benefit the endangered Hines Emerald Dragonfly through a suite of studies on genetics, distribution, and effects of herbicides on this little-known insect.
- Completed the Final Hines Emerald Dragonfly Recovery Plan (2001). (ES)
- Helped coordinate monitoring work for, and provided guidance on habitat improvement and restoration work for the Hine's emerald dragonfly. (ES/ESA Section 6/GLRI)
- Designated Critical Habitat for the Hine's Emerald Dragonfly (ES)
- Continued Pitcher's thistle reintroduction at Illinois Beach State Park and Indiana Dunes National Lakeshore to assist in attaining the recovery goals for the species. *[GLRI Funding]*
- Protected and managed habitat for the eastern prairie fringed orchid, dwarf lake iris, and Pitcher's thistle in Wisconsin to maintain and increase populations *[ESA Section 6, GLRI]*
- Increased the number of singing male Kirtland's warblers from 265 in 1990 to 1,773 in 2010 and expanded breeding range into Wisconsin through habitat management and cowbird control.
- Conducted guided tours to Kirtland's warbler nesting areas in Wisconsin to provide opportunities for birdwatchers and funding agencies to see this endangered species and to promote recovery of the species. *[ES/ESA Section 6]*
- Conducted Kirtland's warbler singing male and nesting surveys, cowbird control, and banding activities in central and northeast Wisconsin to help establish a breeding population in Wisconsin. *[ES/ESA Section 6/Natural Resources Foundation of WI]*
- Increased the number of breeding pairs of the Great Lakes piping plover from a low of 12 in 1990 to 60 in 2010 and expanded breeding range into Wisconsin. Also designated critical habitat for the Great Lakes piping plover.
- Piping plover nested in 2009 for the first time in thirty years at Illinois Beach State Park in an area designated as critical habitat.
- Conducted and helped coordinate piping plover surveys and nest protection activities in Wisconsin at the Apostle Island National Lakeshore, Seagull Bar (Marinette), and Wisconsin Point. *[ES/ESA Section 6/GLRI]*

- Developed a Section 10 Recovery permit with Landowner Protections for the Partners for Fish and Wildlife program to benefit copperbelly water snake.
- Assisted in ongoing reintroduction to establish a migratory population of whooping cranes in eastern North America. *[ES/NFWF/ Natural Resources Foundation of WI]*
- Initiated reestablishment of a Midwestern migratory flock of whooping cranes using captive-reared cranes based at Necedah National Wildlife Refuge.
- The Service is a founding member of the Whooping Crane Eastern Partnership which was established in 1999 and is devoted to reintroduction of a migratory population of whooping cranes in eastern North America. The partnership has successfully established a migratory population that currently numbers more than 100 birds. The population has demonstrated high levels of adult survival, as well as appropriate reproductive behavior, and although nesting has occurred each year since 2005, so far only 3 chicks have been reared to fledging. Research to determine the causes of poor nest success is ongoing, and the partnership is optimistic that current problems with reproduction can be overcome.
- Quantify the status and distribution of brook trout at a sub watershed level, identify primary threats to brook trout and complement efforts of the Eastern Brook Trout Joint Venture to provide a comprehensive view of the status of brook trout across their range in the United States.
- Delisted the Western Great Lakes Distinct Population Segment of the gray wolf *(Canis lupis)* (ES).

Priorities for the Future

- Continue working to increase the population of the Lake Erie water snake and reduce threats the species.
- Remove threats to lake sturgeon to stabilize and increase the number of populations and preclude listing.
- Increase and expand partnership efforts with private land owners to conduct activities to recovery listed species and preclude listings.
- Increase the number and expand occupied breeding range of the Great Lakes piping plover and propose reclassification from endangered to threatened.
- Increase the number and expand occupied breeding range of the Kirtland's warbler and propose reclassification from endangered to threatened.
- Increase partnership efforts with private land owners to restore and manage habitat for copperbelly water snake.
- Increase partnership efforts with Federal, State, local, and private organizations and land owners to restore and manage habitat for Karner blue and Mitchell's satyr butterflies.
- Propose delisting Pitcher's thistle.
- Remove threats to existing massasauga rattlesnake populations and increase their numbers to the extent that listing this species is no longer necessary.

- Continue to work on restoring populations of the eastern prairie fringed orchid, dwarf lake iris, and Pitcher's thistle in Wisconsin (ESA Section 6, GLRI).
- Continue to monitor Kirtland's warblers and piping plovers and implement protective measures to encourage the establishment of breeding populations of these species in Wisconsin and work with multiple partners on habitat development projects to create future breeding habitat for the Kirtland's warbler.
- Continue work to establish a migratory population of whooping cranes in eastern North America.
- Continue to work on priority recovery activities for the Karner blue butterfly and Hine's emerald dragonfly (e.g., habitat restoration and management, and population assessment).
- Work to conclude research and modeling efforts to help guide herbicide use in wetland habitats occupied by the Hine's emerald dragonfly. (ES/ESA Section 6/GLRI).
- Continue to work in cooperation with a number of conservation organizations to enhance hundreds of acres of wetland habitat through the removal of invasive plant species in northern Door County. These efforts will improve habitat of Hine's emerald dragonfly and dwarf lake iris. (PFW).
- Finalize permit to Wisconsin DNR pertaining to the Eastern Massasauga Rattlesnake Candidate Conservation Agreement (ES).

Goal VI: Protect, manage, and conserve migratory birds.

Primary Operational Authority and Guidance

- Migratory Bird Treaty Act
- Fish and Wildlife Conservation Act
- North American Waterfowl Management Plan (Upper Mississippi River and Great Lakes Joint Venture)
- Partners in Flight landbird conservation plans (Great Lakes Physiographic Areas)
- U. S. Shorebird Conservation Plan (Upper Mississippi Valley/Great Lakes regional plan)
- North American Waterbird Conservation Plan (Upper Mississippi Valley/Great Lakes regional plan)

Service Programs

- Migratory Bird Program
- National Wildlife Refuge System
- Ecological Services Program
- Private Lands Program
- Fisheries Program
- Law Enforcement Program

Progress 1990-2010

The wide-ranging nature of migratory birds necessitates a collaborative approach to their conservation and management, and in the Great Lakes our Migratory Bird Program works with other Service programs (see above) as well as Federal, state, provincial, and tribal agencies, nongovernmental organizations, universities, industry, and private citizens to conserve the region's avifauna. Birds are an important component of the Great Lakes ecosystem; nearly 500 species breed or winter in, or migrate through, the Great Lakes. Millions of people watch, feed, and hunt migratory birds, and these recreational pursuits have a significant economic impact. Birds are challenged by a number of limiting factors, including habitat loss and degradation, contaminants, disease, climate change, predators, and collisions with obstacles like communications towers, buildings, windows, and wind turbines. One of the Service's major trust responsibilities is to maintain and enhance healthy bird populations and habitats for the continued use and enjoyment of the American people.

The Service has identified about 70 bird species that are of special concern in the Great Lakes because of declining numbers, recreational importance, or "nuisance" problems, and many of our conservation efforts focus on these species. We conduct, coordinate, and fund work in a number of areas. Following are examples of activities in each of these areas that illustrate the scope of our bird conservation efforts in the Great Lakes.

A number of cooperative population monitoring programs have been established to collect information on the status, trends, and distribution of birds in the Great Lakes. One of the most

significant is a bi-national survey of colonial waterbirds that is done periodically in conjunction with other Federal, state, and provincial agencies to census the Great Lakes' gulls, terns, herons, egrets, pelicans, and cormorants using standardized protocols. The latest survey, done from 2007 to 2010, found approximately 413,000 pairs of 14 colonial waterbird species nesting at 310 sites in the U. S. Great Lakes. The Service also partnered with USGS and others to initial aerial surveys of pelagic birds in the Great Lakes to establish baseline data for assessing the impacts of future offshore wind power projects.

Through the Midwest Coordinated Bird Monitoring Partnership, the Service has worked with a number of entities to develop a protocol and sampling framework for monitoring marsh birds (rails, bitterns, coots, and moorhens) in the Great Lakes and elsewhere in the Midwest. Little is known about the status of many of these species because of their secretive nature, and this survey information will be critical to their conservation.

The Service supported research activities through the U. S. Geological Survey, state agencies, universities, and others to obtain information that allowed us to better understand the biology and limiting factors of Great Lakes birds. Research findings were used to improve our management of several species of concern, including the Common Tern, Common Loon, Double-crested Cormorant, American Woodcock, and Golden-winged Warbler.

The North American Waterfowl Management Plan (NAWMP), through the Upper Mississippi River & Great Lakes Region Joint Venture (JV) and adjoining JVs, has worked in the Great Lakes since 1986 to protect, restore, and manage habitats for waterfowl and a variety of other bird species. JV partners have been very active in habitat conservation in the Great Lakes watersheds, working through state and local partnerships.

In addition to the NAWMP, other international bird conservation plans were developed and stepped down to address the needs of land-birds (Partners in Flight), shorebirds, and waterbirds in the Great Lakes. These plans identified priority bird species, habitats, and conservation strategies.

Through our Great Lakes field stations and partners, we worked to promote awareness of the value of migratory birds and their habitats through presentations, publications, displays, curricula, workshops, and events.

Selected Outcomes

- Identified 102 sites in the U. S. Great Lakes that provide important habitat for terns, gulls, herons, egrets, pelicans, and cormorants; these sites will be the focus of protection efforts by the Service and its partners in the future.
- Increased our understanding, through cooperative research efforts, of Double-crested Cormorant impacts on fish populations, the status and limiting factors of Great Lakes Common Terns, the effects of hunting on American Woodcock, and the importance of Great Lakes shorelines and coastal marshes to migrating songbirds and shorebirds.
- Worked with partners to develop four Physiographic Area Landbird Conservation Plans to address the needs of hundreds of species in the Great Lakes, and stepped down the

U.S. Shorebird Conservation Plan and the North American Waterbird Conservation Plan to regional plans for the Great Lakes.

- Educated thousands of people about birds through International Migratory Bird Day events at National Wildlife Refuges in the Great Lakes.
- Participated as an integral partner in the formation of the Wisconsin Bird Conservation Initiative, devoted to across the board conservation of migratory birds in Wisconsin. *[ES]*
- In partnership with consultants, developers, and other agency personnel, the Upper Mississippi River Corridor Mapping project was developed. This initiative identifies areas throughout the highly used migratory bird corridor where birds (and other wildlife species) may be at higher risk (e.g., State Natural Areas, easement land). Once completed, this tool will be used by agency personnel and developers to facilitate wind power facilities being sited in areas that pose less risk to migratory birds. *[ES, USGS]*
- Enhanced 143 acres of habitat specifically designed to provide migratory bird stopover habitat at Forest Beach Migratory Preserve. *[American Reinvestment and Recovery Act]*
- Initiated creation in 2007 of the Great Lakes Wind Collaborative with the express purpose of serving as a forum for all wind power development stakeholders to collaborate in identifying and addressing issues of mutual concern in a proactive and non-confrontational way; the Collaborative, administered by the Great Lakes Commission, includes participation of the 8 Great Lakes states and 2 Canadian provinces, U.S. and Canadian Federal agencies, wind power development interests, and environmental organizations.
- With funds through the GLRI, the Service acquired two avian marine radar units that will be deployed throughout the Great Lakes Basin to identify important migratory and stopover areas for migratory birds; this information will used to site wind power projects in areas that avoid impacts to the Basin's significant migratory bird and bat resources.
- Protected, restored, and enhanced over 107,000 acres of bird habitat within the Great Lakes watershed in the Upper Mississippi River and Great Lakes Region Joint Venture, via North American Wetlands Conservation Act (NAWCA) grants. In total, over $31 million in NAWCA funds have been leveraged by over $89 million in partner funds since 1990.
- In 2010, seven partner projects were selected for funding via the GLRI, $2 million in GLRI funds (combined with matching funds from project partners) will protect, restore, or enhance approximately 1,526 acres of wetland and associated upland habitat in six states in the Great Lakes watershed. *[Great Lakes Watershed Habitat and Species Restoration Initiative through the Upper Mississippi River Great Lakes Region Joint Venture and the Atlantic Coast Joint Venture]*

Priorities for the Future

- Continue to take a leadership role in implementing and integrating conservation plans for waterfowl, landbirds, shorebirds, and waterbirds in the Great Lakes.
- Use landscape-level tools like Geographic Information Systems and modeling to syn-

thesize information from bird planning efforts and identify geographic focus areas where partners can most effectively protect and restore migratory bird habitat in the Great Lakes.

- Continue to develop, coordinate, and implement monitoring programs for colonial waterbirds, pelagic birds, and marshbirds in the Great Lakes.
- Address priority Great Lakes bird research needs through cooperative studies, focusing on limiting factors for species of concern.
- Work with state agencies, USDA Wildlife Services, and others to implement Double-crested Cormorant management to address biological and social concerns associated with this species in the Great Lakes.
- Implement the Service's Strategic Plan for Migratory Bird Conservation by enhancing partnerships and using sound science to monitor and manage bird populations, conserve habitat, and provide bird-related recreational opportunities in the Great Lakes.
- Continue to partner with other agencies (federal and state) in working with wind power project developers and consultants to site facilities in areas that are least detrimental to migratory bird and bat populations.
- Continue work with the Wisconsin Bird Conservation Initiative to conserve migratory birds in Wisconsin.
- Continue to work with wind power stakeholders to ensure wind power is developed in environmentally sensitive and sustainable ways by identifying significant areas for migratory birds and bats, encouraging avoidance of these areas, and working with developers to minimize and mitigate unavoidable impacts.

Discussion and Recommendations

Discussion

This report illustrates how the activities supported through the Act have been a tremendous success from 1998 to 2010. Progress has been made toward nearly all of the 32 recommendations of the 1995 Fishery Resources Restoration Study, through the fish and wildlife restoration proposal process and under the activities conducted by the Service with our many partners.

Because of the Act, the partnerships are growing and becoming more effective, as evidenced by the fact that more partners and stakeholders join in the restoration programs each year. This report shows that 265 organizations participated with the Service in fish and wildlife restoration projects in the Great Lakes Basin, and the list continues to grow each year.

Support for the Act from our partners is strong and speaks to the importance of this legislation. In particular, the fish and wildlife restoration proposal process is considered an outstanding success, because it provides state and tribal management authorities with critical input and resources to pursue cooperative restoration activities within the Act framework. Partners have expressed strong support for increasing funding to conduct restoration projects and partnerships.

Much of the work completed during 1998-2010 focused on research into the status of fish and wildlife populations, on the conditions impeding their restoration, improvements to critical habitats, and on establishing a data sharing framework, including geographic information systems data. Ultimately, this Act funded research supports management efforts while the Act project selection and review process helps bring authorities together as a combined force. This has been an important contribution in the ongoing process of establishing an adaptive, science-based approach in restoring Great Lakes resources. As a result of the Act, direct habitat restoration actions have been taken to restore and preserve important habitats across the basin.

Historically, restoration efforts and programs implemented in large ecosystems have shown the importance of taking an adaptive, science-based approach with science informing management of the appropriate options and strategies. Understandably, because of the great size of this eco-system, the complexity of its restoration challenges, and the international interjurisdictional context in which this work must be accomplished, this process has been slowly building over many years. The Act has, and continues to, help management authorities produce the science that is necessary to approach restoration needs more effectively as well as produce on the ground restoration results.

Interest in the Great Lakes ecosystem by many stakeholders has helped to generate programs to resolve problems at the international, federal, state, provincial, and local levels. These programs support diverse activities including flood plain, shore and coastal zone management; dredging and construction of public facilities; agriculture and forestry; soil, water, air and watershed management; farmland protection and management; education; research; technical assistance and extension services; biological and geological information monitoring; environmental monitoring

and assessment; pollution prevention and remediation; fish and wildlife resource management and many others. Among these programs, those focusing on fish and wildlife resource conservation and on environmental conditions and restoration in the Great Lakes are of the most direct relevance to the Act. The Act provides a platform to help coordinate these programs.

Parallel restoration efforts are ongoing in Canadian waters. Coordination between U.S. and Canadian environmental restoration programs in the Great Lakes is well established in some areas but as threats continue to arise there is much room for joint progress and cooperation.

The Great Lakes Fish and Wildlife Restoration Act projects are helping to fill gaps in the complicated management structure within the Great Lakes in several ways. The Act has helped provide resources for states and tribes to move forward with research questions about the status of populations and habitat, and cause-and-effect relationships, at a scale that would not be possible for each individual authority. This has facilitated the development of decision-support processes and databases which have in turn stimulated more work toward bringing resource management and environmental objectives together.

Resources provided through the Act have helped forge stronger links among the programs administered by the Service. For example, Service fishery biologists supported through the Act have helped document contaminants impacts to fisheries through the natural resource damage assessment program under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Similarly, Service fishery biologists have implemented many restoration actions to preclude the need to list Great Lakes fishes under the Endangered Species Act of 1973.

Finally, the Act provides a focal point for coordination between Service, state, and tribal fish and wildlife restoration and management activities. The Act provides a key piece of the overarching strategy for Great Lakes restoration. Simply stated, the fish and wildlife resources of the Great Lakes basin support human health, increase quality of life, and support economies that millions of people rely on. Ultimately, the work completed under the umbrella of the Act is imperative to the continued ecological and economic health of the Great Lakes Basin.

Recommendations

The following recommendations are consistent with comments from an inter-agency and intra-agency review of this report, and reflect major needs for future improvement of the Act.

1. **Activities funded under the Act should continue to be consistent with the recommendations of the Great Lakes Regional Collaboration** –
In December 2005, the Great Lakes Regional Collaboration, established under Executive Order 13340, released the "Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes." This Strategy includes recommendations for actions to restore and protect the Great Lakes that should be taken over the next five years. The recommendations focus on: aquatic invasive species; habitat conservation and species management; coastal health; areas of concern associated with contaminants, pollution and excessive habitat loss; non-point source pollution; toxic pollutants; indicators and information; and sustainable development. Future activities funded under the Great Lakes Fish and Wildlife Restoration Act should be consistent with these recommendations.

2. **Continue to support the state and tribal restoration proposal process** –
This process has been an outstanding success and has become a primary force in supporting interagency restoration activities under the Joint Strategic Plan for Management of Great Lakes Fisheries. The demand for funds to support high priority fish and wildlife restoration proposals greatly exceeded available resources during 1998-2010. This is a testimony to both the high demand for and success of the restoration proposal process.

3. **Refocus the Act toward adaptive resource management processes and sustainability** –
Because the Great Lakes are degraded and not in a balanced or self-sustaining state, they are not finite resources that can be restored with a one-time-fix approach. Great Lakes fish and wildlife resources are in a state of continual flux as influenced by many factors acting together in an extremely complex relationship. The actions of resource management agencies often have the desired effect; however, the results may be minimized or mitigated by confounding influences and may therefore be short lived. By continually monitoring the status of populations, their habitat and influencing factors, and adjusting management programs accordingly, we may be able to achieve some measure of balance and sustainability of resources in these ecosystems over the long-term.

4. **Strengthen focus on interagency databases and decision making tools** –
Research and monitoring to answer basic questions about the problems impeding our restoration efforts must continue indefinitely because of the complexity of issues involved and the unbalanced nature of the Great Lakes. In order to support an adaptive, science-based approach, we need to increase interagency focus on tools to support decision-making such as geographic information systems and cooperative resource monitoring programs. This focus will allow us to track fish and wildlife resources and to measure progress toward our restoration goals. Infrastructure to host interagency databases and decision-making tools is lacking and could be created through the Act.

5. **Focus on environmental education and public involvement** –
The diversity of stakeholders involved with Great Lakes resources is immense and we have only begun to tap into the interests, energy and resources they could bring forward. Consideration could be given to new authority to conduct outreach through public venues such as National Fish Hatcheries, Fish and wildlife Conservation Offices, National Wildlife Refuges, and the existing network of Great Lakes visitor centers. It may also be possible to employ these facilities as centers to create new public partnerships to facilitate restoration work at the local level. Connecting the public with nature will help to create a groundswell of support for our current and future fish and wildlife restorations efforts.

Final Statement
The Great Lakes, the largest surface freshwater system in the World, are Canadian and U.S. national treasures. Increasing stresses on the system from climate change, population growth, demand for water, invasive species, pollution and contamination, habitat alteration and destruction, fish and wildlife diseases, and changes in native species community and structure, will result in increasing conservation challenges. Over the course of the past twenty years, the Act has provided authority to complete important work towards the restoration and conservation in the Great Lakes Basin. In the last twelve years, it has also played a key role in the support of this goal by providing funding for projects, which have made strides forward in terms of environmental research, on the ground restoration, and future conservation in the Great Lakes Basin.

The Great Lakes Fish and Wildlife Restoration Act offers powerful and effective tools to address these challenges and help resolve the fish and wildlife conservation side of environmental restoration programs in the Great Lakes region. The Act has the capacity to provide consistent funding of interagency initiatives and open new possibilities for international conservation programs. Continuing investment in the Act will yield direct ecological, health, and economic benefits to the more than 34 million people living within this unique region.

Appendix I: Funded Proposal Summaries 1998-2010

Regional Projects:

Title: State and Federal Refuge Protection Buffers in the Southwest Lake Erie Watershed Phase I

Status: Active ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-A-J359

Funding Year(s): 2010

GLFWRA Funding: $630,100 ***Total Non-federal Match/In-Kind:*** $0

Investigator(s): Mindy Koch, David Graham, Jennifer Christman, and Kevin Joyce, Jason Lewis

Sponsor: N/A

Restoration Study Goals Addressed: Goals III and VI, Recommendations 11 and 12

Background: The Great Lakes Fish and Wildlife Restoration Act as well as many other recent conservation plans that include the Southwest Lake Erie region, identify land and habitat protection as important for achieving long term conservation goals and management objectives. The ability to buffer the existing state and federal wildlife refuges in this area with conservation easements one private lands is the most cost effective way to achieve that goal. This project will purchase conservation easements on 330+ acres of private lands identified by project partners as priorities for protection.

Highlights: This Regional Project will results in the acquisition of more than 330 acres of wetlands near southwest Lake Erie that border the Detroit River International Wildlife Refuge and the Ottawa National Wildlife Refuge, have been identified in the Ohio and Michigan State Wildlife Action Plans, and in the Upper Mississippi River and Great Lakes Region Joint Venture 2007 Implementation Plan. The ability to buffer the existing state and federal wildlife refuges in this area with conservation easements on private lands is the most cost effective way to achieve that goal.

Requesting Agencies/Partners: Deputy Director, Michigan Department of Natural Resources; Chief, Ohio Division of Wildlife; Ducks Unlimited.

Title: Building Capacity for Fisheries Management on the Great Lakes: Implementation of Mass Marking Technology

Status: Active ***Project Type:*** Biology and Ecology of a Target Species

Agreement Number(s): 30181-A-C136

Funding Year(s): 2010

GLFWRA Funding: $2,600,000 ***Total Non-federal Match/In-Kind:*** $0

Investigator(s): Dr. Kelly Smith

Sponsor: N/A

Restoration Study Goals Addressed: Goals III and VI, Recommendations 11 and 12

Background: Stocked fish are a primary tool for the rehabilitation and maintenance of valued fish stocks in the Great Lakes. At the same time, the ability of fishery management agencies to evaluate the effectiveness of these fish stocking actions is limited because only a small fraction of fish stocked are marked each year. Mass marking of stocked fish, which includes the use of coded-wire tags and fin clips, is necessary to effectively and efficiently assess the contribution and performance of nearly 30 million fish stocked annually.

Highlights: Great Lakes fishery agencies have established a goal to fin clip and coded-wire tag every trout and salmon stocked in to the Great Lakes (31 million fish annually, U.S. and Canada). This project enabled the Service to acquire two AutoFish tagging trailers for its Great Lakes Mass Marking program implemented on behalf and in partnership with the Great Lakes States and Tribes. The implementation of mass marking techniques throughout the Great Lakes will provide state, tribal, and federal management agencies information related to critically important fishery management objectives. These trailers will contribute to the Great Lakes Mass Marking program for years to come.

Requesting Agencies/Partners: Director, Michigan Department of Natural Resources; Director, Indiana department of Natural Resources.

Non-Regional Projects:

Title: First Phase Removal of the Ballville Dam, Sandusky River Tributary to Lake Erie

Status: Active ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): F11AP-0-0031

Funding Year(s): 2010

GLFWRA Funding: $2,000,000 ***Total Non-federal Match/In-Kind:*** $2,310,000

Recipient: Ohio Department of Natural Resources

Investigator(s): Roger Knight

Sponsor: Ohio Department of Natural Resources

Restoration Act $2,000,000 Non-federal Match $2,310,000

Restoration Study Goals Addressed: Goals I and III, Recommendations 11, 12, 19

Background: Removal of the Ballville Dam will open 22 miles of habitat above the structure and restore natural hydrological processes to over 40 miles downstream. This Project will improve conditions for native fish communities in the Sandusky River system, specifically walleye, white bass, and the state-threatened species greater redhorse. The Sandusky River is a known spawning location for walleye and this project will dramatically increase the amount of habitat available. Monitoring projects before and after the project will be used to investigate the ecological effects. Ohio Department of Natural Resources has been pushing for the removal of this dam for approximately 10 years and now has an agreement in place with the City of Fremont, Ohio that it must be removed within the next two years.

Highlights: The formal National Environmental Policy Act - Environmental Impact Statement process is underway with completion expected by next summer. An initial public scoping meeting and comment period has occurred and was posted to the Federal Register. Pending the outcome of that process, the dam could potentially be removed during low flow periods in fall 2012. However, the Environmental Impact Statement will help to guide decisions and investigate alternative options to achieving project goals.

Partner(s): City of Fremont, Ohio EPA and the United States Army Corps of Engineers

Title: Viral Hemorrhagic Septicemia: An understanding of the Disease Ecology and Risks in the Great Lakes Basin

Status: Active ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-A-G198

Funding Year(s): 2010

GLFWRA Funding: $230,700 ***Total Non-federal Match/In-Kind:*** $122,800

Recipient: Michigan State University

Investigator(s): Dr. Amber Peters, Dr. T. Brenden, Dr. J. Tsao, and Dr. M. Faisal

Sponsor: Keweenaw Bay Indian Community

Restoration Study Goals Addressed: Goals I and V, Recommendations 12 and 28

Background: Since Viral Hemorrhagic Septicemia Virus (VHSV) was first detected in the Great Lakes basin in 2005, its spread throughout the basin has raised serious concerns regarding its possible impact on both Great Lake and inland fisheries. Moreover, because VHSV has been found in 28 species of fish in the Great Lakes, the diversity of its hosts can lead to ecological impacts that cascade through the food web. Therefore, a thorough understanding of the biology and disease ecology of VHSV is urgently needed.

Highlights: Clearly, the most exciting preliminary result from the project to date is the confirmed presence of the VHS virus in Budd Lake during the Spring of 2011. The virus was confirmed by PCR in all the pools of samples of largemouth bass from both April and May. We have also confirmed the VHS virus in 2 of the muskellunge samples in May. After the initial die-off in 2007, the virus was not detected in the lake until this study. Our positive samples were sent to an outside company for DNA sequencing and the results show two strains of VHSV in the lake; the one that has previously been found, and, a new strain of VHSV in Budd lake. We have not found any signs of the virus in the 360 naïve largemouth bass from the cage study using PCR analysis. It is possible that the virus will be detected with further assays. If no sign of the virus is found among any of the fish in the cage study, we might need to revisit our rationale for performing a secondary cage study in 2012. It might prove more informative to conduct a second ecosystem sampling in 2012 as opposed to a second cage study. Our preliminary results have been presented at the Annual Budd Lake Association Meeting in Harrison, Michigan in June 2011 to a group of stakeholders that live on or near the lake. These results have also been presented at a Great Lakes aquatic laboratory meeting for the Michigan State University Department of Fisheries and Wildlife in October of 2011.

Partner(s):

Title: Shiawassee Flats Wildlife and Fish Habitat Restoration

Status: Active ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-A-G194

Funding Year(s): 2010

GLFWRA Funding: $589,100 ***Total Non-federal Match/In-Kind:*** $194,400

Recipient: Michigan Department of Natural Resources

Investigator(s): Barbara Avers

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals III and VI, Recommendations 11 and 12

Background: The proposed project has ecological benefits at multiple scales. Project completion will restore and protect the management of critical waterfowl breeding and migration habitat and have impacts throughout the Mississippi Flyway. Water quality improvements will have Lake Huron basin benefits. Within the watershed, the project will offset the dramatic and continued loss of wetland habitat. Locally, the ability to control water levels will enable us to effectively control invasive species and thousands of recreational trips will be improved and protected.

Highlights: All on-site surveys and planning for the radial gates portion of this project has been completed and permits have been secured. The rip rap for the inlet and outlet channel stabilization has been delivered and is on-site. Pre-construction monitoring of water velocities will be completed by the engineering firm in May once the spring floods have receded and water velocities return to more normal conditions. The contractor is also waiting for flood waters to recede so they can construct a cofferdam and pump the project site down before starting the work.

Partner(s):

Title: Pointe Mouillee Coastal Wetland Restoration and Dike Rehabilitation

Status: Active ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-A-G193

Funding Year(s): 2010

GLFWRA Funding: $489,800 ***Total Non-federal Match/In-Kind:*** $163,300

Recipient: Michigan Department of Natural Resources

Investigator(s): Mark Sargent and Joe Robison

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: Pointe Mouillee State Game Area in Monroe County, Michigan, encompasses 4,040 acres of wetlands on the western end of Lake Erie, Some of the original estuary wetland types are still found in the bay; however, they tend to be restricted behind dike systems. The dikes serve to allow optimal wetland management for wildlife values as well as reducing wave erosion while trapping sediments. Through funds received from this grant, the Michigan Department of Natural Resources and Environment will restore, resurface or raise elevations of the 2.85 miles of dike to improve water level control in the wetland.

Highlights: We have rehabilitated 0.4 miles of dike within the Walpatich unit this summer. State employees and State owned equipment was used to accomplish our goal. We also sprayed around 20 acres of phragmites. Getting a head of phragmites will help in the future for desired management of coastal wetlands.

Partner(s):

Title: Predicting Climate-Change Induced Distributional Shifts in Great Lakes Region Reptiles

Status: Active ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-A-G189

Funding Year(s): 2010

GLFWRA Funding: $35,800 ***Total Non-federal Match/In-Kind:*** $34,200

Recipient: Northern Illinois University

Investigator(s): Richard King

Sponsor: Northern Illinois University

Restoration Study Goals Addressed: Goals III and V, Recommendations 11 and 12

Background: This project is designed to describe the effects of climate change on seven species of snakes and five species of turtles in the Great Lakes Region. Most of these species make extensive use of both wetland and upland habitat and have been negatively impacted by habitat loss and degradation resulting from wetland drainage, agriculture, and urbanization. This study will provide recommendations to state and federal agencies concerning the conservation status of reptiles in the Great Lakes Region.

Highlights: A major accomplishment during the past six months has been the compilation of locality data for twelve focal species. As reported previously, queries of the HerpNET network of herpetological collections (http://herpnet.org/) returned more than 9,000 records from 36 institutions. These have been augmented with data provided by individual institutions, including institutions that do not participate in HerpNET, through correspondence with collection curators. In addition, requests for Element Incident Records from appropriate state and provincial agencies and other sources have been filled or are pending, bringing the total number of records obtained to more than 27,000.

Partner(s):

Title: Assessment of Lake Sturgeon Restoration Efforts in Green Bay, Lake Michigan

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-A-G188

Funding Year(s): 2010

GLFWRA Funding: $118,200 ***Total Non-federal Match/In-Kind:*** $40,500

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Michael Donofrio, Edward Baker, Robert F. Elliot, Brian Sloss, and Kim Scribner

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goals I and V, Recommendations 11, 12 and 29

Background: This project addresses goal one of the Great Lakes Fish and Wildlife Restoration Act by contributing to the restoration of a self-sustaining fishery resource. The Great Lakes Fishery Resources Restoration Study and the Great Lakes Regional Collaboration's "Strategy to Restore and Protect the Great Lakes" recommendations for Lake Michigan are also addressed by protecting and sustaining a diverse community of native fishes especially fish communities that support sustainable fisheries.

Highlights: Eight new sonic receivers were surgically implanted into 8 adult sturgeon in the Peshtigo river on 5/25/11; all of those fish were detected with the Peshtigo receivers shortly after surgery. Of those, one of those sturgeon was detected in a Oconto river receiver 4 days post-surgery. Genetic tissue samples were collected from those 8 sturgeon, 21 additional sturgeon from the Peshtigo River and several adult sturgeon below the Grand Rapids dam, and developed a new population estimate for the Grand Rapids population of lake sturgeon.

Partner(s): Michigan Department of Natural Resources and Environment, University of Wisconsin-Stevens Point, and Michigan State University

Title: River Care - A Framework for Restoring Stream Connectivity and Habitat in the Upper Great Lakes

Status: Active ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-A-G154

Funding Year(s): 2010

GLFWRA Funding: $750,000 ***Total Non-federal Match/In-Kind:*** $940,000

Recipient: Conservation Resource Alliance

Investigator(s): Amy Beyer

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendations 11 and 12

Background: The proposed project will restore habitats and connectivity of some of the highest quality streams feeding the Great Lakes, a cornerstone element in implementing the Great Lakes Collaboration Strategy adopted by coalition partners and agencies in 2007. In this project, CRA, Huron Pines and GTB will coordinate the efforts of experienced partners to design and complete specific priority projects, such as dam removals, stream crossing improvements, erosion control, and wildlife habitat improvement on 18 watersheds draining to northern Lakes Michigan, Huron and Superior.

Highlights: Progress is on track with several key implementation projects being completed. Pre-construction monitoring was initiated at the Platte River/Reynolds Road site in summer 2011; this site is one of the long-term monitoring sites being undertaken by the Grand Traverse Band and Conservation Resource Alliance to help document channel morphology response and fish population trends.

Partner(s): Huron Pines, Grand Traverse Band of Ottawa and Chippewa Indians, United States Forest Service, The Nature Conservancy, and Trout Unlimited

Title: Quantifying Genetic, Phenotypic, and Reproductive of Siscowet and Lean Lake Trout Reared in a Controlled Environment

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-A-G153

Funding Year(s): 2010

GLFWRA Funding: $79,900 ***Total Non-federal Match/In-Kind:*** $63,300

Recipient: Great Lakes WATER Institute, University of Wisconsin-Milwaukee

Investigator(s): Frederick W. Goetz, Shawn P. Sitar

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 12, 28, and 29

Background: The overall goals of this study are to continue to characterize differences or similarities between cultured siscowets and leans reared under identical environmental conditions to help delineate differences that may be genetically defined between the morphotypes or a result of the environment that they inhabit. Further, we seek to identify other possible differences between the morphotypes (e.g., expression of immune genes) that might have important biological and management implications.

Highlights: Good progress has been made in continuing to assess growth, lipid levels and morphometry in the cultured leans and siscowets. The data from this analysis indicates that siscowets continue to outgrow leans in culture with significantly higher conditions factors. Fatmeter readings demonstrate that siscowets continue to have higher fat levels than leans and that fat levels are the single best character to differentiate the two morphotypes.

Partner(s): Michigan Department of Natural Resources

Title: Conservation of Native Freshwater Mussel Refuges in Great Lakes Coastal Zones

Status: Active ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-A-G152

Funding Year(s): 2010

GLFWRA Funding: $381,200 ***Total Non-federal Match/In-Kind:*** $206,800

Recipient: Central Michigan University

Investigator(s): Dr. D. Zanatta (Principal Applicant), Dr. L. Burlakova, Dr. A. Karatayev, Dr. R. Krebs, Dr. M. Hoggarth, Dr. F. A. de Szalay, Dr. J. Bossenbroek, E. Meyer, M. Walsh, Dr. M. Schlesinger, R. Haas, T. Crail, P. Badra, N. Welte, L. Holst, D. Schloesser,

Restoration Study Goals Addressed: Goals I and III, Recommendations 11, 12 and 29

Background: This project will assess known coastal and near-shore unionid mussel refuges in the lower Great Lakes to describe existing unionid diversity, habitat characteristics, and prioritize areas for conservation and management. This project will also examine gene flow and differentiation among refuge sites and nearby riverine populations and examine their evolutionary significance. The investigators will also model habitat characteristics to determine key environmental attributes and identify additional potential refuges. The final outcome will be to develop management recommendations to state and federal agencies to protect and conserve unionid communities in coastal refuges.

Highlights: The group (17 co-PIs and students) met at Cleveland State University on Nov 12, 2012. We presented summaries of the data collected and (very) preliminary results. We discussed next steps including filling data gaps in Lake Erie/ St. Clair and plans for sampling in Lake Ontario for summer 2012. We are making excellent progress towards achieving the goals of this project.

Partner(s): Buffalo State College, Cleveland State University, Otterbein College, Kent State University, University of Toledo, Pennsylvania Natural Heritage Program, Ney York Natural Heritage Program, Michigan Department of Natural Resources, Michigan Natural Features Inventory, Pennsylvania Fish and Boat Commission, New York Department of Environmental Conservation, an United States Geological Survey – Great Lakes Science Center

Title: Assessing Wetland Change in the Great Lakes

Status: Active ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-A-G151

Funding Year(s): 2010

GLFWRA Funding: $112,500 ***Total Non-federal Match/In-Kind:*** $37,500

Recipient: Ducks Unlimited

Investigator(s): Rob Macleod

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendations 10, 11 and 12

Background: This federal assistance is being provided to help the Recipient develop a spatial data layer including current wetlands (extent and type) and the ability to track wetland changes over time located in the Great Lakes watershed. To accomplish this goal, the Recipient intends to utilize geographic information systems (GIS). These actions will help assist conservation planning efforts in targeting areas of wetland loss for restoration activities and protect remaining wetland areas that are significant to water quality, fish and wildlife, and humans. This agreement is part of the Great Lakes Restoration Initiative (GLRI) that has identified five principal areas on which to focus efforts.

Highlights: The methods for assessing and reporting the change in wetland types have been developed and tested for Illinois, Indiana, and Ohio. A final report will be created when the Michigan NWI update is completed. The potential wetland restoration sites layer is currently being created through the NWI update process and will be finalized when the Michigan NWI update is completed. All of the field data has been collected for the accuracy assessment and 5,103 sites have been compared to the NWI update and entered into the database. There are approximately 200 additional sites to be entered. Once all of the sites have been entered, a report will be created that describes the accuracy of the NWI update. The web site architecture has been designed and some of the custom web tools have been created for the mapping site.

Partner(s):

Title: Pere Marquette instream habitat enrichment project, Baldwin, Michigan

Status: Active ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-A-G017

Funding Year(s): 2009

GLFWRA Funding: $60,000 ***Total Non-federal Match/In-Kind:*** $34,700

Recipient: Conservation Resource Alliance

Investigator(s): Kim Balke

Sponsor: Michigan Department of Natural Resources

Restoration Act $60,000 Non-federal Match $34,700

Restoration Study Goals Addressed: Goals I and III, Recommendations 11, 12

Background: The project meets the Great Lakes Regional Collaboration Strategy for riverine habitats in that it restores instream habitat in the Pere Marquette River as a Lake Michigan tributary, and promotes self-sustaining trout (including native brook trout, *Salvelinus fontinalis*) and salmon populations by providing instream hiding and resting cover, and food in the form of aquatic insect substrate. By incorporating project reports and fish assessments into the "Northern Michigan River Restoration" online database, this cooperative effort contributes to the widespread network of stream restoration project tracking that can be translated into practical information and products useful to decision makers, educators and the general public.

Highlights: Conservation Resource Alliance (CRA) staff have completed site plans for 18 of the targeted 40 sites. CRA staff floated the first section of river in May 2010 with members of the Pere Marquette River Restoration Committee to review individual sites and determine site prescriptions. The US Forest Service, USFWS, Pere Marquette Watershed Council, Michigan River Guides Association, Kanouse Outdoor Restoration, Lake County Road Commission, and Orvis Pere Marquette River Lodge were all represented on the float trip. In June and July 2010, CRA waded and floated the first section again to take accurate site measurements, refine site plans, confirm GPS locations, and assess access needs. CRA staff produced final site plans complete with site photos and a summary of site measurements and notes for all permitting agencies and project partners. CRA has obtained MDNRE permits, SHPO permits, Natural Rivers approval, and secured a cooperative agreement (#11-CS-11090403-004) with the US Forest Service.

Partner(s): Michigan Department of Natural Resources Fisheries Division, US Forest Service, and Pere Marquette Watershed Council

Title: Open-Land Enhancement at French Creek Wildlife Area and Swan Lake Wildlife Area

Status: Completed ***Project Type:*** Upland Habitat Restoration

Agreement Number(s): 30181-9-G030

Funding Year(s): 2009

GLFWRA Funding: $6,800 ***Total Non-federal Match/In-Kind:*** $2,300

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Sara Kehrli and Ryan Fisher

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The goal of this project is to enhance 48 acres of open-land in Columbia and Marquette Counties, Wisconsin by using prescribed burns, chemical treatment, possible mechanical treatment, and inter-seeding techniques to control invasive species. Nesting and rearing areas for grassland birds, habitat which has declined around the region, will be improved per objectives in the Upper Mississippi River and Great Lakes Region Joint Venture 2007 Implementation Plan.

Highlights: The renovation sites were burned and treated with an herbicide during Spring 2009. The fields were replanted with a mix native warm season prairie grasses and forbs. Encroaching box elder trees and aspen trees were also removed. These methods proved to be an economical approach to return former row crop land to restored native prairie.

Partner(s): Pheasants Forever

Title: Reducing the Incidental Catch of Lake Trout in Large-Mesh Gillnet Fisheries for Lake Whitefish

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-A-G016

Funding Year(s): 2009

GLFWRA Funding: $24,700 ***Total Non-federal Match/In-Kind:*** $34,800

Recipient: Great Lakes Indian Fish and Wildlife Commission

Investigator(s): William Mattes and Matthew Symbal

Sponsor: Great Lakes Indian Fish and Wildlife Commission

Restoration Study Goals Addressed: Goal I, Recommendations 8 and 12

Background: This project directly addresses the USFWS Great Lakes Fish and Wildlife Restoration Act goal to restore and maintain self-sustaining fish and wildlife resources by significantly reducing the incidental catch of lake trout in gillnet fisheries. The goal of this project is to estimate the change in catch rate and overall harvests of lake trout and lake whitefish associated with modifications made to a typical monofilament large-mesh gillnet used for in the commercial fishery of lake white fish.

Highlights: Nets have been set and retrieved as indicated in the project methods. Data has been entered into database and preliminary analyses have been conducted.

Partner(s): Red Cliff Band of Lake Superior Chippewa's

Title: Updating and tracking wetland changes in the Great Lakes

Status: Active ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-A-G015

Funding Year(s): 2009

GLFWRA Funding: $150,000 ***Total Non-federal Match/In-Kind:*** $50,000

Recipient: Ducks Unlimited

Investigator(s): Rob Macleod

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 10 and 11

Background: This project addresses the Great Lakes fish and/or wildlife restoration needs by contributing to the development of a consistent and accurate spatial data layer of Michigan wetlands that can be used to apply research results to conservation planning and modeling for fish and wildlife.

Highlights: Duck Unlimited has completed draft versions of the National Wetlands Inventory update for seventy seven counties in Michigan with one county currently in progress. More to come as this project continues to progress.

Partner(s): Michigan Department of Environmental Quality

Title: Rice Creek connectivity restoration project

Status: Active ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-A-G014

Funding Year(s): 2009

GLFWRA Funding: $48,600 ***Total Non-federal Match/In-Kind:*** $26,400

Recipient: Calhoun Conservation District

Investigator(s): Kristine Boley-Morse and Rick Pierson

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I and III, Recommendation 11

Background: The goal of this project is to restore floodplain ecosystem services including hydrologic retention, nutrient and sediment trapping, spawning, nesting, nursery habitats, and other habitat needs of fish and wildlife on Rice Creek.

Highlights: A geomorphic assessment station was installed on the site to monitor progress and changes pre and post culvert removal. Pictures and GPS points were also taken from various locations surrounding the project site. More details will follow when construction proceeds.

Partner(s): Calhoun County Conservation District, the Calhoun County Road Commission, the Calhoun County Drain Commissioner, the Jackson County Drain Commission, and Michigan Department of Environmental Quality

Title: Development of Non-Lethal Sampling Method for Disease Detection

Status: Active ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-A-G013

Funding Year(s): 2009

GLFWRA Funding: $112,000 ***Total Non-federal Match/In-Kind:*** $41,300

Recipient: Michigan State University

Investigator(s): Mohamed Faisal, Cheryl Murphy, and Jan VanAmberg

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals I and V, Recommendation 28

Background: One of the most limiting factors for the success of fisheries conservation and restoration is the threat posed by the presence of disease-causing microbes. Therefore there is a continuous need to monitor the presence of these pathogens in broodstocks, propagated fish, and wild fish stocks. This project will investigate non-lethal techniques for detecting pathogens or disease.

Highlights: Experimental infection of juvenile muskellunge was initiated according to the three exposure concentrations described under Task 1.1. in the proposal. Sampling of fish commenced on Day 1 post-infection and was continued in until Day 56 post-infection. As projected, the infection design allowed the development of acute, sub acute, and chronic disease course. Mortality in the chronically infected group was more than expected and therefore resulted in a final sampling time that was 14 days earlier than anticipated. Although not all tasks have been analyzed, we are extremely encouraged by the findings obtained thus far.

Partner(s): Michigan Department of Natural Resources

Title: Determining Migratory and Breeding Locations of Scaup Staging at Presque Isle, Erie, Pennsylvania

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-A-G012

Funding Year(s): 2009

GLFWRA Funding: $48,500 ***Total Non-federal Match/In-Kind:*** $31,200

Recipient: Pennsylvania Game Commission

Investigator(s): Kevin Jacobs, Dr. Shannon Badzinski, and Dr. Scott Petrie

Sponsor: Pennsylvania Game Commission

Restoration Study Goals Addressed: Goals III and VI, Recommendation 11

Background: The primary objective of this research project is to determine other spring migratory stopover sites and breeding grounds for lesser scaup that stage on the lower Great Lakes, as well as to determine staging residence times and how long it takes birds to arrive at their breeding areas. A second objective of the project is to evaluate the migration strategies of lesser scaup and determine the amount of variation in strategies among scaup. Presently, little information exists regarding how scaup move across the landscape during spring migration.

Highlights: Lesser scaup have been captured and tagged with internal satellite transmitters. Movement data from these birds is being summarized. The researchers have made some of the data available online via a GIS based map, available here: http://www.bsceoc.org/research/lpwwrf/index.jsp?lang=EN&targetpg=lpwscauperie

Partner(s): Long Point Waterfowl – Bird Studies Canada, Northwest Pennsylvania Duck Hunters Association, Pennsylvania Waterfowl Heritage Society, Wildlife For Everyone Foundation, and Susqehanna River Wetlands Trust

Title: Mapping Pelagic Bird Distribution and Abundance as a Decision-Making Tool for Off-Shore Wind Turbine Development and Conservation Planning

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-A-G011

Funding Year(s): 2009

GLFWRA Funding: $49,300 ***Total Non-federal Match/In-Kind:*** $28,500

Recipient: Ohio Department of Natural Resources

Investigator(s): Keith Lott, Megan Seymour, and Bob Russel

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: This project will create a temporally and spatially explicit depiction of waterbird distribution and abundance in Lake Erie which will be used to identify suitable areas for proposed offshore wind power generation developments, relative to bird habitat and use patterns. The results will be incorporated into Ohio Department of Natural Resources offshore wind power siting guidance, provided to the Great Lakes Wind Collaborative Wind Atlas workgroup, and used in conservation planning. In summary, this project will enable regulatory agencies to protect and conserve migratory birds and their habitat from potential adverse effects from offshore wind power projects, and promote the maintenance of self-sustaining migratory bird resources within Ohio's Lake Erie water.

Highlights: Though Lake Erie does not have the highest wind energy potential of the Great Lakes, its shallow waters and proximity to load centers (Toledo, Cleveland, Detroit, and Buffalo) make it more economically feasible for wind energy than some of the deeper lakes. There are currently no offshore wind turbine facilities within the United States, though European studies have shown that these facilities may have direct (mortalities) and indirect (avoidance and habitat loss) impact on migratory birds. In 2009 and 2010 the Division of Wildlife, in coordination with the U.S. Fish & Wildlife Service (USFWS), flew weekly surveys during the spring and fall migratory period to document the distribution and abundance of pelagic birds using Ohio's portion of Lake Erie. This information will be used to identify vital migratory or over-wintering areas in order to facilitate the siting of wind energy facilities in regions of Lake Erie that would minimize the likelihood of impacting pelagic birds.

Partner(s):

Title: Wetland Restoration and Openland Enhancement at French Creek Wildlife Area

Status: Completed ***Project Type:*** Upland Habitat Restoration

Agreement Number(s): 30181-A-G010

Funding Year(s): 2009

GLFWRA Funding: $14,000 ***Total Non-federal Match/In-Kind:*** $11,200

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Sara Kehrli

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: This project aims to restore 38 acres of grassland from a degraded cool season grassland field that currently has little plant diversity and is being invaded by spotted knapweed. Approximately 3 acres of open-water hemi marsh will also be created in an area that is currently degraded wet prairie/mesic prairie type wetlands.

Highlights: Approximately 3 acres of emergent marsh wetland were created with the removal of two old culverts and building the berm of the old township road higher. 38 acres of uplands were sprayed to kill cool season grasses, then replanted with native warm season grasses. In this 38 acres, 27 was also planted with a diverse forb mix. With further maintenance, this field will be a nice addition of almost 40 acres of native warm season prairie plants. This now completes a conversion of about 100 acres that was formerly degraded grasslands to high quality, naturally diverse prairie plantings. This should improve both nesting opportunities and brood rearing in these areas. The wetland restoration will provide some water in the area in which waterfowl can raise their young.

Partner(s):

Title: Chiwaukee Prairie Wetland Restoration

Status: Active ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-A-G009

Funding Year(s): 2009

GLFWRA Funding: $45,000 ***Total Non-federal Match/In-Kind:*** $15,000

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Marty Johnson, Hannah Spaul, Jerry Ziegler, Dave Clutter, and Pam Holy

Sponsor: Great Lakes Indian Fish and Wildlife Commission

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The Chiwaukee Prairie State Natural Area is a rare coastal wetland located on the southwestern shore of Lake Michigan. The proposed project on this site focuses on maintaining and restoring a rare coastal wetland community that supports several rare plant and animal species from the threats of invasive vegetation. In addition it seeks to find a management strategy that ensures the long term protection of the resource.

Highlights: On-going project, awaiting first report

Partner(s): The Nature Conservancy, Natural Resource Foundation, Chiwaukee Prairie Preservation Fund

Title: Avian migration within the Lake Superior coastal region of Minnesota

Status: Active ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-A-G006

Funding Year(s): 2009

GLFWRA Funding: $38,100 ***Total Non-federal Match/In-Kind:*** $41,600

Recipient: University of Minnesota - Duluth

Investigator(s): Dr. Gerald J. Niemi, Dr. Meredith Cornett, and Anna Peterson

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed: Goal VI, Recommendations 11 and 12

Background: This project will assess the timing, distribution, and relative abundance of fall migrants along the North Shore of Lake Superior. Another goal will be the examination of fine-scale stopover habitat selection during fall migration in the Lake Superior coastal region of Minnesota. Results from this project will help provide recommendations for conservation priorities to ensure protection of migratory bird populations by estimating the proportion of potential high quality stopover habitat in the Lake Superior coastal region.

Highlights: Funds from this grant were used to aid in the data entry of birds recorded during the 2009 migration. A portion of these funds will be used to fund the 2010 migration field season. Preparation for the 2010 migration season is underway as surveys begin mid-August 2010 and continue through early November 2010. Although not yet complete, over 22,000 birds representing over 120 species were recorded utilizing stopover habitat and actively migrating within the coastal region of Lake Superior.

Partner(s): The Nature Conservancy

Title: Evaluation of Lake Trout Spawning Reef Suitability in Illinois Waters of Lake Michigan

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-9-G032

Funding Year(s): 2008

GLFWRA Funding: $120,000 ***Total Non-federal Match/In-Kind:*** $40,000

Recipient: University of Illinois

Investigator(s): Sergiusz Czesny, Scudder D. Mackey, Rebecca Redman, and Christine Geddes

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goals I and III, Recommendations 11 and 12

Background: Identify suitable lake trout spawning habitat, measure egg deposition, and assess post-hatch survival at Julian's and Waukegan Reefs in southern Lake Michigan. Results will be incorporated into Lake Michigan Lake Trout Working Group reports and used to evaluate progress toward objectives listed in A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan. Restoring self-sustaining native lake trout, an important recreational and commercial species, through stocking and sea lamprey control has been an important focus for the USFWS, States, and Tribes in the Great Lakes since the 1960's.

Highlights: Based on sidescan sonar data, multiple sites exhibit physical habitat characteristics deemed suitable for lake trout spawning on both Waukegan and Julian's Reefs. These were targeted with egg traps to validate whether or not they are actively used as spawning habitat. No intact eggs or egg chorions were found in egg traps deployed over either reef.

Partner(s): University of Michigan

Title: Brook Trout Habitat Protection and Restoration in the Salmon Trout River Watershed

Status: Completed ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-9-G031

Funding Year(s): 2008

GLFWRA Funding: $73,400 ***Total Non-federal Match/In-Kind:*** $24,500

Recipient: Superior Watershed Partnership

Investigator(s): Geraldine Larson

Sponsor: Keweenaw Bay Indian Community

Restoration Study Goals Addressed: Goals I and III, Recommendation 11 and 12

Background: Reduce sedimentation at several sites and improve passage for fish and other aquatic organisms at one site in the Salmon Trout River watershed in Marquette County, Michigan. This project will prevent further habitat degradation and make additional habitat available for fish spawning, rearing, and feeding. The lower Salmon Trout River is home to one of the last surviving populations of naturally reproducing coaster brook trout in the Lake Superior basin.

Highlights: Over 5 miles of stream habitat were restored in the Salmon Trout River when a stream crossing structure was removed, eliminating a barrier to fish passage. The project also reduced an estimated 73 tons of sediment input to the system by improving the road approaches at the priority road/stream crossing site. Another component of this project was the installation of six log check dam structures and one log revetment in the upper reaches of Murphy's Creek to reduce velocity and dissipate energy in steep gradient sections of stream and increase deposition of bed-load materials. This project also established baseline data for long-term evaluation of coaster brook trout habitat in the lower Salmon Trout River including documentation of physical stream characteristics and sediment loading. The completion of this project along with the cooperation of partners increased awareness of the problems in the watershed.

Partner(s): Michigan Department of Natural Resources, Keweenaw Bay Indian Community, Northern Michigan University, Michigan Technological University, and Huron Mountain Club

Title: Evaluation of Habitat Remediation in Thunder Bay Lake Huron, on Lake Trout Spawning Success

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-9-G029

Funding Year(s): 2008

GLFWRA Funding: $64,000 ***Total Non-federal Match/In-Kind:*** $32,900

Recipient: Michigan Department of Environmental Quality

Investigator(s): Janice Adams, J. Ellen Marsden, James Johnson, and Natalie Dingledine

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals III and V, Recommendations 11 and 12

Background: The goal of this project is to enhance a degraded spawning reef in Lake Huron near Alpena, Michigan and evaluate the effect on spawning success of lake trout. This project will provide information necessary to make management decisions regarding reef construction as a tool for increasing spawning and survival of lake trout. Restoring self-sustaining native lake trout, an important recreational and commercial species, through stocking and sea lamprey control has been an important focus for the USFWS, States, and Tribes in the Great Lakes since the 1960's.

Highlights: Pre-construction fry density data have been collected on a natural, unimpacted reef (East Reef), on the impacted reef (CKD), and a heavily silted natural reef (Cement Plant). These data serve as a baseline to evaluate spawning success on the constructed reefs in 2011-2012. Monies from grant have enabled us to purchase 90 egg bags and will allow us to purchase additional fry traps for use next spring. Fry trapping results are encouraging; fry density on the natural reef, East Reef, is comparable to fry densities measured in Parry Sound, Lake Huron, where there is a self-sustaining population. In contrast, the impacted reef and adjacent CKD Reef did not yield any fry; both reefs are heavily infilled with silt and do not have the interstitial spaces that are needed for lake trout egg entrainment and subsequent incubation. In addition to lake trout fry, we also collected *Hemimysis anomala* (bloody red shrimp) in the fry traps; this is the first sighting of this exotic species in western Lake Huron and provides a valuable early warning of the potential effects of the species on the littoral food web.

Partner(s): University of Vermont, Michigan Department of Natural Resources

Title: Great Lakes Spotted Muskellunge Restoration Natural Spawning Effort and Recruitment Evaluation

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-9-G028

Funding Year(s): 2008

GLFWRA Funding: $62,600 ***Total Non-federal Match/In-Kind:*** $38,800

Recipient: Wisconsin Department of Natural Resources

Investigator(s): David Rowe, James Diana and Mike Donofrio

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 11 and 12

Background: The goal of this project is to evaluate the current muskellunge spawning activity in the Green Bay, Wisconsin area and develop management recommendations to restore a self-sustaining population. Once an important component of the fishery, and key native predator, in southern Green Bay, muskellunge were decimated during the early to mid-1900's by habitat destruction, pollution, and overexploitation.

Highlights: Menominee River muskellunge preferred spawning in areas with low to moderate bottom slopes, where woody debris was present, where there was medium vegetative coverage, and in substrates containing silt. Based on electivity and model results, muskellunge were preferentially selecting specific habitat as spawning areas. Utilizing these identified habitat preferences allowed successful modeling of spawning areas that effectively identified known spawning locations. Two modeling types were utilized, Maxent and classification trees. The Maxent model proved most effective at predicting additional potential spawning locations and correctly classifying known spawning sites. Classification tree models present a useful management tool to guide habitat restoration in rehabilitation areas to increase muskellunge spawning habitat potential.

Potential management implications of this project and model results include identification of suitable stocking locations, critical habitat designation to protect important spawning locations, as well as targeting areas for projects designed to rehabilitate muskellunge spawning habitat. Habitat preferences identified by classification tree models can serve as important guidelines during future restoration projects.

Partner(s): University of Michigan, Musky Clubs Alliance of Wisconsin, and other local angler clubs

Title: Surveillance of Botulism E Related Mortality in Waterbirds on the Wisconsin Great Lakes

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-9-G027

Funding Year(s): 2008

GLFWRA Funding: $28,400 ***Total Non-federal Match/In-Kind:*** $9,000

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Sean Strom, Julie Langenburg, and Mike Meyer

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal VI, Recommendations 3 and 12

Background: Evaluate the scope and scale of waterbird mortality due to Type E botulism (BotE) in the Wisconsin Great Lakes region, with a specific focus on impacts to loons. BotE has been implicated in waterbird die-offs on the Great Lakes since the 1960's and has been responsible for thousands of avian deaths. Monitoring BotE is important given the potential impacts to birds including common loons, gulls, mergansers, and other migratory waterfowl.

Highlights: Survey transect sites were established along 300 miles of the Door County Peninsula, Wisconsin shoreline. No large scale mortality events were observed during either the 2008 or 2009 transect year. The low number of mortalities seen during the Wisconsin Department of Natural Resources surveillance efforts was similar to the low numbers of mortalities observed in other Great Lakes states. However, the small number of positive Bot E cases observed in both 2008 and 2009 suggest a constant, low level presence of the botulism toxin in the waters surrounding the Door County peninsula.

Partner(s):

Title: Spatial and Temporal Components of Variation in Great Lakes Percid Populations: Implications for Conservation and Management

Status: Active ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-9-G026

Funding Year(s): 2008

GLFWRA Funding: $67,900 ***Total Non-federal Match/In-Kind:*** $53,200

Recipient: Michigan State University

Investigator(s): Dan Hayes, Tyler Wagner, James R. Bence, Brian Irwin, and Nigel Lester

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 7 and 12

Background: Provide recommendations for surveys of yellow perch and walleye populations in the Great Lakes basin. Surveys are the primary means for collecting data on fish populations in the basin and are often used to evaluate the success of restoration efforts and improve our understanding of population changes over time. Restoration of native percid populations in the Great Lakes is priority for the USFWS.

Highlights: This project relied on multiple agencies providing long-term data series, and we received contributions from several sources across the Great Lakes Basin. Partitioning total variability into component temporal and spatial sources is a powerful approach to better understand ecological time series data and for elucidating population trends. As an alternative to using the Gaussian distribution, we developed new negative binomial mixed models to quantify both spatial and temporal variability. We applied these newly developed models to several fishery-independent surveys across the Great Lakes basin. The analyzed data represented over 11,000 gillnet sets and almost 350,000 collected percids. We developed a highly flexible simulation tool to evaluate different sampling designs with respect to their statistical power to detect temporal trends. We have also prepared the first complete manuscript planned for submission to a peer-reviewed journal (others anticipated). This project is the focus of 3 professional conference abstracts. We had several interactions with data providers as well as additional outreach activities over the course of this project and have identified areas for future research.

Partner(s): United States Geological Survey – Pennsylvania Cooperative Fish hand wildlife Research Unit and Ontario Ministry of Natural Resources

Title: Saginaw Bay Lake Plain Prairie and Oak Opening Restoration Project

Status: Active ***Project Type:*** Upland Habitat Restoration

Agreement Number(s): 30181-9-G025

Funding Year(s): 2008

GLFWRA Funding: $90,000 ***Total Non-federal Match/In-Kind:*** $30,000

Recipient: Michigan Department of Natural Resources

Investigator(s): Dan Kennedy and Ryan O'Connor

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: Restore 300 acres of lake-plain prairie and oak openings for birds, reptiles, amphibians and plants in the Saginaw Bay region, Michigan. This area provides important migratory, breeding, and non-breeding habitat for numerous waterfowl and other migratory birds. Endangered, threatened, and special concern species such as American bittern, common tern, marsh wren, yellow-headed blackbird, spotted turtle, and eastern prairie-fringed orchid will also benefit.

Highlights: At the MNA Saginaw Bay Wetlands Nature Sanctuary, fire breaks were constructed around lakeplain prairie restoration management units 4-6 (Figure 1) totaling 15 acres. These burns will be completed in Spring, 2011. Michigan Natural Features Inventory (MNFI) conducted prairie-fringed orchid surveys at the Michigan Nature Association's (MNA) Saginaw Bay Wetlands Nature Sanctuary (Figure 2). Transect lines were walked throughout the property and 260 plants were observed. Prairie-fringed orchids will be used as an indicator species to determine how lakeplain prairies will respond to habitat management as part of this restoration project. Approximately 10 acres of brush was removed from the Berger Road lakeplain prairie at Fish Point State Wildlife Area, Tuscola County, Michigan (Figure 3). Approximately 10 acres of brush was mowed and treated with herbicide at Wildfowl Bay State Wildlife Area.

Partner(s): Michigan Natural Features Inventory

Title: Glacial Habitat Restoration Area and Rush Lake Initiative to Restore and Enhance Wetlands and Associated Uplands Habitat

Status: Completed ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-9-G024

Funding Year(s): 2008

GLFWRA Funding: $30,000 ***Total Non-federal Match/In-Kind:*** $28,600

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Bryan Woodbury

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The goal of this project was the restoration of 30 acres of wetlands and 100 acres of uplands within the Glacial Habitat and Rush Lake restoration areas in southeast Wisconsin. Restoring these habitats will provide critical breeding and migratory habitat for waterfowl, shorebirds, colonial waterbirds, and migratory songbirds per the goals of the North American Wetland Management Plan.

Highlights: The goals were met with the restoration of 15 wetland basins totaling 31 acres and the replanting of 104 acres of upland prairie grasses and forbs. This project falls under the Glacial Habitat Restoration Area's goal of establishing 38,600 acres of grassland nest cover and the restoration of 11,000 acres of wetlands.

Partner(s):

Title: Lake Erie Watershed Wetland Restoration Program

Status: Completed ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-9-G023

Funding Year(s): 2008

GLFWRA Funding: $50,000 ***Total Non-federal Match/In-Kind:*** $20,000

Recipient: Ducks Unlimited

Investigator(s): Roy Kroll

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The goal of this project is to restore 100 acres of wetlands in the Lake Erie watershed in Ohio. Restoring these wetlands will improve water quality and increase habitat available for breeding, migrating, and wintering waterfowl and other wetland-dependent fish and wildlife, including several threatened and endangered species. Several waterfowl species in the watershed have been categorized in the North American Waterfowl Management Plan (NAWMP) as "high conservation priority." This project is a continuation of Ohio Department of Natural Resources-DOW's efforts in which over 4000 acres of wetlands have been restored.

Highlights: The first year of this project funded the restoration of 84 acres of emergent wetlands at six locations in Ashtabula and Trumbull counties, Ohio. Wetlands were restored by breaking drain tiles, plugging drainage ditches, constructing low-level earthen berms, and installing water control structures where needed. Buffer zones of at least 100 feet were planted with native vegetation. Additional work will complete the 100 acre goal listed in the proposal.

Partner(s): Ohio Department of Natural Resources

Title: The Importance of the Larval State of Cisco Recruitment Variation in the Great Lakes

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-8-G018, 30181-8-G046

Funding Year(s): 2007 and 2008

GLFWRA Funding: $223,300 ***Total Non-federal Match/In-Kind:*** $169,900

Recipient: Chippewa Ottawa Resource Authority and Michigan State University

Investigator(s): Mark Ebener, Dan Yule, Randy Claramunt, Ken Cullis, Mike Jones, Seth Moore, Henry Quinlan, Mike Seider, Don Schreiner, Shawn Sitar, Jason Stockwell, and Jared Myers

Sponsor: Chippewa Ottawa Resource Authority

Restoration Study Goals Addressed: Goal I, Recommendations 4, 6, and 13

Background: This project is designed to evaluate possible impediments to cisco recruitment in the Great Lakes. Cisco were once the most abundant native prey fish in the Great Lakes and supported the largest freshwater commercial fishery in North America. Understanding impediments to recruitment will augment development of interagency rehabilitation plans for this important native species. Cisco restoration is a high priority for the USFWS in the Great Lakes.

Highlights: Inclement weather in 2008 delayed this ongoing project which will require field work into the 2012 field season. Larval and adult cisco surveys have been conducted using trawls and gillnets. Maps showing cisco abundance have been included in progress reports. Researchers are also using hydro-acoustic echo-sounders, larval fish trawls, and zooplankton nets to determine abundance and food availability for this important fish.

Partner(s): Minnesota Department of Natural Resources, Michigan Department of Natural Resources, Wisconsin Department of Natural Resources, United States Geological Survey - Gulf of Maine Research Institute, United States Geological Survey - Great Lakes Science Center, Michigan State University, Grand Portage Band of Chippewa's, and Gulf of Maine Research Institute

Title: Identifying Potential Lake Trout Spawning Habitat in Lake Erie

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-8-G021

Funding Year(s): 2007

GLFWRA Funding: $85,400 ***Total Non-federal Match/In-Kind:*** $41,800

Recipient: Ohio Department of Natural Resources

Investigator(s): Ann Marie Gorman, Scudder D. Mackey, Patricia M. Kocovsky, Tom MacDougall, Hans Biberhofer, and James Markham

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 10 and 11

Background: The goal of this project is to evaluate the utility of new GIS tools and field equipment to verify habitat suitable for lake trout spawning based on comparisons with environmental characteristics from historic spawning sites. Locating high-quality lake trout spawning habitats will help identify potential lake trout stocking sites and further advance rehabilitation efforts in Lake Erie. Restoring self-sustaining native lake trout, an important recreational and commercial species, through stocking and sea lamprey control has been an important focus for the USFWS, States and Tribes in the Great Lakes since the 1960's.

Highlights: The use of modern GIS tools and upgraded sonar technology allowed researchers to more precisely identify certain habitats in Lake Erie. Several historic lake trout spawning areas were surveyed and found to have increased sedimentation and an abundance of zebra mussels. The new technology allowed researchers to update substrate maps which were out-of-date and in some cases incorrect.

Partner(s): Ontario Ministry of Natural Resources, National Water Research Institute, New York Department of Environmental Conservation, and United States Geological Survey

Title: Genetic Population Structure of Lake Whitefish in Lake Huron

Status: Active ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-8-G020

Funding Year(s): 2007

GLFWRA Funding: $49,000 ***Total Non-federal Match/In-Kind:*** $16,300

Recipient: University of Michigan

Investigator(s): Wendylee Stott, Mark P. Ebener, Lloyd C. Mohr, Kathleen Koorhan

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 12, 13, and 29

Background: The goal of this project is to determine the genetic stocks of lake whitefish in Lake Huron and the adjoining Great Lakes. This genetic stock information is required for scientifically sound management in order to help maintain the diversity of lake whitefish, to set safe harvest levels, and to ensure a self-sustaining fishery. Scientifically sound lake whitefish management is a high priority for the USFWS in the Great Lakes.

Highlights: Lake whitefish genetic samples from were taken from lakes Huron, Superior and Michigan. Over 2,300 individual samples were used to identify genetic stocks of lake whitefish. The data were used to examine stock structure in the northern main basin and compare the results to those of a recent tagging study. Genetic data from Great Lakes Science Center forage assessments were used to determine which stocks are being sampled by assessment surveys in the northern main basin.

Partner(s): United States Geological Survey Wisconsin Cooperative Fishery Research Unit, and University of Wisconsin-Stevens Point

Title: Ashland Flats State Wildlife Management Area Grassland Restoration Project

Status: Active ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-8-G017

Funding Year(s): 2007

GLFWRA Funding: $56,962.50 ***Total Non-federal Match/In-Kind:*** $18,987.50

Recipient: Ducks Unlimited

Investigator(s): Doug Gorby, Sarah Fleming, Irene Mazzocchi

Sponsor: New York Department of Environmental Conservation

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The Ashland Flats State Wildlife Management Area (WMA) is located with the St. Lawrence Valley in Jefferson County, New York. This WMA contains over 2,000 acres of crucial bird (both migratory and indigenous) habitat. This project's focus is the removal of invasive vegetation and the restoration of native grasslands. This project addresses regional habitat restoration goals for certain bird species in the North American Waterfowl Management Plan—Atlantic Coast Joint Venture and in the Partners in Flight Landbird Conservation Plan: Bird Conservation Region 13—Lower Great Lakes/St. Lawrence Plain.

Highlights: Early removal of exotic vegetation on this project was a success, however, inclement weather and rocky soils have made slowed the completion of this project. Further herbicide and disking will be employed to accomplish the project goals. Native grassland communities have been restored at some locations and site conditions have been improved for further maintenance and management of the WMA.

Partner(s): New York Department of Environmental Conservation

Title: Poor Quality of Spawning Habitat: A serious impediment to cisco rehabilitation in the Great Lakes

Status: Active ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-8-G016

Funding Year(s): 2007

GLFWRA Funding: $74,602 ***Total Non-federal Match/In-Kind:*** $33,393

Recipient: University of Michigan

Investigator(s): Kathryn DeWitt, Edward S. Rutherford

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 11 and 12

Background: Evaluate the suitability of cisco spawning habitat in Green Bay, Lake Michigan to determine whether degraded conditions at this historic spawning area represent a serious impediment to cisco rehabilitation. Understanding habitat conditions will help determine where stocking and reintroduction of cisco, once the most prolific native prey fish in the Great Lakes, is appropriate. Cisco restoration is a high priority for the USFWS in the Great Lakes.

Highlights: The management implications of our work are that efforts to improve water quality in Green Bay through nutrient reductions have worked. Dissolved oxygen concentrations in winter would now permit good survival of young lake herring and other fishes, thus improving suitability of spawning and nursery habitats. Thus, management efforts now underway to restore lake herring would not go to waste given that environmental conditions are now suitable.

Partner(s): Michigan Department of Natural Resources and United States Geological Survey – Great Lakes Science Center

Title: Estimating spawning date, hatch date, and strain contribution for lake trout at Lake Michigan's Mid Lake Reef complex

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-6-G108, 30181-8-G019

Funding Year(s): 2006 and 2007

GLFWRA Funding: $172,600 ***Total Non-federal Match/In-Kind:*** $63,000

Recipient: University of Wisconsin – Milwaukee

Investigator(s): John Janssen, Brian Sloss, and Jeffery Allen

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendations 11 and 12

Background:

This project was funded to evaluate lake trout spawning success and identify which strains are best suited for stocking efforts on deep spawning reefs in Lake Michigan. Restoring native a self-sustaining population of lake trout, an important recreational and commercial species, through stocking and sea lamprey control has been an important interagency focus in the Great Lakes since the 1960's.

Highlights:

The researchers found that temperatures could vary significantly with a 10M depth difference between reefs. While most of the spawning occurred between mid-October and Mid-November, estimated hatch dates ranged over two months. The genetics objective of this project led to a recommendation of further research to find more genetic markers between the multiple strains of stocked and native lake trout.

Partner(s): United States Geological Survey – Wisconsin Cooperative Fishery Research Unit, and the United States Geological Survey Great Lakes Science Center

Title: Lake St. Clair coastal wetland enhancement

Status: Completed ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-6-G110

Funding Year(s): 2006

GLFWRA Funding: $56,468 ***Total Non-federal Match/In-Kind:*** $23,251

Recipient: Ducks Unlimited

Investigator(s): Russel Terry, Heather Braun, and Ernie Kafcas

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: The State of Michigan has lost over 50% of its wetlands. One of the major contributors to wetland degradation is the rampant growth of exotic wetland plant species. Phragmites (common reed) is a species of plant that forms dense monotypic stands which displace native vegetation and provide little value to fish and wildlife. The goal of this project was to restore over 300 acres of coastal wetland associated with the St. Clair Flats of Lake St. Clair in Michigan.

Highlights: Chemical herbicides as well as prescribed burns and flooding were used to remove Phragmites from over 300 acres of coastal wetland. The chemicals were applied from a helicopter. When the plants had browned, the areas were flooded to hinder reestablishment. When condition allow, the area will be drained and burned to continue this removal process. Native plants will be reintroduced when the Phragmites is under control.

Partner(s): Michigan Department of Natural Resources

Title: Modeling historic and temporal variation of Great Lakes walleye maturation schedules

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-6-G107

Funding Year(s): 2006

GLFWRA Funding: $75,170 ***Total Non-federal Match/In-Kind:*** $30,186

Recipient: University of Michigan

Investigator(s): Tomas O. Höök, Hui-Yu Wang, Kevin Wehrly, Troy Zorn, Kevin Kayle, Lars Rudstam, and Scott Peacor.

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 12

Background: The goal of this project was to identify Great Lakes walleye populations at risk of over-harvest and provide harvest recommendations to maximize yield and minimize genetic changes to the population. Harvest levels based on ecological and genetic diversity are essential for restoring and maintaining healthy Great Lakes walleye populations.

Highlights: The researchers calculated age and size specific probabilities of maturity, and use established statistical approaches to estimate and statistically compare mean population parameters. Their findings pointed out the need to standardize collection and aging protocols, at the least, the need to account for sampling-induced biases when comparing maturation schedules. Another interesting off-shoot of this project was the recognition of looking at egg size between sizes and populations of Great Lakes walleye.

Partner(s): Ontario Ministry of Natural Resources, Ohio Department of Natural Resources, New York State Department of Environmental Conservation, Cornell University

Title: Linking yellow perch movements to nearshore bottom substrate

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-6-G105

Funding Year(s): 2006

GLFWRA Funding: $95,966 ***Total Non-federal Match/In-Kind:*** $31, 999

Recipient: University of Illinois

Investigator(s): Sergiusz Czesny, Karen Stainbrook, John M. Dettmers, and Dan Makauskas

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendation 11 and 12

Background: Yellow perch are the most popular recreationally caught fish in Lake Michigan and recently the population has declined rapidly. Previous studies have shown yellow perch spawn in areas with hard substrate present. The goal of this project was to compile substrate data along with yellow perch catch and tagging data to describe yellow perch spawning and movements in nearshore habitats of Lake Michigan.

Highlights: Sediment and substrate data was compiled from 26 sources to provide 1,682 data points within the Illinois waters of Lake Michigan. The study identified the transition areas (which are too numerous to list here) and characterized the substrate changes in geographic reference to cities along Lake Michigan. One hundred thirty seven net nights of fish sampling captured fish to use for a tagging study to determining site fidelity. Overall, it was determined yellow perch had a higher site fidelity toward larger, courser substrates.

Partner(s): Illinois Department of Natural Resources, Great Lakes Fishery Commission, and Illinois Natural History Survey

Title: Boggy bottoms wetland restoration

Status: Completed ***Project Type:*** Wetland Habitat Restoration

Agreement Number(s): 30181-6-G104

Funding Year(s): 2006

GLFWRA Funding: $54,263 ***Total Non-federal Match/In-Kind:*** $18,136

Recipient: Ducks Unlimited

Investigator(s): Heather Brauns and Scott Butterworth

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: This project was designed to restore a 50 acre wetland in northwest Ohio. The majority of the wetlands surrounding the great lakes were converted to agricultural fields. This degraded habitat fragments wildlife and aquatic organisms and does not provide valuable cover to migratory birds. An emergent wetland on Pickeral Creek Wildlife Area was chosen as a habitat restoration site.

Highlights: Funding from this grant was to construct a water control structure and pump system to manage water levels to mimic natural hydrology. A 2,700 ft. earthen levy was built and old field drain tiles were removed to return this wetland to a functioning state. Restoration of this wetland should lead to increased use by wildlife, native vegetation and migratory birds. As a benefit to the rest of the Sandusky River watershed, this wetland will help buffer floodwaters and contain sediment.

Partner(s): Ohio Department of Natural Resources

Title: Development of a GIS for Great Lakes aquatic habitat

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-3-J230(A), 30181-3-J230(B), 30181-6-G109

Funding Year(s): 2003, 2005, and 2006

GLFWRA Funding: $439,500 ***Total Non-federal Match/In-Kind:*** $163,400

Recipient: University of Michigan

Investigator(s): Edward Rutherford, James Johnson, Paul Seelbach, Mark MacKay, Donna Myers, Scott Nelson, Troy Zorn

Sponsor: Michigan Department of Natural Resource

Restoration Study Goals Addressed: Goals III, Recommendations 1, 10, and 11

Background: This project provided additional funding for the further development of a Great Lakes Basin wide GIS database. Synthesis of existing habitat inventories is the first step toward sustainable management of natural resources. This inventory will allow for United States and Canada to plan for all of the Lakes future, monitor its status and target the most cost-effective restoration efforts.

Highlights: A universal, readily accessible data-base describing habitat and biological features in the Great Lakes was developed to support data sharing and holistic management. The GIS base maps will serve as a decision support tool to provide information to address issues identified in the Lake-wide Management Plans. Funding for the GIS-based projects eventually led to the creation of the Great Lakes Information Network in 2007 and made it available for public consumption via the Great Lakes Commission web site (http://gis.glin.net).

Partner(s): United States Geological Survey, Ontario Ministry of Natural Resources, and Ontario Ministry of Natural Resources

Title: Developing and Testing Models of Cisco Population Dynamics in Lake Superior

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-5-G135

Funding Year(s): 2005

GLFWRA Funding: $95,966 ***Total Non-federal Match/In-Kind:*** $31,999

Recipient: Michigan State University

Investigator(s): Mike Jones, Jason Stockwell, and Daniel Yule

Sponsor: Great Lakes Indian Fish and Wildlife Commission

Restoration Study Goals Addressed: Goal I, Recommendations 12 and 13

Background: Reestablishment of lake herring throughout their historic range is a priority for management agencies. Lake Superior, the only Great Lake where viable populations of lake herring still exist, can serve as a model system for understanding lake herring population dynamics and the factors that influence recruitment. The goals of this project were to (1) Examine evidence for biotic and abiotic controls on cisco demographics in Lake Superior; (2) Develop a mechanistic model that includes known and hypothesized processes influencing cisco population dynamics; (3) Apply the model to assess conditions under which specific processes might strongly influence cisco dynamics in Lake Superior, and run simulations to assess which specific processes may be important in the lower Great Lakes;

Highlights: This study greatly increased the knowledge of Great Lakes Cisco populations. Cisco reproduction is highly variable from year to year depending on environmental conditions as well as the abundance of rainbow smelt. Several reports and peer reviewed articles were produced due to the funding of this project.

Partner(s): United States Geological Survey – Great Lakes Science Center

Title: Responses of Lake Trout and Chinook Salmon to Unprecedented Declines in Major Prey Fish Abundance in Lake Huron

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-5-G124

Funding Year(s): 2005

GLFWRA Funding: $142,000 ***Total Non-federal Match/In-Kind:*** $93,575

Recipient: Michigan State University

Investigator(s): James Bence, Ji X. He and James Johnson

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendation 7, 9, 12, and 13

Background: Alewife and rainbow smelt reached an unprecedented low biomass in Lake Huron during 2003 and 2004, with large individuals being particularly scarce. Coincident with the decline in prey fish biomass, growth and body condition of Chinook salmon and older lake trout declined to the lowest levels seen in the Great Lakes outside Lake Superior. Maturity schedules have also changed, but in complex ways. The contrast afforded by these new conditions provides a unique opportunity: we propose to carefully evaluate how predators' consumption, growth, body condition, and maturity schedule respond to these low prey abundances. Our project will improve our understanding, predictive ability, and ability to manage. This project will combine collecting new information with analysis of long-term data from ongoing sampling programs.

Highlights: "Chinook salmon are capable of consuming substantially more prey per unit biomass than lake trout and over a life span they consume substantially more biomass per recruit to the population because they have higher maximum growth rates and thus achieve their life time consumption while suffering less mortality along the way. Even after substantial declines in growth and consumption this remained true for fish that recruited to the fish eating and fishable populations." (excerpt from final report)

Partner(s): Michigan Department of Natural Resources, United States Geological Survey – Great Lakes Science Center, Chippewa Ottawa Resource Authority, and Ontario Ministry of Natural Resources

Title: Lake Erie water snake recovery plan implementation: Demographic responses to invasive round gobies

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-5-G123

Funding Year(s): 2005

GLFWRA Funding: $40,912 ***Total Non-federal Match/In-Kind:*** $31,362

Recipient: Northern Illinois University

Investigator(s): Richard B. King, Kristin M. Stanford and Peter Jones

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendation 12

Background: The Lake Erie water snake is endemic to the American and Canadian islands of western Lake Erie. This population has shown a history of decline. In recent years, Lake Erie water snakes have received protection through state and federal agencies. It is listed as endangered in Canada and threatened in the United States Since the invasion of the round goby in the Great Lakes, the Lake Erie water snake population has shifted diets. This study was designed to look at the response of the snakes to the shift in diet.

Highlights: The Lake Erie water snake has adapted well to the change in the available prey base. The invasive round goby now comprises over 90% of water snake diet. This has led to an increase in growth, body size and fecundity in Lake Erie water snakes. A laboratory portion of this study allows researchers to determine adult water snakes would eat round gobies at a rate three to seven percent of their body weight per day if given a constant supply of gobies. Field observations of free ranging snakes found that snakes would swim up to 229 meters from shore to find gobies.

Partner(s):

Title: Lake Sturgeon Rehabilitation Using Stream-Side Rearing Facilities

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-5-G122

Funding Year(s): 2005

GLFWRA Funding: $40,000 ***Total Non-federal Match/In-Kind:*** $13,333

Recipient: Wisconsin Department of Natural Resources

Investigator(s): Bradley Eggold, Steven Hogler, Steve Fajfer, Marty Holtgren, Marc White, and Brian Sloss

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendation 12

Background: Juvenile lake sturgeon imprint on their natal streams and return to them to spawn almost two decades later. While, this is an interesting life history fact, it complicates things for restoration efforts of this species. Since wild fish are typically brought into the hatchery, spawned, and the juveniles raised at the hatchery. The problem with that is the juvenile sturgeon are imprinting on the hatchery's water source, which may not be their natal stream.

Highlights: Funds from this grant were used to purchase equipment and tags for use in a stream-side rearing facility. Water from the lake sturgeon natal stream will be used to raise the fish through its vulnerable life stage. A major step forward in this project was an agreement with Biomark for the purchase of 12,000 PIT tags at a discounted cost. The discounted price allowed the team to purchase 2,350 tags more tags than were originally quoted. These tags should last at least four years, based on estimated production figures.

Partner(s): Little River Band of Ottawa Indians, University of Wisconsin – Stevens Point, and Riveredge Nature Center

Title: Identification of Putative Pheromones in Lake Trout

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-5-G121

Funding Year(s): 2005

GLFWRA Funding: $103,976 ***Total Non-federal Match/In-Kind:*** $34,660

Recipient: Michigan State University

Investigator(s): Sang Seon Yun

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal 5, Recommendation 12

Background: It has been suggested that lake trout employ pheromones to communicate with each other to coordinate their reproduction. In lake trout and rainbow trout, previous studies have linked the source of pheromone compounds to bile. If these compounds can be synthesized, they could attract lake trout to reefs to encourage spawning.

Highlights: Samples of bile and feces were collected from four separate life stages of lake trout (fingerlings, yearlings, juveniles, and adults). Chemicals suspected to be pheromones were identified from the samples. These samples were introduced into raceways containing lake trout to observe any effects on the fish. Unfortunately, no reliable behavioral actions were noticed in the study fish.

Partner(s):

Title: Quality control of proposals

Status: Completed ***Project Type:*** Project Planning

Agreement Number(s): 30181-3-J231(A), 30181-3-J231(B), 30181-3-J231(C)

Funding Year(s): 2003, 2004, and 2005

GLFWRA Funding: $36,000 ***Total Non-federal Match/In-Kind:*** $15,863

Recipient: Great Lakes Fishery Commission

Investigator(s): Charles Krueger

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed:

Background: This project will establish a management program for the research proposal process in 2004 and 2005. The goal for the program is to ensure that when research projects are undertaken with Restoration Act funds that projects are well integrated with existing knowledge. The project must also have understandable objectives, explicit methodologies to accomplish the objectives, appropriate experimental designs, and connect statistical analytic procedures. This project will establish consistent standards by which to judge full proposals and be used in decision-making regarding which proposals to fund.

Highlights: The proposal review process has changed substantially since this project and is currently a strong partner led process that centers around the Proposal Review Committee, made up of State and Tribal Representatives.

Partner(s):

Title: Dynamics and Biology of Siscowet Lake Trout in Lake Superior

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-4-J260

Funding Year(s): 2004

GLFWRA Funding: $81,498 ***Total Non-federal Match/In-Kind:*** $27,166

Recipient: Michigan State University

Investigator(s): James Bence

Sponsor: Great Lakes Indian Fish and Wildlife Commission

Restoration Study Goals Addressed: Goal 5, Recommendation 12

Background: This study compiled data obtained from 1975 through 2006 in an effort to describe the Lake Superior siscowet lake trout population. In recent years, there was anecdotal information that siscowet lake trout forms were becoming more abundant than the lean form. Data was obtained from Michigan Department of Natural Resources, Chippewa Ottawa Resource Authority, Great Lakes Indian Fish and Wildlife Commission, Red Cliff Fishery Department, and the USFWS.

Highlights: Data from over 13,000 lake trout were used to describe trends in abundance, age and size composition, growth rates, and diets. Researcher found an increase in abundance estimates but decreases in length at age (growth) and weight at age (condition) during the survey period. Estimates were also made about the carrying capacity and productivity of Lake Superior. The investigators also studied the overlap of diets between the lean and siscowet lake trout forms.

Partner(s): Michigan Department of Natural Resources, Chippewa Ottawa Resource Authority, and Red Cliff Fishery Department

Title: Huron-Erie Corridor System Habitat Assessment- Changing Water Levels and Effects of Global Climate Change

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-4-J259

Funding Year(s): 2004

GLFWRA Funding: $34,107 ***Total Non-federal Match/In-Kind:*** $14,455

Recipient: Ohio State University

Investigator(s): Scudder D. Mackey, Jeffrey M. Reutter, Jan J.H. Ciborowski, Robert C. Haas, Murray Charlton, and Russell Kries

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal 3, Recommendation 10 and 11

Background: The Huron-Erie corridor (HEC) system is defined as St. Clair River, Lake St. Clair and the Detroit River. This system, connecting Lakes Huron and Erie, has an extensive delta system that creates a vast amount of spawning and nursery habitat for fish as well as important habitat for migratory birds. This study examined the physical habitat of the HEC to determine the effects of climate change on the system.

Highlights: By mapping the HEC with high resolution bathymetry, the investigators were able to determine the amount of habitat be lost if water levels receded. The study predicts a loss of 22,000 ha (85 square miles) if lake levels fall by one meter. This dramatic loss of habitat would affect documented spawning areas of many important sport and forage fish.

Partner(s): Habitat Solutions, University of Windsor, Environment Canada, and United States Environmental Protection Agency

Title: A Biophysical Model of Lake Erie Walleye Recruitment: Explaining Historical Recruitment and Anticipating Consequences of Future Climate Change

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-4-J258

Funding Year(s): 2004

GLFWRA Funding: $97,272 ***Total Non-federal Match/In-Kind:*** $32,424

Recipient: Michigan State University

Investigator(s): Michael L. Jones, Brian J. Shuter, Yingming Zhao

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendation 12

Background: Lake Erie supports a large and complex walleye fishery with contributing stocks managed by four states and Ontario. The Lake Erie Committee relies on the use of fishery models to manage walleye stocks. The goal of this project was to determine the effectiveness the ELCOM hydrodynamic modeling environment in linking walleye spawning to the biophysical environment Lake Erie. This model was also used to examine the interaction of temperature-induced changes in the timing of spawning with an emphasis on climate change.

Highlights: The investigators were able to use the model to link years with high current to low fish recruitment. They suggest that high flow rates in the lake may transport eggs or new hatch fry to unsuitable nursery habitat. They predict that a 2 °C increase in temperature would push peak hatching about four days earlier.

Partner(s): University of Toronto

Title: Development of Genetic Management Guidelines for Lake Sturgeon

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-4-J257

Funding Year(s): 2004

GLFWRA Funding: $84,600 ***Total Non-federal Match/In-Kind:*** $28,200

Recipient: University of California-Davis

Investigator(s): Bernie May, Amy Welsh, Tracy Hill, Robert Haas, Ronald Bruch, and Charles Krueger

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendation 12 and 29

Background: Lake sturgeon populations in the Great Lakes are considered threatened or endangered due to habitat modification or overfishing. Lake sturgeon stocks were in need of genetic description in order to assign any given fish a genetic group. Genetic description of the lake sturgeon stocks will be useful in creating stocking plans for the Great Lakes Basin.

Highlights: This project identified genetic primers used to identify stocks of lake sturgeon in the Great Lakes. This greater genetic understanding will allow managers to look at particular stocks of lake sturgeon as separate management priorities.

Partner(s): Michigan Department of Natural Resources and Great Lakes Fishery Commission

Title: Food Habits of Lake Ontario Offshore Prey Fish: A Reassessment of the Magnitude and Dynamics of Planktivory

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-4-J256

Funding Year(s): 2004

GLFWRA Funding: $34,000 ***Total Non-federal Match/In-Kind:*** $12,000

Recipient: Great Lakes Fishery Commission

Investigator(s): Tom Stewart, Bob O'Gorman, Brian Lantry, and Mike Whittle

Sponsor: New York Department of Environmental Conservation

Restoration Study Goals Addressed: Goal 1, Recommendation 7 and 13

Background: During the 1990's Lake Ontario was invaded by several species of aquatic invertebrates. In particular, two species of zooplankton have caused shifts in the food web of the great lakes. The spiny water flea *Bythotrephes longimanus* and fish hook water flee *Cercopagis pengoi* have become increasingly abundant. Since many small fish feed on aquatic invertebrates, concern was raised over changes in the Great Lakes food web. This study investigated the diets of prey fish and compared them to prior studies.

Highlights: The stomachs of 10,872 alewife, rainbow smelt, three-spine stickleback and slimy sculpin were analyzed for this study. Non-native zooplankton were found in the stomachs of all three species, and the native *Diporeia* sp. were found at lower than historical levels. The increase in consumption of the native *Mysis* shrimp was also linked to shifts in the invertebrate community.

Partner(s): University of Toronto at Mississauga, United States Geological Survey - Great Lakes Science Center, and Department of Fisheries and Oceans - Canada

Title: Evaluations of Pilot-Scale Venturi Oxygen Stripping to Prevent Ballast Water Invasions

Status: Completed ***Project Type:*** Preventing Impacts from Non-Native Species

Agreement Number(s): 30181-4-J255

Funding Year(s): 2004

GLFWRA Funding: $75,784 ***Total Non-federal Match/In-Kind:*** $25,261

Recipient: University of Maryland Center for Environmental Science

Investigator(s): Ian Huybregts, Mario Tamburri, and Gregory Ruiz

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal 1, Recommendation 14

Background: Many introductions of aquatic invasive species have been link to ballast water used in large ships. When ships take on ballast water at one port, they can transport aquatic organisms to their next port. This study investigated the use of a Venturi Oxygen Stripping system (VOS) to remove oxygen from water to kill unwanted organisms.

Highlights: The investigators found the VOS system to be very effective in oxygen removal. Positive laboratory results led to the installation and test of this system on a large ocean-going shipping vessel. The system can lower dissolved oxygen levels to less than 1mg/l which is lethal to 99% of all aquatic organisms. An added benefit of the oxygen removal is a reduction of corrosion in ballast tanks.

Partner(s): Smithsonian Environmental Research Center

Title: Assessment of Pit Tags for Estimating Exploitation of Walleyes in Lake Erie and Saginaw Bay

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): **30181-4-J254**

Funding Year(s): 2004

GLFWRA Funding: $105,000 ***Total Non-federal Match/In-Kind:*** $38,420

Recipient: Ohio Department of Natural Resources

Investigator(s): Chris Vandergroot, Dan Isermann, Brian Locke, Bob Haas, David Fielder, Don Einhouse, and Roger Kenyon

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal 1, Recommendation 12

Background: The Lake Erie Walleye Task Group used expanded tag reporting rates to estimate exploitation rates and extrapolate a natural mortality for walleye stocks in Lake Erie. Natural mortality is a critical component in the catch-at-age population model used to estimate population size, and establish annual total allowable catch (TAC). Because natural mortality and harvest at age data are primary inputs in the model accurate natural mortality estimates are necessary. If exploitation rates remain biased by unrecognized tag loss, tag mortality or variable non-reporting rates, natural mortality estimation and population size projections would contain error, with the potential of setting TACs too high which could lead to overexploitation of fish stocks.

Highlights: Mark-recapture studies from this project gave managers and researchers a wealth of information. Data on population structure and movement are crucial to the management of this valuable recreational and commercial fishery. This study provided manager's new techniques of mark-recapture that do not rely on angler voluntary returns (PIT tags vs. traditional visible jaw tags) which eliminates the error surrounding the reporting rate.

Partner(s): Michigan Department of Natural Resources, New York Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, and Ontario Ministry of Natural Resources

Title: The Use of Unmanned Submersibles to Study Lake Trout Spawning on the Lake Michigan Mid-Lake Reef

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-2-J258, 30181-3-J224

Funding Year(s): 2002, 2003, and 2004

GLFWRA Funding: $116,700 ***Total Non-federal Match/In-Kind:*** $44,800

Recipient: University of Wisconsin- Milwaukee

Investigator(s): John Janssen, David Jude and Thomas Edsall

Sponsor: Wisconsin Department of Natural Resources

Restoration Study Goals Addressed: Goals I and III, Recommendations 9, 11, and 12

Background: Lake trout were extirpated from Lake Michigan by the 1950s, and there has been an extensive restoration program in operation for more than 4-decades. Stocking of lake trout at offshore sites directly over historically important spawning reefs, such as Lake Michigan's Mid-Lake Reef Complex, has been successful in steadily rebuilding lake trout spawning populations. However, recruitment of lake trout to these offshore populations from natural reproduction has yet to be observed. This study will improve our understanding of natural reproduction at this site and factors the may be impeding it.

Highlights: Potential lake trout spawning reefs in Lake Michigan were identified and mapped with a multi-beam sonar. A remotely operated vehicle (ROV) was used to videotape and collect lake trout eggs and fry. A beam trawl was used to further collect eggs and fry. Genetic analysis of these eggs and fry indicate that the Seneca strain of lake trout are the dominant spawners at these Lake Michigan reefs.

Partner(s): University of Michigan, United States Geological Survey, and National Underseas Research Program

Title: Otolith microchemistry for percid production in Lake Erie

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-3-J232

Funding Year(s): 2003

GLFWRA Funding: $30,000 ***Total Non-federal Match/In-Kind:*** $10,000

Recipient: Great Lakes Fishery Commission

Investigator(s): Sarah E. Bartnik, Timothy B. Johnson, Peter F. Sale, and Brian J. Fryer

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal 1, Recommendation 12

Background: Different stocks of walleye in Lake Erie were thought to exist. It is important for managers to know what each stock is contributing to the population. The objectives of this study were to identify and describe the mixed stock structure of Lake Erie walleye. Otolith microchemistry can detect trace elements in a bone of the fish. Since the otolith grows along with the fish, it provides chronological "snapshot" of the fish's life history, including information about the water chemistry where it hatched.

Highlights: Otolith microchemistry identified three distinct stocks of walleye from the Western Basin of Lake Erie. The Maumee River, Ontario Reefs and Sandusky River each have their own identifiable chemical signature. The study also looked at length at age between the Ontario Reef and Maumee River walleye, finding the Maumee River age-0 walleye grew slightly larger at the time of capture.

Partner(s): University of Windsor and Ontario Ministry of Natural Resources

Title: Lake Huron Lake Whitefish Distribution Study

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-3-J229

Funding Year(s): 2003

GLFWRA Funding: $174,334 ***Total Non-federal Match/In-Kind:*** $114,000

Recipient: Chippewa Ottawa Resource Authority

Investigator(s): Mark Ebener

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal 1, Recommendation 12

Background: The goal of this project is to determine whether or not stocks of lake whitefish in the main basin of Lake Huron are spatially distinct. Another goal of this project is determine the contribution of hypothesized stocks to commercial fishery yields.

Highlights: To date, 36,780 lake whitefish have been tagged in Lake Huron by seven agencies. Lake whitefish were tagged at 17 different sites around Lake Huron. In total, 1,833 fish were recaptured. The recapture portion of this study allowed researchers to determine that the hypothesized stocks move freely across international boundaries and contribute to commercial fishery yields in other political jurisdictions.

Partner(s): Ontario Ministry of Natural Resources, Michigan Department of Natural Resources, and University of Guelph

Title: Potential impact of steel-hulled barges on movement of fish across an electric barrier to prevent the entry of invasive carp into Lake Michigan

Status: Completed ***Project Type:*** Preventing Impacts from Non-Native Species

Agreement Number(s): 30181-3-J227

Funding Year(s): 2003

GLFWRA Funding: $59,500 ***Total Non-federal Match/In-Kind:*** $10,096

Recipient: University of Illinois

Investigator(s): John Dettmers, Bethany A. Boisvert

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal 1, Recommendation 14

Background: Asian carp escaped from Mississippi River basin aquaculture facilities and have been advancing up the Illinois River toward Lake Michigan. The Chicago Area Waterway System (CAWS) connects the Illinois River to Lake Michigan through canals built in the 1800's. An electric barrier was placed in the canal system to prevent passage of Asian carp and other invasive species. Concerns have been raised that steel-hulled barges may disrupt the field of this electric barrier, decreasing its effectiveness.

Highlights: Common carp, suckers (catostomids) and temperate bass were placed in plastic cage attached to the sides of different watercraft in a manner in which they could be observed via video monitoring. A steel-hulled barge and a fiberglass-hulled boat were used for this experiment to determine if hull type affected the electrical field. The watercrafts were maneuvered across the barrier at normal barge operating speeds. The fish's behavior in the cage was monitored for circling, darting, zigzagging, vibrating, and erratic swimming. The fish were immobilized three times longer next to the steel-hulled barge, but took slightly longer to become immobilized. The investigators caution that fish swimming in front of a barge may not be affected by the electricity due to the bending of the electrical waves.

Partner(s):

Title: An analysis of the diet of steelhead trout in Lake Erie to provide resource managers with a basic understanding of their role in lake-wide predator/prey dynamics

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-3-J225

Funding Year(s): 2003

GLFWRA Funding: $18,000 ***Total Non-federal Match/In-Kind:*** $7,861

Recipient: State University of New York- Fredonia

Investigator(s): Mark Clapsadl, James L. Markham, Kevin A. Kayle, Chuck Murray, and Brian Locke

Sponsor: New York Department of Environmental Conservation

Restoration Study Goals Addressed: Goal 1, Recommendation 4 and 13

Background: Steelhead trout have been stocked in Lake Erie since the late 1800's. Stocking numbers have been as high as 2.75 million fish per year. Diet studies have been conducted in other Great Lakes basins but the forage base in differs between the basins.

Highlights: Steelhead trout were collected from the eastern and central basins of Lake Erie. Three hundred forty-nine stomachs from these fish were obtained from fish processing stations as well as through Ohio Department of Wildlife's annual gillnet surveys. Rainbow smelt and shiners were the primary diet items, but samples from the eastern basin contained higher numbers of the invasive round goby. Other fish, including yellow and white perch, and invertebrates were identified in steelhead stomachs. The variation in diet indicates steelhead trout feed at various depths, with pelagic fish being the most common diet item. While invertebrates were encountered in the stomachs, 99% of the total dry weight was fish biomass.

Partner(s): New York Department of Environmental Conservation, Ohio Department of Wildlife, Pennsylvania Fish and Boat Commission, and Ontario Ministry of Natural Resources

Title: Analysis of tagging data to quantify lake trout migration in Lake Huron

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-3-J223

Funding Year(s): 2003

GLFWRA Funding: $30,000 ***Total Non-federal Match/In-Kind:*** $10,000

Recipient: University of Michigan- Ann Arbor

Investigator(s): Sara Adlerstein, Edward Rutherford, James Johnson, Aaron Woldt, and Lloyd Mohr

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendation 4

Background: The Lake Huron Lake trout fisheries collapsed in the 1940's because of commercial fishing and sea lamprey-imposed mortality. Stocking of hatchery reared lake trout began in 1973. Post-stocking movement, mortality and strain evaluation were needed to ensure the success of this stocking program.

Highlights: Data from 4,240 coded wire tagged lake trout were analyzed to determine movement in Lake Huron. Coded wire tagged fish were recovered from recreational fishers and agency sampling. Overall, about 40% of the Lake Trout were recaptured in the same area in which they were stocked. Catch rates in surrounding areas (statistical districts) were similar to stocking locations indicating movement after stocking.

Partner(s): Michigan Department of Natural Resources and Lake Huron Management Unit

Title: Lake Erie Walleye Stock Discrimination

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-2-J257

Funding Year(s): 2002 and 2003

GLFWRA Funding: $66,000 ***Total Non-federal Match/In-Kind:*** $66,900

Recipient: Great Lakes Fishery Commission

Investigator(s): Timothy Johnson, Brian Dixon, Carol Stepien and Christopher Wilson

Sponsor: Ohio Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 7, 12, and 29

Background: Walleye remain one of the most sought after fish by sport, charter, and commercial fishermen in Lake Erie. A recent peer review of walleye management in Lake Erie recommended that management agencies do a better job of identifying separate stocks of fish and manage those stocks independently to reduce the likelihood of over-harvest. Several molecular genetic techniques are being used to address this recommendation, however to date the techniques have not been directly compared. This project will assist us in identifying the accuracy and utility of four genetic techniques for discriminating stocks of walleye in Lake Erie.

Highlights: Four popular genetic techniques were used by three independent research labs to identify walleye stocks and their contributions to fisheries in Lake Erie. Tissue samples from known walleye spawning stocks were provided to the labs in a “blind-sample” experiment in order to directly compare results from the four genetic techniques. This provided an explicit description of the level of confidence expected from each of the techniques in identifying stock contributions from a fishery harvesting several stocks at once. The combination of genetic techniques allowed researchers to successfully assign a particular fish to a stock.

Partner(s): Ontario Ministry of Natural Resources, New York Department of Environmental Conservation, Cleveland State University, University of Waterloo and Trent University

Title: In Situ Determination of Depth and Thermal Habitat Use by Chinook Salmon

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-1-N023, 30181-3-J228(A), 30181-3-J228(B)

Funding Year(s): 2001, 2002, and 2003

GLFWRA Funding: $112,400 ***Total Non-federal Match/In-Kind:*** $75,900

Recipient: United States Geological Survey Great Lakes Science Center

Investigator(s): Ray Argyle, Jim Johnson, and Roger Bergstedt

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 6 and 7

Background: Chinook salmon were first introduced into the upper Great Lakes in 1967, and have become a critically important component of Great Lakes fish communities. Little is known about prey consumption, energy requirements, or depths and temperatures occupied by Great Lakes Chinook salmon. Temperature is one of the most important parameters governing fish movement, food consumption, and fish growth. This research focuses on addressing these information gaps to improve management of Great Lakes Chinook salmon.

Highlights: This research provides new information on Great Lakes Chinook salmon depth and temperature preferences, in addition to metabolism, food consumption and growth parameters. About 100 Chinook salmon from Lake Huron were tagged with programmable, archival temperature and depth recording tags. This information will provide a better understanding of: Chinook salmon adaptability to the upper Great Lakes, predator-prey relationships and vulnerability of Chinook salmon to fishing, disease outbreaks and sea lamprey predation.

Partner(s): Michigan Department of Natural Resources and Chippewa Ottawa Resource Authority

Title: Status of a Refuge for Native Freshwater Mussels in the Delta Area of Lake St. Clair

Status: Completed ***Project Type:*** Preventing Impacts from Non-Native Species

Agreement Number(s): 30181-2-J252

Funding Year(s): 2002

GLFWRA Funding: $22,800 ***Total Non-federal Match/In-Kind:*** $18,100

Recipient: Great Lakes Fishery Commission

Investigator(s): Janice Smith, Don Schloesser, Paul Marangelo, Michael Williams, Michael Arts and David Zanatta

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal V, Recommendation 11 and 12

Background: Freshwater mussels are among the most endangered organisms in North America, with nearly 70% of the ~300 native species at risk of extinction. Habitat loss and degradation and the introduction of the non-indigenous zebra mussel have decimated native freshwater mussel populations in the Great Lakes. Significant populations have continued to survive however, including in the delta region of Lake St. Clair, which supports at least 22 of the 32 species once known to occupy Lake St. Clair. We do not clearly understand why native mussels are able to co-exist with the zebra mussel in these "refuge sites."

Highlights: Significant freshwater mussel communities have continued to survive in near-shore areas of Lake Erie and in an important refuge site in the delta region of Lake St. Clair. This project evaluated the health of freshwater mussels in the Lake St. Clair refuge and allowed us to understand the conditions most favorable for their survival. The results of this study will be used to predict the locations of other natural sanctuaries and to guide management for the preservation of Great Lakes mussels.

Partner(s): Great Lakes Fishery Commission, Environment Canada, United States Geological Survey, The Nature Conservancy, Walpole Island First Nation, and Detroit Edison Company

Title: Effects of Barriers and River Fragmentation on Fish Population Ecology and Genetics

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-2-J253

Funding Year(s): 2002

GLFWRA Funding: $24,000 ***Total Non-federal Match/In-Kind:*** $119,100

Recipient: Great Lakes Fishery Commission

Investigator(s): Leon Carl, Chris Wilson, Troy Zorn, and Scott Reid

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals I, III, and V, Recommendations 7, 11, 12, 19, and 29

Background: The Great Lakes Fishery Resources Restoration Study identified the assessment of impacts of hydroelectric facilities and dam operations on fishery resources as a high priority concern. Dam construction can adversely affect fish by altering or limiting habitat, restricting fish movement and limiting gene flow between populations. This project, focused on the Trent River, a Lake Ontario tributary, had broad applications in understanding the impacts of dams on Great Lakes basin river fish communities and ecosystem function.

Highlights: We compared demographics, genetic diversity and relatedness, and described the spatial population ecology of redhorse in relation to fragmentation by dams. This information aided in assessment of dam construction and/or removal proposals and helped us identify opportunities for mitigation through fishways.

Partner(s): Trent University, Ontario Ministry of Natural Resources, Ontario Power Generation, Department of Fisheries and Oceans - Canada, Natural Sciences and Engineering Research Council of Canada, Trent-Severn Waterway, and Heritage Canada

Title: Botulism Type E in Lake Erie – Ecology and Lower Food Web Transfer

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-2-J254

Funding Year(s): 2002

GLFWRA Funding: $37,000 ***Total Non-federal Match/In-Kind:*** $43,900

Recipient: State University of New York- Fredonia

Investigator(s): Alicia Perez-Fuentetaja, Theodore Lee, Mark Clapsadl

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goals I and V, Recommendations 3, 28, and 31

Background: Botulism type E, a neuroparalytic disease, transmitted through diet and resulting from a toxin produced by the microorganism *Clostridium botulinum*, caused large mortalities of wildlife, including imperiled species such as common loon and lake sturgeon, in Lake Erie during 1999- 2002. The pathological mechanisms for the disease outbreak and transmission are not fully understood. This project will examine the conditions associated with the recent outbreaks and provide information to enable lake managers and other authorities to reduce the incidence and minimize public exposure.

Highlights: Large mortalities of waterfowl and fish were observed in Lake Erie during 1999-2002 and were connected with botulism type E, a neuroparalytic disease. Researchers described environmental conditions in areas where botulism type E is present, and analyzed the transfer of the disease through the food web. Methods to predict detect and manage the incidence of outbreaks and minimize public exposure to contaminated areas and foods were identified.

Partner(s): Ohio Department of Natural Resources

Title: A Comparative Study of Growth Rates, Lipid Dynamics, and Nutritional Stress in Great Lakes Chinook Salmon

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-2-J255

Funding Year(s): 2002

GLFWRA Funding: $34,000 ***Total Non-federal Match/In-Kind:*** $305,000

Recipient: Michigan State University

Investigator(s): Michael Jones, Jim Bence, and Amber Peters

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 9 and 28

Background: Chinook salmon have been stocked into the Great Lakes in large numbers since 1967. Chinook are not native to the Great Lakes and there is growing evidence that their lack of adaptation to harsh winter conditions makes them highly vulnerable to stresses caused by prey depletion and insufficient energy reserves. Fall lipid levels will be measured and strategies that chinook salmon use for regulating energy reserves during the winter months will be investigated. Occurrences of Bacterial Kidney Disease with nutritional stress will be compared and a common protocol to assess chinook salmon health will be proposed.

Highlights: Harsh winter conditions in the Great Lakes cause nutritional stress on chinook salmon and can lead to mortality associated with Bacterial Kidney Disease. Fall (end of growth season) energy reserve levels will be compared for chinook salmon stocks in Lakes Michigan, Huron and Ontario as an indicator of nutritional stress. A common protocol for chinook salmon nutritional health assessment, including methods, expected precision, and costs, was developed.

Partner(s): Great Lakes Fishery Trust

Title: Comparative Bioenergetic Modeling if Lake Whitefish Populations in Lake Erie and Lake Ontario

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-2-J256

Funding Year(s): 2002

GLFWRA Funding: $66,000 ***Total Non-federal Match/In-Kind:*** $76,000

Recipient: Great Lakes Fishery Commission

Investigator(s): Jim Hoyle, Timothy Johnson, and Tom Stewart

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendation 6, 7, and 12

Background: Lake whitefish are a prominent member of the Great Lakes cold-water fish community and have been an important component of the fisheries since the early 1900s. The lake whitefish is the last remaining abundant native cold-water species in Lake Ontario, and continued poor growth and failed recruitment threaten the viability of these fish. It is imperative that we understand the causes of the recent declines in these stocks and develop fishery management options to conserve this important native fish.

Highlights: Lake whitefish, a native Great Lakes cold-water species, are showing dramatic declines in body condition and growth in portions of Lakes Ontario and Erie. These changes have been associated with the disappearance of the Great Lakes amphipod, Diporeia, an important prey type in the lake whitefish diet. Comparative bioenergetic models will be developed describing growth and diet of lake whitefish for use in fisheries management plans aimed at rehabilitating these stocks.

Partner(s): Ontario Ministry of Natural Resources and University of Windsor

Title: Lake Sturgeon Habitat in the Tributaries of Lake Superior

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-2-J259

Funding Year(s): 2002

GLFWRA Funding: $20,000 ***Total Non-federal Match/In-Kind:*** $22,000

Recipient: Bad River Band of Lake Superior Tribe of Chippewa Indians

Investigator(s): Rick Huber, Henry Quinlan, Owen Gorman, and Gary Cholwek

Sponsor: Bad River Band of Lake Superior Tribe of Chippewa Indians

Restoration Study Goals Addressed: Goals III and V, Recommendations 1, 11, and 12

Background: The Bad River, near Ashland, Wisconsin, is an important Lake Superior tributary supporting populations of lake sturgeon, walleye, small mouth bass and other species. Nursery habitat requirements and utilization by young lake sturgeon, and the relationship between habitat and fish production, are not well understood. This study will investigate lake sturgeon nursery activity and habitat in the Bad River. A CD-ROM with the electronic habitat data will be provided to the Lake Superior Technical Committee, and it is expected that this method will eventually be used in each of the 16 additional Lake Superior tributaries that historically supported lake sturgeon.

Highlights: Nursery and rearing habitat use was quantified in the Bad River, Wisconsin, one of the most important lake sturgeon producing tributaries to the Great Lakes. Aquatic habitat in the lower Bad River, and Lake Superior near-shore waters adjacent to the mouth of the River, was electronically mapped in 2003 using a shallow water hydroacoustic transducer. The Bad River is also a major producer of parasitic sea lamprey and an improved understanding of in-stream habitat will lead to more effective sea lamprey control.

Partner(s): United States Geological Survey and Great Lakes Indian Fish and Wildlife Commission

Title: Lake Erie Aquatic Habitat Geographic Information System (GIS)

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-2-J260

Funding Year(s): 2002

GLFWRA Funding: $114,000 ***Total Non-federal Match/In-Kind:*** $38,000

Recipient: Michigan Department of Natural Resources

Investigator(s): Robert Haas, Jeff Tyson and Troy Zorn

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendations 1, 10, 11, 19 and 31

Background: The Lake Erie GIS, including Lake St. Clair and connecting channels, will link up with the recently developed Lake Huron GIS and provide comprehensive information on natural resources and habitat over a large portion of the Great Lakes basin. Synthesis of existing habitat inventories is the first step toward sustainable management of natural resources. This inventory will allow for States and Ontario to plan for Lake Erie's future, monitor its status and target the most cost-effective restoration efforts.

Highlights: A universal, readily accessible data-base describing habitat and biological features in Lake Erie was developed to support data sharing and holistic management. The Lake Erie GIS will serve as a decision support tool to provide information to address issues identified in the Lake Erie Lake-wide Management Plan. The Lake Erie GIS complemented the analogous project completed for Lake Huron and represents one more step toward a Great Lakes-wide GIS.

Partner(s): Ohio Department of Natural Resources, Ontario Ministry of Natural Resources, and United States Environmental Protection Agency

Title: An Investigational Model of an Investigational Model of Double-Crested Cormorant Impacts on Great Lakes Fish Communities Double-Crested Cormorant Impacts on Great Lakes Fish Communities

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-2-J261

Funding Year(s): 2002

GLFWRA Funding: $16,100 ***Total Non-federal Match/In-Kind:*** $5,400

Recipient: Central Michigan University

Investigator(s): James Gillingham and Nancy Seefelt

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 7, 12, and 32

Background: The Double-crested Cormorant, a deep diving avian fish predator, has substantially increased in numbers in the Great Lakes Basin over the past 20 years. The increased abundance of birds, combined with their fish eating behavior, has led to their implication in declines of sport and commercial fisheries in the Great Lakes. This study investigated cormorant-prey relationships at two sites in the Great Lakes and integrated information into models for assessing these complex relationships. The Michigan Department of Natural Resources provided fish population data to support this study.

Highlights: Predatory/prey relationships were examined between cormorants and smallmouth bass in the Beaver Islands, Lake Michigan, and between Cormorants and yellow perch in the Les Cheneaux Islands, Lake Huron. Cormorant/fish predatory/prey models were developed to help unravel the complex relationships between Great Lakes cormorants and fish populations. These data sets were integrated to model the regional impact of double-crested cormorants on fishery resources, primarily, smallmouth bass abundance and recruitment. The models suggested that cormorant predation was not the only factor influencing smallmouth bass recruitment

Partner(s): Michigan State University

Title: Port of Indiana Lake Trout Spawning

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-2-J262

Funding Year(s): 2002

GLFWRA Funding: $115,800 ***Total Non-federal Match/In-Kind:*** $38,600

Recipient: University of Illinois- Urbana-Champaign

Investigator(s): John Dettmers

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 9, 11, and 12

Background: Lake trout were extirpated from Lake Michigan by the 1950s. Today, an aggressive stocking program exists with the goal of restoring self-sustaining stocks. Lake trout spawned successfully near the Port of Indiana during 1992-1996, and fry were observed during surveys in 1993-1997. During Fall 2001 assessments, Indiana Department of Natural Resources personnel discovered that 18% of collected lake trout were unmarked, indicating that they may be of natural origin. The timing of this observation suggests that these fish may be the first from the 1992-1996 year classes returning to spawn.

Highlights: Recent evidence of possible natural reproduction of lake trout on reefs near the Port of Indiana break-wall has spurred interest from fishery managers. Egg nets, fry traps and gillnets were deployed at sites at the Port of Indiana to detect lake trout eggs, fry and adults. Natural reproduction is occurring at the Port of Indiana. High numbers of invasive round gobies and low numbers of eggs and fry indicate goby predation may be a significant factor in lake trout reproduction.

Partner(s): Indiana Department of Natural Resources and Illinois Natural History Survey

Title: Survival Rates of Lake Superior Lake Trout

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-1-J230

Funding Year(s): 2001

GLFWRA Funding: $35,900 ***Total Non-federal Match/In-Kind:*** $13,600

Recipient: North Carolina State University

Investigator(s): Kenneth Pollock, Mary Fabrizio, Stephan Schram, Bruce Swanson, and James Nichols

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 6, 7, and 12

Background: Gull Island Shoal was established as a refuge in 1976 to reduce fishing mortality on one of Lake Superior's most important lake trout spawning stocks. This study analyzed an important long-term data set of lake trout survival near Gull Island and updated several currently used lake trout models. These activities provided new data on lake trout survival and supports interagency efforts to refine lake trout management in Lake Superior.

Highlights: Survival rates were calculated for lake trout near Gull Island using data from 54,000 fish tagged during 1969-1995. This critical lake trout survival information was used by agencies to update fishery models. Research also revealed the usefulness of refuge sites, such as Gull Island Shoal, for lake trout restoration.

Partner(s): Wisconsin Department of Natural Resources, National Marine Fisheries Service and United States Geological Survey

Title: Genetic Assessment of Steelhead Recruitment and Contribution to Harvests in Lake Michigan

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-1-J229

Funding Year(s): 2001

GLFWRA Funding: $88,100 ***Total Non-federal Match/In-Kind:*** $31,900

Recipient: Michigan State University

Investigator(s): Kim Scribner and Meredith Bartron

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 9, 12, and 29

Background: Michigan, Indiana, Illinois and Wisconsin spend millions of dollars annually to produce and stock steelhead into the Lake Michigan basin. We have developed capabilities to evaluate the relative contribution of hatchery strains of steelhead using strain-specific genetic characteristics. This information is being used to evaluate the ecological effects of stocking and improve the effectiveness of stocking strategies.

Highlights: Genetic markers were used to evaluate the four hatchery strains of steelhead commonly stocked by management agencies into Lake Michigan. Steelhead returning to Michigan streams are of different strains, stocked by different states, and sport harvest may not be proportional to stocking efforts. Changes in stocking practices have increased the survival of hatchery fish, leading to significant increases in the contribution of hatchery adults in spawning runs.

Partner(s): Michigan Department of Natural Resources

Title: Little Silver Creek Habitat Improvement

Status: Completed ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-1-J186

Funding Year(s): 2001

GLFWRA Funding: $20,000 ***Total Non-federal Match/In-Kind:*** $7,500

Recipient: Keweenaw Bay Indian Community Natural Resources Department

Investigator(s): Michael Donofrio, Bruce Petersen, Doug Mills, and Henry Quinlan

Sponsor: Keweenaw Bay Indian Community

Restoration Study Goals Addressed: Goal III, Recommendation 11

Background: Little Silver Creek is a 2,500-acre watershed located a few miles northeast of L'Anse, Michigan. This stream provides important recreational opportunities for area residents. Little Silver Creek is capable of providing a sustainable "coaster" brook trout fishery for area. The Keweenaw Bay Indian Community has implemented a restoration program including habitat enhancements and the stocking of native brook trout into Little Silver Creek.

Highlights: A record rainfall during 1968 caused severe damage to fish habitat in Little Silver Creek, a tributary to Lake Superior near L'Anse, Michigan. A large culvert was installed at a road crossing to provide fish passage, sediment was removed from the stream and the adjacent banks were stabilized to limit further erosion. Stocking and habitat improvements should lead to a sustainable coaster brook trout population in the Little Silver Creek watershed.

Partner(s): USDA Natural Resources Conservation Service and Baraga County Road Commission

Title: Thermal and Depth Distribution of Lake Trout in Eastern Lake Superior

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-1-J187

Funding Year(s): 2001

GLFWRA Funding: $55,800 ***Total Non-federal Match/In-Kind:*** $44,800

Recipient: Great Lakes Indian Fish and Wildlife Commission

Investigator(s): Bill Mattes and Roger Bergstedt

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 6, 7, and 12

Background: Temperatures and depths occupied by lake trout are important data for understanding feeding and growth, and interactions with other species including parasitic sea lamprey. One hundred archive tags, which record water temperature and depth information continuously for up to three years were implanted into Lake Superior lake trout during November 2001. Once a sufficient number of the tags have been recovered, a full description of temperatures and depths occupied by lake trout in Lake Superior will be provided.

Highlights: Specialized recording devices were implanted in lake trout in Eastern Lake Superior to collect information on temperatures and depths occupied on a daily and seasonal basis. The information will increase the ability to predict lake trout growth and maturity, interactions between fish species, sea lamprey mortality and harvest patterns in Lake Superior fisheries.

Partner(s): Keweenaw Bay Indian Community, United States Geological Survey and Michigan State University – Sea Grant

Title: Spatial and Temporal Dynamics of the Lake Erie Walleye Fishery

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-1-J228

Funding Year(s): 2001

GLFWRA Funding: $64,000 ***Total Non-federal Match/In-Kind:*** $25,600

Recipient: Cornell University

Investigator(s): Patrick Sullivan

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 4, 6, 7, and 12

Background: The nature and timing of the commercial and sport harvest, and the influence of spatial patterns in fishing and fish movement, are not fully understood. Lake Erie supports one of the World's largest and most complex walleye fisheries with numerous contributing stocks managed by four States and Ontario. The Lake Erie Committee relies heavily on the use of fishery models to guide the management and restoration of walleye stocks. A recent peer review of the current approach to walleye management recommended the incorporation of more intricate spatial and temporal data into the existing population and community assessment models.

Highlights: This study responds to a recent recommendation to use more intricate spatial and temporal data in Lake Erie walleye population models. Research allows for full recognition of different sub-populations of walleye within Lake Erie in assessment modeling and fishery management. A comprehensive database, exploratory data analysis, and updated fishery management models were prepared and presented in an interagency workshop.

Partner(s): New York State Department of Environmental Conservation, Ontario Ministry of Natural Resources, Cornell University and Lake Erie Walleye Task Group

Title: Cesium 137 Based Estimates of Energy Conversion in Lake Superior

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-1-J227

Funding Year(s): 2001

GLFWRA Funding: $11,000 ***Total Non-federal Match/In-Kind:*** $8,000

Recipient: Great Lakes Fishery Commission

Investigator(s): Bryan Henderson, Stephen Schram and Don Schreiner

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendation 6, 12, 28, and 29

Background: Life history characteristics differ markedly between three phenotypes of lake trout and may represent physiological or anatomical adaptations to depth and habitat. Since most of Lake Superior, and much of Lakes Huron and Michigan, are comprised of waters deeper than 50 meters, it is important to consider the option of restoring deepwater habitats with lake trout adapted to deepwater. This lake-wide comparison of Lake Superior lake trout stocks will provide important information to determine the most suitable phenotype for restoration stocking into deepwater habitats in the Great Lakes.

Highlights: Three phenotypes of lake trout are found in Lake Superior, including one shallow water form (lean) and two deepwater forms (humper and siscowet). Growth, maturity, fecundity, age, diet, protein/lipid composition and cesium content were assessed for 50 fish of each type from 3 areas in Lake Superior. These characteristics represent adaptations to various depths and habitats and will be compared to determine the best lake trout strains for deep-water restoration.

Partner(s): Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Ontario Ministry of Natural Resources and University of Toronto

Title: Effect of Thiamine Deficiency on Spawning Migration of Salmonids in the Great Lakes Basin

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-1-H018

Funding Year(s): 2001

GLFWRA Funding: $43,500 ***Total Non-federal Match/In-Kind:*** $92,000

Recipient: Great Lakes Fishery Commission

Investigator(s): John Fitzsimons, George Ketola, Dale Honeyfield, Tom Chiotti and Charles Pecor

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 9, 25, and 28

Background: Some Great Lakes salmonids with high alewife diet contents exhibit thiamine deficiency which has been associated with Early Mortality Syndrome (high larval mortality). Using thiamine injection of adult female coho salmon entering the Platte River in Northeastern Lake Michigan, the study indicates that survival of thiamine-injected fish was almost twice that of controls and that injection did not affect the number of fish migrating upstream.

Highlights: This study investigated the effects of salmonid thiamine deficiency on in-stream migration and survival. A thiamine injection method was used to experimentally raise egg thiamine levels and observe effects on larval mortality. Mortality was significantly lower in the eggs of thiamine-injected fish, suggesting that adult thiamine injection may be an effective method for countering Early Mortality Syndrome in salmonids.

Partner(s): Michigan Department of Natural Resources, Department of Fisheries and Oceans – Canada and United States Geological Survey

Title: Lake Huron aquatic habitat geographic information system (GIS)

Status: Completed ***Project Type:*** GIS and Habitat Mapping

Agreement Number(s): 30181-0-J173(A), 30181-0-J173(B)

Funding Year(s): 2000 and 2001

GLFWRA Funding: $207,300 ***Total Non-federal Match/In-Kind:*** $207,000

Recipient: Michigan Department of Natural Resources

Investigator(s): Troy Zorn, James Johnson, Robert Haas, Mark MacKay, Dennis Albert, Dave Reid, and Lloyd Mohr

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goal III, Recommendations 1, 3, and 4

Background: A universal, readily accessible information system describing habitat and biological features across the Great Lakes is prerequisite to holistic management. Most of the existing digital base-maps and ecological classifications for the Lake Huron basin have been compiled into the Lake Huron Geographic Information System (LHGIS). The LHGIS provides comprehensive information for use by management authorities in monitoring natural resources and making decisions affecting the future of resources.

Highlights: Habitat and biological information maintained by numerous United States and Canadian agencies was integrated into one Geographic Information System (GIS) for use by management authorities in Lake Huron. The Lake Huron GIS serves as a pilot for the development of information and management decision support systems in other Great Lake basins. Although designed primarily for fisheries managers, this set of information can serve as the foundation for a variety of aquatic or terrestrial conservation efforts in the Lake Huron basin. Copies of the LHGIS, along with software required to access the information, were provided to management agencies in January 2001.

Partner(s): Michigan Natural Features Inventory, Ontario Ministry of Natural Resources, The Nature Conservancy and Great Lakes Fishery Commission

Title: Restoration of deepwater cisco in Lake Ontario

Status: Completed ***Project Type:*** Biology and Ecology of Target Species

Agreement Number(s): 30181-0-J166(A), 30181-0-J166(B)

Funding Year(s): 2000 and 2001

GLFWRA Funding: $45,590 ***Total Non-federal Match/In-Kind:*** $15,250

Recipient: Great Lakes Fishery Commission

Investigator(s): Tom Stewart, Glenn Hooper, and Randy Eshenroder

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 12 and 13

Background: Over-fishing, sea lamprey parasitism, and competition with smelt and alewives has led to the collapse of the valuable deepwater cisco fishery in Lake Ontario. Reintroduction of deepwater cisco, *Coregonus hoyi*, from a healthy donor population is being explored to restore the collapsed fishery in Lake Ontario.

Highlights: This project has identified major impediments to the restoration of deepwater cisco, a native prey species in Lake Ontario. Two collections of source stock from Michipicoten Bay, Lake Superior have been attempted. Deepwater cisco in spawning condition have been extremely difficult to capture because spawning occurs in deep water during the winter. Despite identified impediments, this study indicates that restoration through reintroduction remains a viable option for deepwater cisco in Lake Ontario. Additionally, experimental culture methods and facilities have been developed for hatchery production of deepwater cisco.

Partner(s): Ontario Ministry of Natural Resources

Title: Lake-Wide Acoustic Monitoring Program for Lake Superior Pelagic Fishes

Status: Completed ***Project Type:*** Aquatic Community Dynamics and/or Monitoring

Agreement Number(s): 30181-0-N032

Funding Year(s): 2000 and 2001

GLFWRA Funding: $61,900 ***Total Non-federal Match/In-Kind:*** $20,700

Recipient: USGS – Great Lakes Science Center

Investigator(s): Michael Hoff and Doran Mason

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 1, 3, 4, 5, 6, and 13

Background: Our goal is to develop a standard Lake Superior-wide acoustic assessment program to quantify the abundance of pelagic prey fishes (rainbow smelt, lake herring, and bloater). Mid-water trawl fish sampling and acoustic data collections were performed 50 times in Lake Superior during spring and summer 2001. Four acoustic systems were evaluated, and comparisons of the outputs from the four systems will help us evaluate them for future assessments on Lake Superior.

Highlights: Acoustic monitoring is being used to develop fish length and weight relationships for lake herring, bloater, and rainbow smelt to better assess populations. Models to differentiate rainbow smelt, bloater, and lake herring will increase useful information and reduce the cost of future acoustic monitoring programs. Four hydro-acoustic systems were evaluated, which will lead to recommendations for future acoustic monitoring surveys in Lake Superior.

Partner(s): Minnesota Department of Natural Resources and NOAA-Great Lakes Environmental Research Laboratory

Title: Development of a lake-wide lake trout model for Lake Superior

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-8-J850, 30181-9-J119, 30181-0-J095

Funding Year(s): 1998-2001

GLFWRA Funding: $53,000 ***Total Non-federal Match/In-Kind:*** $38,300

Recipient: Chippewa Ottawa Resource Authority

Investigator(s): Michael Hansen, Mark Ebener, Joan Bratley and Kevin Kapuscinski

Sponsor: Minnesota Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 7 and 12

Background: More than 46,000 lake trout were tagged at 195 sites in Lake Superior from 1973-2000. Information from nearly 3,000 recaptures was examined and lake trout traveled, on average, about 33 miles between tagging and recovery. Lake trout populations in Lake Superior have been managed using models that assume lake trout do not move between management units. Fishery managers can use this new information to account for lake trout movement in statistical catch-at-age models, determine the degree to which spawning stocks are mixing between spawning events, and predict movement distances of lake trout.

Highlights: This study provides new information on lake trout origin, movement, contribution to the fisheries, and population restoration trends. Information from 3,000 tagged lake trout indicates that a large percentage of lake trout are moving across management unit boundaries. Movement across management unit boundaries is common for fish originating from spawning reefs nearest to those boundaries.

Partner(s): Michigan Department of Natural Resources, University of Wisconsin-Stevens Point, Great Lakes Indian Fish and Wildlife Commission, Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, United States Geological Survey, Ontario Ministry of Natural Resources and Great Lakes Fishery Commission

Title: Development of a Management Plan for Lake Sturgeon Based on Population Genetic Structure – Mitochondrial DNA Markers

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-0-J169

Funding Year(s): 2000

GLFWRA Funding: $30,000 ***Total Non-federal Match/In-Kind:*** $10,250

Recipient: Michigan State University

Investigator(s): Kim Scribner, Pat Dehaan, Scot Libants and Christopher Lowie

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals I and V, Recommendations 6, 8, 12, and 29

Background: Since the mid-1800's lake sturgeon populations have suffered dramatic declines coincident with their harvest and the loss and blockage of spawning habitat. Sound stewardship of fisheries resources requires a fundamental understanding of how populations are structured genetically and of the effects of stocking and other anthropogenic forces on genetic diversity. This study will contribute to a better understanding of the genetic structure among remaining lake sturgeon populations which is necessary to guide Great Lakes restoration and enhancement.

Highlights: This study developed genetic markers based on mitochondrial DNA to augment markers based on DNA microsatellites developed in a parallel study by Dr. Bernie May (30181-0-J174). Screening of tissue samples resulted in the development of mitochondrial DNA markers to determine the extent of lake sturgeon stock separation or mixing. These markers will allow lake sturgeon hatchery stocks to be developed for restoration stocking while ensuring genetic diversity.

Partner(s): Great Lakes Fishery Commission

Title: Evaluation of Steelhead Production in Cattaraugus Creek, New York

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-0-J167

Funding Year(s): 2000

GLFWRA Funding: $15,400 ***Total Non-federal Match/In-Kind:*** $17,200

Recipient: State University of New York- Fredonia

Investigator(s): Robert Roth Jr. and David Orvos

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 6, 8, and 11

Background: Cattaraugus Creek, New York, which supports an important steelhead fishery, was studied to identify factors limiting steelhead production. Lower tributaries were sampled for wild emigrating juvenile steelhead. Results from this study contribute to a better understanding of steelhead production in tributaries of Eastern Lake Erie.

Highlights: Steelhead smolt production from the Cattaraugus Creek watershed was described from 1999- 2001. Maximum catches of emigrating juvenile wild steelhead ranged from 26 to 75 fish per day. One and two year old fish accounted for 73% and 27% of the catch, respectively. The information from this study and observations of fishing pressure and habitat conditions will allow for improved management of this fishery.

Partner(s): Sweet Briar College and Great Lakes Fishery Commission

Title: Development of a Management Plan for Lake Sturgeon Based on Population Genetic Structure – Development of Microsatellite Markers

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-0-J174

Funding Year(s): 2000

GLFWRA Funding: $83,000 ***Total Non-federal Match/In-Kind:*** $28,000

Recipient: University of California-Davis

Investigator(s): Amy Welsh, Marc Blumberg, Bernie May, and Christopher Lowie

Sponsor: Michigan Department of Natural Resources

Restoration Study Goals Addressed: Goals I and V, Recommendations 6, 8, 12 and 29

Background: Lake sturgeon are an important part of both the ecosystem and the culture of the Great Lakes. Lake sturgeon populations are declining due to a combination of overfishing, dams, and pollution. Successful recovery of this unique fish will require restoration stocking. A better understanding of the genetic structure among remaining lake sturgeon populations is needed to guide these enhancement efforts. Without this information, stocking programs could eliminate genetic diversity.

Highlights: Screening of lake sturgeon tissue samples resulted in the development of 10 molecular markers that target DNA microsatellites to allow for stock segregation. These markers will allow fishery managers to develop a management plan based on development of distinct lake sturgeon hatchery stocks which will ensure genetic diversity throughout the Great Lakes Basin.

Partner(s): Michigan Department of Natural Resources

Title: Restoration of River and Near-Shore Habitats and Fish Stocks in Eastern Lake Erie

Status: Completed ***Project Type:*** Aquatic Habitat Restoration

Agreement Number(s): 30181-0-J170

Funding Year(s): 2000

GLFWRA Funding: $97,500 ***Total Non-federal Match/In-Kind:*** $368,000

Recipient: Great Lakes Fishery Commission

Investigator(s): Todd Howell, Brian Shuter, Chris Wilson, and Don Einhouse

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goals I and III, Recommendations 11 and 12

Background: Walleye and yellow perch stocks have declined in eastern Lake Erie since the introduction of the zebra mussel due to changes in food availability. This study investigated water quality in major yellow perch spawning tributaries and in near shore habitats, identified and monitored major yellow perch stocks and associated habitats, and further described the population dynamics and ecology of the Grand River walleye stock.

Highlights: Information collected in this study builds on previous research to improve the understanding of fish population dynamics in Eastern Lake Erie. Water quality data, fish genetic structure, and fish habitat conditions during spawning were compared to evaluate ecological integrity from a system perspective. Integration of these ecological attributes has led to a greater understanding of the factors limiting Lake Erie walleye and yellow perch abundance and production.

Partner(s): Ontario Ministry of Natural Resources and Grand River Conservation Authority

Title: Development of an age-structured yellow perch population model for Lake Michigan

Status: Completed ***Project Type:*** Biological Modeling

Agreement Number(s): 30181-0-J168

Funding Year(s): 2000

GLFWRA Funding: $58,500 ***Total Non-federal Match/In-Kind:*** $20,000

Recipient: Great Lakes Fishery Commission

Investigator(s): James Bence, Michael Wilberg, and David Clapp

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendation 7, 12, and 29

Background: Yellow perch abundance declined greatly in the main basin of Lake Michigan during the mid to late 1990's. Our analysis of available data indicates annual mortality rates for mature females between 50 to 94% during 1986-1995. These mortality rates are quite high for a species like yellow perch that can live more than 10 years.

Highlights: Preliminary information indicates that yellow perch abundance in Lake Michigan during 2001 was less than 5% of 1986 levels. Analysis of available data suggests that high fishing mortality led to reproductive failure and population collapse in Lake Michigan during the mid to late 1990's. This study provides the information to model fishing mortality and shows a direct relationship between mortality and recovery for Lake Michigan yellow perch.

Partner(s): Michigan Department of Natural Resources, Indiana Department of Natural Resources, Wisconsin Department of Natural Resources, Michigan State University and Little Traverse Bay Band of Odawa Indians

Title: Questionnaire Regarding Fish Community Objectives for the St. Lawrence River

Status: Completed ***Project Type:*** Project Planning

Agreement Number(s): 30181-9-J118

Funding Year(s): 1999

GLFWRA Funding: $2,300 ***Total Non-federal Match/In-Kind:*** $5,500

Recipient: Great Lakes Fishery Commission

Investigator(s): Alastair Mathers, Steven LaPan, and Tommy Brown

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 1, 6, 12, and 31

Background: The St. Lawrence River ecosystem has undergone dramatic changes recently and public input was needed to realign fishery management activities. Toward meeting this need, a 26-question survey was handed out at a series of six public meetings to define fisheries issues and inform managers of the public's preferences. The results were used to set management objectives and priorities for the St. Lawrence River. These objectives and priorities were then opened to the public for further comment and refinement.

Highlights: St. Lawrence River angler preferences were gathered through a questionnaire provided at a series of six public meetings during the summer of 2000. Results were incorporated into the "Fish-Community Objectives for the St. Lawrence River." This new public opinion information will help guide effective change in St. Lawrence River fishery management activities.

Partner(s): Ontario Ministry of Natural Resources and Cornell University

Title: Assessment of genetic population structure in yellow perch

Status: Completed ***Project Type:*** Health and Genetics

Agreement Number(s): 30181-9-J117(A), 30181-9-J117(B)

Funding Year(s): 1998-1999

GLFWRA Funding: $60,000 ***Total Non-federal Match/In-Kind:*** $35,000

Recipient: University of Minnesota- Twin Cities

Investigator(s): Loren Miller and Anne Kapuscinski

Sponsor: Illinois Department of Natural Resources

Restoration Study Goals Addressed: Goal I, Recommendations 7, 12 and 29

Background: Understanding and preserving the genetic diversity of Lake Michigan yellow perch is essential to maintaining strong and productive fish populations. The recent decline in Lake Michigan's yellow perch has prompted interest in the genetic structure of perch populations.

Highlights: This study assessed genetic population structure among 16 yellow perch populations, focusing on spawning groups within Lake Michigan. Little difference was found among spawning groups within southern Lake Michigan or within Green Bay; however, Green Bay spawning groups were found to be genetically distinct stocks from those in southern Lake Michigan. These results provide evidence for continued management of yellow perch in Lake Michigan based on separate Green Bay and Lake Michigan stocks.

Partner(s): Great Lakes Fishery Commission

Title: Eastern Lake Ontario food web studies

Status: Completed ***Project Type:*** Aquatic Community Dynamics and /or Monitoring

Agreement Number(s): 00000-0-0000

Funding Year(s): 1998

GLFWRA Funding: $27,300 ***Total Non-federal Match/In-Kind:*** $9,100

Recipient: Great Lakes Fishery Commission

Investigator(s): Tom Stewart, Jim Hoyle, Jim Bowlby, Ted Schaner, Andy Smith and John Cassleman

Sponsor: New York State Department of Environmental Conservation

Restoration Study Goals Addressed: Goal I, Recommendations 3, 6, 7, and 12

Background: Changes in the Lake Ontario aquatic food web have resulted in declines in smallmouth bass and lake whitefish populations. The objectives of the study were to augment existing assessment and research programs by filling in major knowledge gaps to better assess the potential impacts of a changing eastern Lake Ontario aquatic food web. Understanding recent changes in the aquatic food web in Lake Ontario will guide fishery management and enhance restoration opportunities.

Highlights: Angler catch surveys, smallmouth bass sampling, and lake whitefish diet sampling were integrated to assess food web changes. Smallmouth bass abundance was found to be strongly related to mid-summer water temperatures; while over-fishing, walleye predation, and cormorant predation were not significant factors. Results also indicate that declines in the Great Lakes amphipod Diporeia, formerly the most important prey item in whitefish diet, have contributed to poor body condition in lake whitefish. Understanding recent changes in the aquatic food web in Lake Ontario will guide fishery management and enhance restoration opportunities.

Partner(s): Ontario Ministry of Natural Resources

Appendix II: Partners in Support of the Great Lakes Fish and Wildlife Restoration Act

One of the most important observations upon reviewing the list of fish and wildlife restoration proposals is the extensive list of partners involved in implementing these projects. In addition to those partners, there are also those that assist in supporting the six goals of the Act. The Service acknowledges the following partners both within and outside of the Great Lakes basin, who have made valued contributions toward pursuing the Service goals under the Great Lakes Fish and Wildlife Restoration Act either through funded proposals or through other means. The list includes 265 organizations that provided funding and/or expertise, including 61 state or local agencies, 28 U.S. federal agencies/offices, 8 Canadian institutions, 1 commission, 57 non-governmental organizations etc., 21 Native American governments and treaty authorities, 39 colleges and universities, 35 local institutions, and 15 Other organizations such as private business's or Zoo's:

State and Local Agencies (61)

Alabama Department of Conservation and Natural Resources
Alaska Department of Fish and Game
Antrim Conservation District
Arkansas Game and Fish Commission
Ashland Bayfield Douglas and Iron Counties Land Conservation Department
Baraga County Road Commission
Calhoun Conservation District
City of Chicago
City of Traverse City
Connecticut Department of Environmental Protection
Delaware Division of Fish and Wildlife
Elk Skegemog Lakes Association
Florida Game and Fresh Water Fish Commission
Georgia Department of Natural Resources
Grand Traverse County
Hawaii Division of Forestry and Wildlife
Illinois Department of Natural Resources
Illinois Natural History Survey
Illinois Nature Preserve Commission
Indiana Department of Environmental Management
Indiana Department of Natural Resources
Iowa Department of Natural Resources
Kentucky Department of Fish and Wildlife Resources
Maine Department of Inland Fisheries and Wildlife
Maine Department of Marine Resources
Maryland Department of Natural Resources
Massachusetts Division of Fisheries and Wildlife
Michigan Department of Attorney General
Michigan Department of Natural Resources and Environment
Michigan Natural Features Inventory
Minnesota Department of Natural Resources
Mississippi Department of Wildlife, Fisheries and Parks
Nebraska Game and Parks Commission
Nevada Division of Wildlife
New Hampshire Fish and Game Department
New Jersey Division of Fish, Game and Wildlife
New York Sea Grant
New York State Canal Corporation
New York State Department of Environmental Conservation
New York State Office of Parks, Recreation and Historic Preservation
North Carolina Wildlife Resources Commission
Northeastern Illinois Planning Commission

Ohio Biological Survey
Ohio Department of Natural Resources
Ohio Department of Transportation
Ohio Environmental Protection Agency
Ohio Office of Administrative Services
Ohio Sea Grant
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Pennsylvania Sea Grant
Tennessee Wildlife Resources Agency
Texas Parks & Wildlife Department
Vermont Department of Fish and Wildlife
West Virginia Division of Natural Resources
Wisconsin Department of Agriculture Trade and Consumer Protection
Wisconsin Department of Justice
Wisconsin Department of Natural Resources
Wisconsin Department of Transportation
Wisconsin Public Service Commission
Wisconsin Wetland Association

U.S. Federal Agencies/Offices (28)

National Park Service, Apostle Islands NL
National Park Service, Indian Dunes National Lakeshore
NOAA - Great Lakes Environmental Research Laboratory
NOAA - National Marine Fisheries Service
NOAA - National Undersea Research Program
U.S. Air Force
U.S. Army Corps of Engineers
U.S. Bureau of Indian Affairs
U.S. Coast Guard
U.S. Customs
U.S. Department of Agriculture, Animal and Plant Health Inspection Service
U.S. Department of Agriculture, Conservation Reserve Program
U.S. Department of Agriculture, Forest Service
U.S. Department of Agriculture, Natural Resources Conservation Service, Timberland RC&D
U.S. Department of Commerce, National Oceanic and Atmospheric Administration
U.S. Department of Defense, U.S. Army 10th Mountain Division and Fort Drum Division of Natural Resources
U.S. Department of Justice, Assistant United States Attorney, Timothy O'Shea
U.S. Environmental Protection Agency
U.S. Federal Aviation Administration, Baltimore
U.S. Federal Communications Commission
U.S. Forest Service
U.S. Geological Survey, Columbia Environmental Research Laboratory
U.S. Geological Survey, Great Lakes Science Center
U.S. Geological Survey, Leetown Science Center
U.S. Geological Survey, Midcontinent Ecological Science Center
U.S. Geological Survey, Patuxent Wildlife Research Laboratory
U.S. Geological Survey, Upper Midwest Science Center
U.S. National Park Service

Canadian Institutions (8)

Canada Fisheries and Oceans
Canada Natural Sciences and Engineering Research Council
Canadian Heritage Environment
Canadian Wildlife Service
Environment Canada
Ontario Ministry of Natural Resources
Province of Quebec
Trent-Severn Waterway

Commissions (1)

Great Lakes Fishery Commission

NGOs, Foundations and Public Interest Groups (57)

American Fisheries Society
American Fisheries Society, Ohio Chapter

Atlantic Flyway Council
Audubon Society
Bird Conservation Network
Central Flyway Council
Chicago Audubon
Chicago Wilderness
Conservation Resource Alliance
Defenders of Wildlife
Door County Land Trust
Ducks Unlimited
Fish Creek Natural Resource Damage Assessment Trustee Council
Fox Valley Land Foundation
Friends of Jordan River Watershed
Friends of Sleeping Bear Dunes
Fruithaven Farmland Preservation Corporation
Grand River Conservation Authority
Grand Traverse Regional Land Conservancy
Great Lakes Children's Museum
Great Lakes Fishery Commission
Great Lakes Fishery Trust
Green Tree Garden Club
Inland Seas Education Association
International Crane Foundation
International Joint Commission
Izaak Walton League of America, Ohio Division
Leelanau Conservancy
McGraw Wildlife Foundation
Michigan United Conservation Clubs
Mississippi Flyway Council
Mussel Mitigation Trust
National Audubon Society
National Fish and Wildlife Foundation
National Wildlife Federation
Natural Resources Foundation of Wisconsin
Ohio Environmental Education Fund
Ohio Farm Bureau Federation
Ohio Federation of Soil and Water Conservation
Ohio Lepidopteran Society
Ohio Wetlands Foundation
Operation Migration
Ozaukee Washington Land Trust
Pacific Flyway Council
Pheasants Forever
Pheasants Forever, Erie-Ottawa-Sandusky Chapter
Pheasants Forever, Lenawee County Chapter
Ridges Sanctuary
Shirley Heinze Environmental Fund
Sturgeon of Tomorrow
Superior Watershed Partner ship
The Conservation Fund
The Nature Conservancy
Trout Unlimited
Water Management Association of Ohio
Wisconsin Natural Resources Foundation
Wisconsin Society for Ornithology
Commissions

Native American Governments (18)

Bad River Band of Chippewa Indians
Bay Mills Indian Community
Fond du Lac Band of Chippewa Indians
Grand Portage Band of Chippewa Indians
Grand Traverse Band of Ottawa and Chippewa Indians
Keweenaw Bay Indian Community
Little River Band of Ottawa Indians
Little Traverse Bay Band of Odawa Indians
Match-E-Be-Nash-She-Wish Band of Potawatomi
Menominee Indian Tribe of Wisconsin
Nottawaseppi Huron Band of the Potawatomi
Oneida Tribe of Indians of Wisconsin
Red Cliff Band of Chippewa Indians
Red Lake Band of Chippewa Indians
Saginaw Chippewa Tribe
Sokaogon Chippewa Community
St. Regis Mohawk Tribe
Walpole Island First Nation

Native American Treaty Authorities (3)

1854 Authority

Chippewa-Ottawa Resource Authority
Great Lakes Indian Fish and Wildlife Commission

Schools, Colleges and Universities (39)

Ascension Lutheran School
Calvin College
Central Michigan University
Chicago State University
Clemson University
Cleveland State University
Concordia Lutheran School
Cornell University
Lake Superior State University
McGill University
McMasters University
Michigan State University
Michigan State University - Sea Grant
Michigan Technical University
North Carolina State University
Northern Illinois University
Northland College
Notre Dame University
Ohio State University
Otterbein College
Purdue University
State University of New York – Fredonia
State University of New York at Buffalo
State University of New York at Oswego
State University of New York College of Environmental Science and Forestry
Sweet Briar College
Trent University
University of California – Davis
University of Illinois
University of Maryland – Center for Environmental Science
University of Michigan – Ann Arbor
University of Minnesota – Duluth
University of Minnesota – Twin Cities
University of Toledo
University of Toronto
University of Waterloo
University of Windsor
University of Wisconsin – Milwaukee
University of Wisconsin – Stevens Point

Local Institutions and Organizations (35)

Black Swamp Bird Observatory
Chicago Park District
City of Buffalo Parks Department
City of Chicago
City of Cuyahoga Falls
City of Toledo
Cleveland Metro parks
Columbus Zoo and Aquarium
Coshocton Soil and Water Conservation District
Crystal Lake Park District
Elkhart Environmental Center
Erie County Department of Environment and Planning
Erie County Soil and Water Conservation District
Field Museum of Natural History
Holden Arboretum
Ionia County Drain Commission
Jimtown Historical Museum
John G. Shedd Aquarium
Lagrange County Parks Department
Lake Metro parks
Lenawee and Hillsdale County Soil and Water Districts
Lenawee County Soil and Water Conservation District
Monroe County Health Department
Niagara County Soil and Water Conservation District
O'Hare International Airport
Orleans County Soil and Water Conservation District
Put-in-Bay Port Authority
Rosamond Gifford Zoo
Seneca Park Zoo
St. Charles Park District
Summit County Metro parks
Toledo Metropolitan Park District
Toledo Port Authority

Toledo Zoo
Whitefish Point Bird Observatory

Others (15)

A&E Television
Detroit Edison Company
Grand River Partners Inc.
Great Lakes Carrier Association
Great Lakes Power LTD
Hull and Associates
Information Design Group
Lincoln Park Zoo
Morton Arboretum
Office of Senator Carl Levin
Ontario Power Generation
Plum Creek Timber Company
Sault-Edison Electric Company
The Mead Corporation Paper Division, Woodlands Department
United States Steel Corporation

Appendix III: Great Lakes Fishery Resources Restoration Study 32 Recommendations (1995)

1. Develop and Adopt Aquatic Community and Habitat Goals and Objectives to Support Ecosystem Management. Create a mechanism to promote strategic planning, monitoring, and coordination of management activity on a lake by lake basis. This will require reconsideration of the central role of objective setting. Various agreements mandate the development of Ecosystem Objectives, Fish Community Goals and Objectives, and Environmental Objectives for the Great Lakes. Ambiguities associated with these objectives, however, have made derivation of indicators and end points nearly impossible and forced managers to make policy choices. Ideally, objective set-ting represents social preference for tradeoffs of user interests as balanced by responsible stewardship for the natural resources of the Great Lakes. A more strategic approach requires: 1) viewing the development of ecosystem objectives as a progressive, vision clarifying process; 2) developing end points from objectives; and 3) including explicit milestones to gauge progress toward the objectives as part of the objective setting process. In cooperation with the International Joint Commission, Great Lakes Commission, Great Lakes Fishery Commission, other interjurisdictional agencies, the states' resource agencies and Native American tribal partners, Aquatic Community and Habitat Goals and Objectives should be developed and adopted.

2. Fully Implement the Strategic Plan for Management of Great Lakes Fisheries. The Great Lakes Fishery Convention and the Strategic Plan for Management of Great Lakes Fisheries provide institutional frameworks for coordination of fishery management on the Great Lakes, and linkages to environmental management of the Great Lakes. However, the parties signatory to these agreements need to increase their commitment to implementing these frameworks if the agreements are to be successful. In addition, the Great Lakes Fishery Commission and U.S. and Canadian Federal Governments should quickly propose and provide arbitration procedures acceptable to all signatories of the plan including an evaluation process. If funded at authorized levels, the Act could support the efforts of the signatory parties.

3. Conduct Comprehensive and Standardized Ecological Monitoring. Lack of sufficient ecological information exists to make well advised decisions. Limited ecological monitoring at different trophic levels is occurring, however this needs to be broadened among states, provinces and agencies, and in time and space. Using improved methods and techniques that are currently being developed, monitor all offshore, nearshore and tributary areas and trophic levels of the ecosystem. Efforts should include density and diversity measurements of the aquatic community, especially phytoplankton, zooplankton, and benthic organisms.

4. Standardize Fish Community Assessment Data and Establish Comprehensive Fishery Databases. Compatibility of assessment data between management agencies is required to meet future needs of the Great Lakes fish community. Usefulness of collected assessment data must

be enhanced by establishing database systems that enable maintenance of data integrity among all agencies. The Service should work with other Federal and non-Federal agencies, as appropriate, to develop a uniform, comprehensive lake-wide database containing all available information on: commercial and recreational catch in U.S. waters; fish stocking; stock assessment; coded-wire tagging; and mark-recapture statistics. These databases should be updated on a timely basis in concert with the Lake Technical Committees and individual jurisdictions to achieve data quality and uniformity, as well as continuity with historic data. Programs that will benefit from data standardization include lake-wide creel census programs, lake-wide assessment surveys, stocking programs and recovery of externally and internally marked fish including those with binary coded-wire tags. Protocols for data collection, storage and analyses will be developed along with a database management system that will make information accessible to all agencies.

5. Develop Offshore Capabilities. One or more capable offshore research vessels should be deployed on Lake Superior to gather information on offshore and pelagic fish stocks. Construction of the vessel already funded by the U.S. Congress should be completed without further delay. Midwater trawling and hydroacoustics should be incorporated with bottom trawling to better estimate total species biomass and distribution in all areas of the lake.

6. Fish Community Assessment Program. The need to move to fish community management will require fish community research and monitoring. Many current monitoring programs target a single species, often in limited areas. New methods of sampling need to be developed to assess fish communities and their use of available habitat. Understanding fish recruitment mechanisms and the interaction between species before recruitment will enable managers to develop strategies that will promote self-sustaining fish populations. Ongoing assessment of forage species with hydroacoustic and trawling gear needs to be expanded to include assessments of predator and inshore species. Due to limited vessels to conduct lake-wide assessments, the testing and development of new techniques would require a multi-agency effort. Incorporating existing monitoring programs, such as those using binary coded-wire tags, into a lake-wide fish community assessment also needs to be evaluated. Development and testing of new sampling gear and subsequent protocols will likely take a minimum of five years, after which a specific annual assessment program could be initiated.

7. Fish Community Modeling. Population models combining ecological theory and population dynamics information from assessment programs are useful tools for testing our knowledge of Great Lakes fish community functions and predicting responses to management actions. Recent modeling exercises such as SIMPLE (Sustainability of Intensively Managed Populations in Lake Ecosystems) and IMSL (Integrated Management of Sea Lamprey) have provided valuable insight on species interactions in Lake Michigan, but these models need to be adapted for use in the other Lakes. Further development of population modeling coupled with an enhanced lake-

wide assessment program will provide a powerful and necessary tool for the rehabilitation and management of Great Lakes fisheries.

8. Coordinate State and Native American Tribal Harvest Monitoring and Management: Measure Commercial and Recreational Fish Catches. The Service should assist state and Native American tribal governments in coordination of harvest monitoring and management to ensure that the fishery resource is protected, consistent with the sovereignty and rights of the respective governments. Standardized commercial catch and effort databases need to be developed and historical catch and effort data needs to be integrated with these standardized databases. In addition, fishery agencies should fund and conduct a basin-wide survey to estimate commercial catch and effort, and repeat the survey annually. Currently some agencies conduct recreational fishery surveys while others lack resources to do so. Standard basin-wide creel surveys provide biological, social and economic information for planning and evaluating management actions. A basin-wide creel survey should be conducted to estimate recreational angler catch and effort, the survey should be repeated at intervals sufficient to detect trends in the recreational fishery. The Service should work with the states and Canadian agencies to promote complete creel survey coverage of a uniform quality throughout the Great Lakes.

9. Evaluate Ecological Effects of Stocking and Revise Stocking Strategies, as Necessary, to be Consistent with Proposed Aquatic Community and Habitat Goals and Objectives. Stocking is used throughout the Great Lakes, however the effects of stocking large numbers of fish on the ecosystem and its ability to sustain those fish is not clearly understood. One technique contributing to the evaluation of the ecological effect of stocking is marking all stocked fish. Marking provides an indirect means of measuring natural reproduction by comparing the contribution of marked and unmarked fish in the fisheries, and a means of evaluating the effectiveness of stocking programs. Where stocking is deemed necessary for restoration or to support local fisheries, stocked fish should be distinctively marked to distinguish them from wild fish of the same species.

10. Ecological Information Clearinghouse/Geographic Information System. To evaluate net loss or gain of fish and wildlife habitat, establish a uniform, comprehensive basin-wide ecological database containing all available information linked to physical location in the each of the Great Lakes. In consultation with the International Joint Commission, Great Lakes Commission, Great Lakes Fishery Commission, other interjurisdictional agencies, the states' resource agencies and Native American tribal partners, provide, for each Lake, a single clearinghouse for compiled ecological information to meet research and management needs. It is envisioned that this effort would consist of a distributed network, with each agency maintaining its own data in-house and shipping updated files to the ecological information clearinghouse as necessary in read-only format (this process could be made automatic and transparent). For each of the Great Lakes, a comprehensive Geographic Information System would house the ecological information. Several initiatives have made progress in the development of Geographic

Information System databases, but more effort is required. This effort would focus on determining lake-wide Geographic Information System needs for each Lake and consolidating/interfacing existing Geographic Information System efforts to ensure comparability.

11. Identify, Inventory, Protect and Rehabilitate Significant Habitats. Significant habitats necessary for self-sustaining populations of fish and wildlife are threatened or impaired. Actions should include: identifying and protecting habitats used by fish and wildlife for spawning, breeding, nesting, rearing and feeding; and rehabilitating degraded habitats to be utilized by a diverse community. Service Coastal Refuges present an opportunity to contribute significantly to this effort.

12. Develop and Implement Action, Restoration and/or Enhancement Plans for Exploited and/or Declining Indigenous Aquatic Species. Action, restoration and/or enhancement plans are important tools for maintaining integrity and biodiversity of the ecosystem. The Service should support appropriate Lake Commit-tees and stakeholders in the development of action, restoration and/or enhancement plans for declining indigenous species (including unionid mussels, American eel, Atlantic salmon, lake trout, brook trout, coaster brook trout, shortjaw cisco, lake whitefish, walleye, yellow perch, arctic grayling, lake sturgeon, northern pike, muskellunge, smallmouth bass, large-mouth bass, common loon, mink and river otter) and exploited species (including steelhead, chinook and coho salmon). The plans should be developed to be consistent with the pro-posed Aquatic Community and Habitat Goals and Objectives. Strategies might include, but not be limited to: continuing and expanding monitoring of populations and/or harvest; standardizing assessment procedures; setting harvest limits to protect exploited populations; and identifying and protecting sensitive habitats.

13. Develop and Implement Action/Restoration Plans for Forage Fish. Action plans are an important tool for maintaining integrity and biodiversity of the ecosystem. The Service should support appropriate Lake Committees and stakeholders in the development of an action plan for forage fish consistent with the proposed Aquatic Community and Habitat Goals and Objectives.

14. "Close the Door" on Nonindigenous Species Introductions. Public agencies and non-governmental organizations should cooperate to prevent transport and release of viable organisms into the Great Lakes. Pathways of introduction include ballast water transport, bait bucket transfer, releases from aquaculture or stocking practices and boating. Solutions must be biologically effective, as well as practical, and be based on engineering, operational, regulatory, economic and safety factors. For example, research and development is needed on potential ballast water management options that have already been identified in collaboration with the maritime industry. The studies must be interdisciplinary, involving biologists and engineers, business operators and government personnel. To support research and monitoring of

management options, it will be necessary to develop techniques for bio-sampling of ballast tanks on Great Lakes and ocean-going ships.

15. Implement and Expand Effective Sea Lamprey Control. The U.S. State Department and Fisheries and Oceans Canada, parties to the Great Lakes Fisheries Convention, should meet obligations according to agreed upon funding formulas and fund the Great Lakes Fishery Commission's mandated program. In its Strategic Vision for the Decade of the 1990s, the Great Lakes Fishery Commission has pledged to support fishery management goals by providing "an integrated sea lamprey management program that supports the Fish Community Objectives for each of the Great Lakes and that is ecologically and economically sound and socially acceptable." Fundamental to meeting the vision is an accelerated research program to develop alternative controls to reduce dependence on chemicals, implementation of a control program on the St Mary's River, evaluation of the sterile male release program, and an increase in assessment activities to meet program objectives.

16. Great Lakes Fishery Commission Line Item Funding for Sea Lamprey Control Efforts in the St. Mary's River. The sea lamprey population in the St. Mary's River has been identified as the most serious impediment to sea lamprey control in the Great Lakes. It is also considered one of, if not the most significant, impediments to restoring a healthy fish community in Lake Huron. The size of the river precludes conventional treatment methods and requires the development of specific control strategies. Funding for sea lamprey control has been marginal, at best, over the last several years and has allowed only routine treatments of major lamprey producing tributaries in the upper Great Lakes, excluding the St. Mary's. To ensure proper attention to the most serious problem area, additional funding specifically identified for the St. Mary's River is needed.

17. Fund Implementation of the Great Lakes Fishery Commission's Basin-wide Sea Lamprey Barrier Plan. Construction of low-head dams and electrical barriers to block migrations of spawning adults can reduce lampricide use and provide more effective control by limiting habitat available to lamprey and removing spawning adults at traps. Of the U.S. Great Lakes tributaries regularly treated with lampricide, many have sites where barriers could be constructed. These U.S. projects have the potential to reduce basin-wide lampricide use, cut treated stream mileage, and significantly reduce populations of parasitic lampreys.

18. Prevent or Delay the Spread of Ruffe. The Ruffe Control Program, the first such program to be prepared under the Nonindigenous Aquatic Nuisance Prevention and Control Act, should be implemented by appropriate government and private entities. The program is an integrated plan that addresses each of the ways by which ruffe may spread. Range reduction by chemical treatments, prevention of ballast water transport and education to prevent movement via anglers and bait dealers are all essential to containing the ruffe and must be supported by vigilant monitoring and surveillance. Portions of a control program have been implemented.

19. Determine the Impacts of Hydroelectric Facilities and Dam Operations on Fishery Resources. Fishery resources are impacted by dams inhibiting upstream and downstream passage, creating unstable habitat and causing entrainment-related mortalities. The extent of these impacts on the aquatic community is unknown. Specifically, the following impacts need to be determined: dewatered areas and minimum flow requirements; water-level fluctuations on fish spawning, fecundity and condition, aquatic vegetation and invertebrates; and entrainment on fish communities.

20. Increase Involvement in the Bi-national Program to Restore and Protect Lake Superior and Expand this Mechanism to Lakes Huron, Erie, and Ontario. Fishery managers should increase their involvement with the Bi-national Program.

21. Establish Uniform Tissue and Sediment Contaminant Levels Used by Various Agencies for Ecosystem Health. Contaminant levels are inconsistent or absent among agencies. Uniform levels are needed to prevent reproductive, aesthetic, and consumptive impairments. Specific strategies should include evaluation of agency programs that established the current contaminant levels and conducting additional studies to address information gaps.

22. Broaden the Scope of Current State Anti-degradation Policies. Current state water quality anti-degradation policies do not specifically address biological integrity. These policies should be reviewed and revised, if necessary, to clearly state their goal of biological integrity as the Clean Water Act and Great Lakes Water Quality Agreement intend.

23. Develop and Implement an Action Plan to Analyze Contaminant Level Effects on Aquatic Resources. Monitoring of contaminants and analysis of their effects occurs on a limited basis throughout the basin. A plan should be developed to include the following: establishment of regular monitoring at standard locations; identification of effects on fish reproduction, egg development, fry emergence and larval survival; identification of effects on plants, plankton, macro-invertebrates and piscivorous wildlife; and determination of rates of bioaccumulation within the food web.

24. Participate in Remedial Action Plans, Lake-wide Management Plans, and the Environmental Monitoring and Assessment Program. As remedial action projects are implemented, their effects on the fish and wildlife community need to be assessed. Fishery managers should increase their involvement with Remedial Action Plans and contribute to the Monitoring and Assessment Program planning process in the Great Lakes.

25. Salmonine Egg Viability. The viability of lake trout eggs and Pacific salmon eggs from Lake Michigan has been a point of concern. Cause and effect relationships need to be explored through research efforts. In addition, the effect of poor egg survival needs to be monitored from a rehabilitation and management perspective, to determine the overall effect on Lake Michigan fish communities. The viability and hatching success of lake trout or salmon that mature in Lake

Michigan will provide an indicator of the health of the Lake Michigan ecosystem. A monitoring program needs to be designed to provide a systematic measure of the egg viability of key fish species in Lake Michigan.

26. Establish and Isolation or Quarantine Facility. Management agencies are concerned about maintaining wild genetic strains in hatchery broodstocks of lake trout and possibly coaster brook trout. To accomplish this, wild gametes must pass disease clearance in an isolation facility prior to introduction to hatchery systems. Such a facility should also be designed to support imported adult salmon and other fish from outside the Great Lakes Basin for broodstock development and should be capable of isolating six lots of fish.

27. Develop an Epizootic Epitheliotrophic Disease (EEDV) Diagnostic Test. A diagnostic test for EEVD is needed to expedite determination of disease in lake trout eggs and young fish for the purpose of establishing lake trout broodstocks from wild Great Lakes stocks.

28. Fish Health. Low egg viability and diseased salmonids are examples of the problems that develop when recruitment of these predators is dependent on intensive aquaculture. Maintenance of fish health within the hatchery has been well researched. Wild fish health and its potential to be an indicator of ecosystem health is a field of study that is not as well developed. Appropriate indicators of fish health should be developed for key fish species in the wild. An example is the recent decline of chinook salmon in Lake Michigan where a lack of knowledge concerning fish health in the wild exists.

29. Fish Genetics. Since the collapse of indigenous Great Lakes fish and fisheries in recent decades, the rehabilitation of indigenous fishes is an attempt to recolonize the Lakes, a phenomenon that occurred historically following periods of glaciation. The extinction of gene pools adapted to the Lakes for species like lake trout and possibly lake herring, raises concern over the ability of available genetic strains to effectively recolonize all of the available habitat. Analyses of available genetic strains and their survival in the Lakes are crucial for indigenous species restoration efforts.

30. Lethality of Sea Lamprey Attacks. Research is needed to evaluate the effects of sea lamprey wounding on mortality of fish species other than lake trout. For example, attacks on chinook salmon are extensive, but the timing of these attacks and their contribution to overall mortality is not known. Research has been conducted with lake trout to quantify mortality resulting from sea lamprey attacks but similar work is needed with other species, especially in light of burgeoning lamprey populations in northern Lake Huron.

31. Develop Aquatic Resource Education Programs. Education programs focusing on the values, functions and dynamics of ecosystems are needed so that society understands their role in the system and makes informed decisions. Education programs should focus on issues such as the prevention and control of nonindigenous nuisance species introductions, the role of

deliberately introduced nonindigenous self-sustaining and supplementally stocked species, indigenous species restoration (e.g. lake trout, lake sturgeon), habitat restoration, and endangered species.

32. Conduct a Cormorant Fishery Predation Study. A fishery predation study to determine the diet of the Great Lakes cormorant population, similar to that started in 1992 by the Fish and Wildlife Service, Canadian Wildlife Service and New York State Department of Environmental Conservation should be conducted for each of the Great Lakes to quantify fishery predation and generate recommendations to decrease predatory impacts on newly-stocked fish, if necessary.

Appendix IV: Service Fisheries Program Office Accomplishments 1990-2010

Work of the Alpena, Michigan, Fish and Wildlife Conservation Office (FWCO) is geographically focused within the Lake Huron Basin, the western and central basins of Lake Erie, and the Huron-Erie corridor. This station also chaired and co-chaired the Modeling Sub Committee of the Technical Fisheries Committee and chaired the Technical Fisheries Committee of the U.S. District Court Consent Decree covering 1836 Treaty waters in lakes Superior, Huron and Michigan.

The station is staffed by 13 employees, with two satellite offices In Cheboygan, MI (M/V Spencer F. Baird vessel base) and Waterford, MI (Waterford substation) involved with native lake trout and lake sturgeon restoration, management of lake trout and whitefish fisheries, ruffe and round goby monitoring activities, restoration of wetlands and stream habitat including fish passage, addressing trust responsibilities to 6 tribes and one tribal treaty authority, providing technical assistance to National Wildlife Refuges in Michigan and Ohio, fulfilling the Service's commitments under the Joint Strategic Plan for Managing Great Lakes Fisheries, and providing public education and public use opportunities.

Below are examples of Alpena FWCO accomplishments with funding provided through the Act:

Lake trout restoration activities for Lake Huron

- Evaluated lake trout propagation by National Fish Hatchery System
- Conducted annual fall spawning surveys at Six Fathom Bank Refuge and Yankee Reef complex in central Lake Huron
- Led planning with Ontario Ministry of Natural Resources for the development of a Parry Sound lake trout strain brood stock for use in rehabilitation efforts in U.S. waters of Lake Huron
- Led a project to evaluate the success of a program change at the Jordan River NFH to enhance the quality of yearling lake trout stocked in U.S. waters of Lake Huron
- Led a project to evaluate and quantify movement patterns of stocked lake trout in near shore and offshore waters of Lake Huron
- Collaborated with Michigan DNR, University of Vermont, and DLZ Michigan consulting firm to construct artificial reefs and evaluate the usage of these reefs by lake trout
- Annually processed tags recovered from Service, state and tribal assessment fisheries, state recreational and tribal commercial fisheries in Lake Huron
- Collaborated with Lake Huron management agencies to collect and contribute genetic samples to evaluate genetic diversity of lake trout basin-wide
- Co-authored annual summary of coded-wire tag studies for Lake Huron Committee meeting

- Assisted with the stocking of lake trout throughout the lakes from the new stocking vessel, the M/V Spencer Baird
- Coordinated stocking and biological assessment efforts of the M/V Spencer F. Baird in collaboration with regional National Fish Hatcheries and Fish and Wildlife Conservation Offices.
- Conducted surveys of lake whitefish to assist management actions and establishment of harvest quotas in 1836 Treaty Waters of Lake Superior

Lake sturgeon restoration activities for Lake Huron and the St. Clair Corridor

- Coordinated interagency collaboration for lake sturgeon restoration in Lake Huron, the St. Clair River corridor, and western Lake Erie through the Central Great Lakes Bi-national Lake Sturgeon Group
- Collaborated with Ontario MNR and Michigan DNR for lake sturgeon tagging in the main basin of Lake Huron and the St. Clair River Corridor
- Collected, coordinated and contributed genetic samples, and worked with geneticists, to evaluate genetic diversity of lake sturgeon basin-wide
- Worked with state and tribal commercial fishers and natural resource offices to collect data on incidentally caught lake sturgeon
- Led studies to assess habitat use and movement in the southern Main Basin of Lake Huron, the St. Mary's River, and the upper St. Clair River through the use of ultra-sonic tagging
- Led the development of and provided oversight for a Great Lakes-wide lake sturgeon tagging database
- Developed and managed the Great Lakes Lake Sturgeon Web-Site
- Co-investigator on project to develop a management plan for lake sturgeon within the Great Lakes Basin based on population genetics structure

Lake Huron Technical Committee (LHTC) activities

- Participated as member and cooperate in interagency activities coordinated through the LHTC
- Served as member of LHTC Lake Trout Task Group to coordinate activities associated with rehabilitation efforts in Lake Huron
- Served as chair of the LHTC Lake Sturgeon Task Group to coordinate activities associated with charges received from the LHC relating to lake sturgeon restoration efforts
- Served as co-author for the Offshore Predators and Their Fish Community sections of the 1999 and 2004 State of Lake Huron Reports

- Served as co-author on several Lake Huron Technical Committee special publications including: Strategy and Options for Promoting the Rehabilitation of Cisco in Lake Huron
- Led the development of a standardized Lake Huron coded-wire tagging database that houses all agency tag returns and enhances interagency collaboration and data analysis
- Provided technical assistance, project oversight and administration of Great Lakes Basin Fish Habitat Partnership funded projects in the Lake Huron Watershed
- Continued to develop new partnerships and expand the National Fish Passage Program in the Lake Huron Watershed, especially in the southwestern part of Michigan
- Coordinated with the Partners for Fish and Wildlife program to strategically leverage funds to benefit native fish and wildlife resources in the Lake Huron Basin

Provides Technical Assistance

- Provided statistical catch at age modeling expertise for management agencies
- Provided expertise on wetland and fish habitat restoration projects
- Provided technical assistance to agencies for burbot ageing studies
- Provided assistance to tribal agencies for the development of management plans
- Evaluated lake trout propagation by the National Fish Hatchery System
- Developed brood stock management plan for Service lake trout hatcheries
- Assisted Tribal biologists with assessment study designs and activities
- Participated in Region 3's Habitat Team to promote coordinate and implement habitat restoration projects in the lakes Huron and Erie Watersheds using the best science
- Represented the Service on the Corp of Engineers/FWS team on Wind Power
- Developed SOP for hydroacoustic and trawling efforts performed from the M/V Spencer Baird
- Provided leadership and technical assistance for fish passage improvement programs in northern Michigan
- Provided assistance to tribal agencies for the assessment of walleye stocks in Treaty Ceded Waters
- Provided technical expertise on Federal Energy Relicensing Commission issues in the Thunder Bay River and Lake Huron

Outreach and Education Activities

- Delivered outreach program highlighting agency, station and Great Lakes activities to various public forums (school groups, conservation groups, public festivals), with an emphasis in recent years connecting children with nature
- Developed and updated internet web sites for the station, Region 3 Fisheries Program and Great Lakes Lake Sturgeon

- Began efforts to form an Alpena Fish and Wildlife Conservation Office friends group
- Led efforts for Invasive Species education in northern Michigan and works jointly with the Michigan DNR for an annual Invasive Species Awareness Week at the state capitol

Aquatic Invasive Species Activities

- Conducted annual surveillance surveys for ruffe in Lake Huron
- Participated in activities of the ruffe control committee
- Distributed ruffe identification and educational materials to boaters, anglers, and others
- Conducted annual surveillance specifically for round goby in lakes Huron and Erie

The Lower Great Lakes FWCO Amherst, New York, is currently staffed by 16 employees involved with native lake trout, lake sturgeon, estuary and tributary studies, environmental monitoring, aquatic invasive species, aquatic habitat restoration, and public outreach and education. The geographic focus of Great Lakes work is lakes Erie and Ontario.

Below are examples of Lower Great Lakes FWCO accomplishments with funding provided through the Act:

Lake trout restoration activities for Lake Erie and Lake Ontario

- Participated in Lower Great Lakes Interagency Lake Trout Group
- Participated in Lake Erie Coldwater Task Group
- Coauthored A Management Strategy for Lake Ontario Lake Trout, an update to the Lake Ontario lake trout restoration plan, and A Strategic Plan for the Rehabilitation of Lake Trout in Lake Erie 2008-2020
- Assisted with lake trout tagging and assessment and conducted studies of survival of hatchery fish
- Conducted lake trout genetic evaluation and movement study in the lower Niagara River

Lake sturgeon restoration

- Held the workshop: Conservation and Management of Lake Sturgeon in the Great Lakes: Problems and Perspectives, Issues and Concerns, and published proceedings
- Collaborated with the other Great Lake Fisheries Offices to organize the Great Lakes Lake Sturgeon Coordination Meetings in 2002, 2004, and 2008 and published proceedings for each
- Collected sturgeon samples from several Lower Great Lakes sites for genetic analysis and additional data on those populations

- Tracked movement and habitat use of lake sturgeon in the lower Niagara River from 1998-2000 and again in 2010-2011. In addition, conducted a mark recapture study to determine the lower Niagara River lake sturgeon population size
- Evaluated survival and movement of stocked lake sturgeon in the Oswegatchie River
- Evaluated habitat use by sturgeon on the Genesee River
- Evaluated contaminant levels in Genesee River lake sturgeon
- Worked cooperatively with Canadian commercial fishers and natural resource offices to collect data on incidentally caught sturgeon
- Provided technical expertise and support to partner agencies

Lake Ontario and St. Lawrence River Atlantic Salmon Restoration

- Established and maintained two strains of Atlantic salmon broodstock and provided fish from Allegheny NFH for stocking at Lake Ontario sites
- Conducted studies of habitat and other conditions necessary for Atlantic salmon restoration
- Coordinated the transfer of Atlantic salmon eggs and fry to the St Regis Mohawk Tribes for restoration activities in the St Lawrence River

Aquatic Invasive Species Activities

- Conducted annual surveillance surveys for ruffe in Lake Erie and Lake Ontario. Sites included Sandusky, Toledo, Cleveland, Ashtabula, Conneaut, Erie, Buffalo, and Rochester
- Participated in activities of the ruffe control committee
- Distributed ruffe identification and educational materials to boaters, anglers, and others
- Since 2008, conducted early detection, monitoring, and control (hand pulling and mechanical harvesting) of water chestnut in Tonawanda Creek, a tributary of the Niagara River
- Conducted annual surveillance specifically for round goby in the New York State Canal System including the Erie, Oswego, and Cayuga-Seneca Canals
- Conducted annual early detection surveys for non-native fish across the New York State Canal System
- Conducted early detection surveys for *Hemimysis anomala* in Lake Ontario
- Conducted early detection and monitoring surveys for New Zealand mudsnail in tributaries of Lake Ontario
- Conducted annual surveys since 2004 for Asian carp in the western basin of Lake Erie
- Drafted and produced “WATCH” card for water chestnut as well as factsheets for northern snakehead, the Erie Canal, and water gardens

- Conducted 23 workshops on Erie Canal invasive species for over 400 Great Lakes area educators from 1998 to 2010
- Participated and served on committees of the Great Lakes ANS Panel
- Developed and provided Hazard Analysis and Critical Control Point (HACCP) training to bait dealers, universities, natural resources professionals, and private industry within the Great Lakes basin
- Assisted in rotenone treatment for Asian carp in the Chicago Sanitary and Ship Canal
- Served on the steering committee of the Western New York Partnership for Regional Invasive Species Management

Lake Ontario and St. Lawrence River American Eel conservation

- Assisted USGS Tunison Lab with mark and recapture study of American eel in the Niagara River and St Lawrence River
- Evaluation of obstructed fish passage for tributaries within the Great Lakes and Atlantic coast watersheds to determine habitat loss
- Prepared paper on American eel in Lake Ontario covering distribution, abundance, life history and requirements for restoration

Lake Ontario and Lake Erie fish community and environmental objectives

- Participated on the Lake Ontario Technical Committee
- Participated on Lake Ontario and Lake Erie LaMP executive committees and working groups
- Participated in development of fish community goals and environmental goals for Lake Erie and Lake Ontario, preparing species life histories for burbot, lake herring and lake sturgeon
- Participated on the Lake Erie Committee's Forage Task Group and help coordinate the lower trophic level assessment program and coauthored annual reports

Lower Great Lakes estuary and tributary activities

- Participated in wetland restoration activities
- Conducted sampling activities to assess fish habitat, fish production and trophic conditions for several tributaries
- Participated in activities of the Times Beach Nature Preserve Working Group, developing public access and assessing potential for environmental restoration
- Participated in aquatic habitat and community monitoring for restoration on Ellicott Creek, Buffalo Creek, and Cazenovia Creek, NY

- Prepared Fishery Enhancement Plans for four Lake Ontario tributaries and one St Lawrence River tributary for the New York DEC
- Assisted with coordination and planning for GIS development and data
- Assisted the USGS with development of the Great Lakes Aquatic GAP program Coastal component
- Participated in the Remedial Action Committees for the Buffalo River and Niagara River Areas of Concerns
- Conducted larval and juvenile fish survey of the Niagara River

Outreach and Education Activities

- Hosted LGLFWCO Open House and Fish and Wildlife Festivals, which attract approximately 2,000-3,000 people annually
- Hosted annual University at Buffalo Great Lakes Ecology Class at LGLFWCO
- Provided electrofishing demonstration and fish educational outreach for biennial Great Lakes Student Summit
- Provided electrofishing demonstration and fish educational outreach for Centers for Ocean Sciences Education Excellence – Lake Ontario Workshop
- Participated in NYSDEC Fall Festival at Reinstein Woods
- Participated in Great Lakes Fisheries Leadership Institute
- Participated in Western New York Earth Day celebrations
- Participated annually in Erie County Fair and have won several awards in the Conservation Department
- Participated in Fleet Waterfront Festival
- Worked with Scout Troops and Town of Amherst on the Dann Lake Restoration Program; the Scouts were given a Presidential Award for this program
- Participated in the Niagara County and Orleans County Conservation Field days
- Participated in the Erie Canal Fest
- Participated in the annual Erie County Envirothon
- Provided sportfishing training for “Women in the Outdoors” workshop at Montezuma NWR
- Participated in International Migratory Bird Day
- Participated in the annual New York Power Authority annual Wildlife Festival
- Participated in the annual Tonawanda Kid’s Fishing Derby
- Participated in the Boundary Waters Treaty Centennial Celebration
- Participated in the annual Iroquois NWR Spring Into Nature event
- Provided general Great Lakes outreach and presentations to Scout groups, at school career days, sportfishing organizations, and non-governmental organizations

Habitat Restoration Activities

- Implemented Camillus Dam removal to restore fish passage to 4 miles of stream habitat along Nine Mile Creek
- Replaced Sevier Road crossing and restore 300 linear feet of stream to re-establish fish passage to 1 mile of habitat in the Nine Mile Creek watershed
- Restored 1,600 linear feet of stream habitat restoration along Wiscoy Creek
- Restored ¼ acre of warm season grasslands and wildflower meadow to create Schoolyard Habitats at South Park High School
- Restored 10 acres of warm season grasslands and wildflower meadow along the Robert Moses State Parkway
- Assisted with community-based projects to plant trees and restore habitat and ecological function to stream and wetland riparian buffers
- Led interagency efforts to field assess road-crossings over streams to identify and inventory barriers, and develop a GIS-based database to prioritize fish passage restoration projects in the Lake Ontario plain
- Conducted assessment to characterize fish community and habitat conditions in DeWitt Pond, Scajaquada Creek, and at Iroquois National Wildlife Refuge
- Assisted Lake Ontario Stream Barrier Assessment Team to inventory first and second barriers in the Lake Ontario basin, and identify priority sites for fish passage restoration
- Conducted delineation and functional assessment of wetlands at the Niagara Falls Air Reserve Station
- Provided technical assistance to develop Westfield Dam Fish Passage Restoration along Chautauqua Creek
- Conducted stream surveys to determine brook trout status and threats throughout the eastern basin of Lake Ontario
- Participated in the Tonawanda Creek Watershed Committee
- Provided technical assistance to the Fishery Advisory Committee of the Fish Enhancement Mitigation and Research Fund
- Provided presentations to non-government organizations to promote fish and wildlife habitat conservation and restoration

Work of the Ashland, Wisconsin, FWCO is geographically focused within the Lake Superior Basin and has been in operation since 1978**.** Activities were refocused toward the Service's Great Lakes Restoration Act goals, including restoration of Great Lakes fisheries, beginning in 1992. Work of the Ashland FWCO is geographically focused within the Lake Superior Basin, however it is also engages in aquatic invasive species activities in the Great Lakes, and co-manages the Service's Coastal Program – Great Lakes along with the East Lansing, MI

Ecological Services Field Office, and delivers the Service's Partners for Fish and Wildlife Program across an eight county region in northern Wisconsin.

Ashland FWCO is currently staffed by 7 employees that are involved with: fulfilling the Service's commitments under the Joint Strategic Plan for Managing Great Lakes Fisheries; native lake sturgeon and brook trout restoration; management of lake trout, lake whitefish, and walleye fisheries; fulfilling requirements under the 2000 Consent Decree; coordinating Aquatic Invasive Species (AIS) early detection and monitoring activities; addressing trust responsibilities to 14 tribes and three tribal treaty authorities; providing technical assistance to National Wildlife Refuges, National Forests, and National Parks in the Lake Superior basin; assisting the Division of Ecological Services in the review of federal projects in the Lake Superior basin; coordinating the Great Lakes Basin Fish Habitat Partnership under the National Fish Habitat Action Plan; restoration of wetlands, uplands, coastal areas, and stream habitats including fish passage; representing the Service in the Lake Superior Bi-national Program; and providing public education, outreach, and use opportunities.

Below are examples of Ashland FWCO accomplishments with funding provided through the Act:

<u>Lake Superior Technical Committee (LSTC) activities</u>

- Participated as LSTC member and cooperated in interagency activities coordinated through the Lake Superior Committee
- Chaired the LSTC Lake Sturgeon Work Group, whose objective is to coordinate and monitor lake sturgeon rehabilitation efforts
- Assisted with lake-wide spring gill net surveys of siscowet lake trout
- Fulfilled data requests from fishery agencies and universities researching lake trout diet and demographic characteristics, coaster brook trout and lake sturgeon biological and genetic information, and nearshore fish community composition
- Participated and contribute to Lake Superior Committee functions at Great Lakes Fishery Commission meetings
- Led or co-authored of lake sturgeon, brook trout, nuisance species, and ecological interactions sections of State of Lake Superior reports in 2000 and 2005
- Participated on Lake Superior Binational Program Task Force and Co-Chair the Aquatic Community Committee to develop and implement the Lake Superior LaMP
- Contributed to development of environmental objectives

<u>Brook trout restoration activities in Lake Superior</u>

- Provided subject matter expertise in review of coaster brook trout petition to list as endangered under the Endangered Species Act.

- Implemented management and/or rehabilitation plans with Wisconsin and Michigan DNR, Grand Portage, Bad River, Red Cliff and Keweenaw Bay Indian Tribes, Isle Royale National Park, Pictured Rocks National Lake Shore, and Whittlesey Creek National Wildlife Refuge
- Maintained two strains of coaster brook trout brood stocks from Lake Superior for rehabilitation stocking efforts
- Established remote PIT tag detection stations on six Lake Superior tributaries to monitor movement of brook trout between the lake and stream environments
- Collected samples and coordinate grants and submission of samples to geneticists for basin-wide and regional genetic studies associated with wild and hatchery stocks
- Co-authored papers and contributed data for the Lake Superior Brook Trout Initiative to advance scientific knowledge of coaster brook trout
- Conducted pilot project using side-scan sonar to characterize and geo-reference shallow water substrate in Lake Superior
- Contributed to Canadian efforts to manage coaster brook trout fishery management in Lake Superior, Lake Nipigon, and Nipigon River
- Conducted tributary and nearshore surveys at Isle Royale National Park to assess the status of coaster brook trout and evaluate restoration stocking efforts
- Initiated a brook trout status, distribution, and threats analysis associated with landscape level GIS metrics across their native range in the Great Lakes

<u>Lake sturgeon restoration activities in Lake Superior</u>

- Organized basin-wide coordination meetings to facilitate coordination, communication, and disseminate information that promotes rehabilitation of lake sturgeon
- Implemented lakewide rehabilitation plan by providing technical expertise, consultation, and field assistance on sturgeon projects
- Worked cooperatively with tribal commercial fishers and natural resource offices to collect data on incidentally caught lake sturgeon
- Assessed and evaluated remnant population in Bad and White rivers on Bad River Indian Reservation, Wisconsin
- Co-authored stocking guidelines for the genetic management of lake sturgeon in the Great Lakes basin
- Co-authored identification of non-spawning lake sturgeon in the Great Lakes basin
- Led development of a lake-wide juvenile lake sturgeon index survey to assess population status and monitor rehabilitation progress
- Coordinated collection and submission of lake sturgeon tissue samples and work with geneticists, to evaluate population genetic structure and diversity

- Contributed to development of a lake sturgeon tag identification database to facilitate coordination among researchers and biologists
- As opportunities arose provided lake sturgeon samples for contaminant analysis

Lake Trout

- Provided field support to compare the phenotypic and genetic diversity of lake trout in the Isle Royale region of Lake Superior with that found in other large lakes of Canada
- Contributed to evaluation of ecological and environmental factors underlying genetic and phenotypic lake trout diversity around Isle Royale National Park
- Contributed to examination of timing of reproductive maturation in siscowet lake trout in southern Lake Superior

Cisco (shortjaw and cisco) review

- Peer reviewed range-wide status review, and provided technical assistance to identify data and information gaps
- Contributed in field and as co-author to multi-year project to examine the timing, distribution, and composition of spawning stocks in Lake Superior
- Co-investigator examining the spatial and temporal overlap between rainbow smelt and larval cisco

2000 Consent Decree

- Conducted surveys of lake whitefish to assist management actions and establishment of harvest quotas in 1836 Treaty Waters of Lake Superior

AIS

- Developed a strategic approach to identification and monitoring aquatic invasive species in the Great Lakes Inventory and Monitoring Network parks
- Contributed to development of an early detection and monitoring approach to aquatic invasive species in the St. Louis River estuary, Wisconsin/Minnesota
- Conducted surveys designed for early detection and monitoring of aquatic invasive species in the three busiest shipping ports on Lake Superior

Technical Assistance

- Provided assistance to tribal and university staff rearing walleye and brook trout
- Consulted with state, tribal, and federal biologists and academia to evaluate a plan to re-establish a lake sturgeon population in the Ontonagon River, Michigan

- Assisted with registration and collection of biological and tag data during lake sturgeon spearing on Lake Winnebago, Wisconsin

Conserving fish and wildlife habitat

- Coordinated the Great Lakes Basin Fish Habitat Partnership under the National Fish Habitat Action Plan and served as Co-chair of the Partnership's Steering Committee
- Worked with partners to restore wetlands, uplands, coastal and instream habitats, such as fish passage, to improve fish and wildlife populations in the Lake Superior basin
- Developed a Dendritic Connectivity Index for priority watershed throughout the Lake Superior basin to benefit brook trout fish passage
- Described and inventory priority fish habitats for brook trout and sturgeon
- Developed plan and contribute to study to describe and quantify nearshore habitat for coasters at Isle Royale National Park, Michigan

- Participated in Region 3's Habitat Team to promote coordinate and implement habitat restoration projects in the Lake Superior Watershed using the best science.
- Developed plan and contribute to study to describe and quantify tributary habitat for riverine and migratory species with focus on lake sturgeon

Outreach and Education Activities

- Reports, web sites, Facebook page, aquatic education, participation in public events, professional presentations, and interviews

Work of the Green Bay, Wisconsin, Fish and Wildlife Conservation Office is geographically focused within the Lake Michigan Basin, however, this station provides technical assistance in collecting, analyzing, and reporting fisheries data to Service stations Great Lakes-wide and maintains the Great Lakes Fish Stocking Database.

The station is staffed by 10 employees with a satellite office in Elmira, MI. The office is involved with native lake trout and lake sturgeon restoration, management of lake trout, whitefish, walleye and yellow perch fisheries, restoration of stream habitat including fish passage, addressing trust responsibilities to 7 tribal governments and one tribal treaty authority. We are also involved in fulfilling the Service's commitments under the Joint Strategic Plan for Managing Great Lakes Fisheries, providing technical assistance in our Natural Resource Damage Assessment program, representing the Service on the Scientific Advisory Team to the Great Lakes Fishery Trust, coordinating and conducting a basin-wide program for mass marking,

facilitating streamside rearing and rehabilitation stocking of lake sturgeon, fish passage development at hydroelectric facilities, and providing public education and public use opportunities.

Below are examples of Green Bay FWCO accomplishments with funding provided through the Act:

Activities Supporting the Cooperative Interjurisdictional Fisheries Management through the Lake Michigan Committee and Council of Lake Committees

- Served as Chairman of the lake trout task group; saw to completion *A Guide for the Rehabilitation of Lake Trout in Lake Michigan*
- Served as chair of the Lake Sturgeon Task Group, the Data Committee, and as members on the Benthivore, Data, Habitat, Salmonid, Planktivore, and Sea Lamprey Committees of the Lake Michigan Committee
- Edited the State of Lake Michigan in 2000 special publication of the Great lakes Fishery Commission to the Lake Michigan Committee
- Co-authored or authored State of the Lakes Chapters on lake trout restoration in Lake Michigan and Superior
- Authored chapters in the State of the Lake Reports to the Lake Michigan Committee on lake sturgeon status and rehabilitation in Lake Michigan in 2000, 2005 and 2010
- Co-authored State of the Lakes Chapters on the planktivore and salmonine fish communities in Lake Michigan in 2000 and 2005
- Organized, moderated, and helped present a feature session on Great Lakes lake sturgeon research and rehabilitation for the Lake Committee's Common Session in 2007
- Served as co-chair of the Implementation Task Group on Mass Marking Hatchery-reared salmonines in the Great Lakes at the request of the Council of Lake Committees
- Developed a report outlining the cost and equipment required to implement mass marking in the Great Lakes
- Led the implementation of a mass marking program in the Great Lakes
- Senior authored a book chapter describing the mass marking initiative on the Great Lakes.
- Contributed to the development and work of the Lake Michigan Technical Committee Salmonine Work Group including the co-authoring of annual reports and a published paper on the management of the salmonine fishery in Lake Michigan.
- Led the development of genetic conservation, prorogation and stocking strategies for lake sturgeon in Lake Michigan and co-authored the GLFC published Genetic Guidelines for the stocking of Lake Sturgeon in the Great Lakes Basin.
- Conducted or assisted in spring gill net surveys at five locations following the Lakewide Assessment Plan (LWAP) protocol

Lake Trout Restoration Activities in Lake Michigan and the Great Lakes Basin

- Sampled for young of year wild lake trout at the Midlake Reef Complex to determine rates of natural reproduction
- Assisted with the stocking of lake trout throughout the lakes from the new stocking vessel, the M/V Spencer Baird
- Processed lake trout coded wire tags lake-wide from all agencies on Lake Michigan and maintains database
- Collected lake trout eggs from northwestern Lake Michigan to assess trends in Early Mortality Syndrome
- Evaluated lake trout propagation by the National Fish Hatchery System
- Developed brood stock management plan for Service lake trout hatcheries
- Led the collection of eggs and development of the Klondike strain brood stock from wild Lake Superior lake trout
- Led the completion of a document on possible impediments to lake trout restoration in Lake Michigan
- Collaboratively worked with state, federal, tribal, or university biologists or researchers on the following projects:
    - Researched the gonadal development of lean and siscowet lake trout in Lake Superior
    - Researched identifying specific fatty acid biomarkers for use in monitoring predator (lake trout) diet
    - Researched describing differences in fatty acid composition among lake trout eggs sampled throughout the Great Lakes.
    - Researched comparing lake trout fatty acid compositions to egg thiamine concentrations and larval survival rates for two spawning reefs in Lake Michigan.
    - Analyzed the importance of spatial and phylogenetic differences in applying otolith mass-on-age regressions
    - Estimated the age misclassification probabilities among Lake Michigan biologists aging fish and evaluation of the need to apply corrections to historical data
    - Surveyed the morphological diversity of lake trout found at Isle Royale National Park, Lake Superior
    - Researched the differential movements and habitat use of wild and hatchery lake trout in Lake Huron
- Senior authored the following publications
    - a multi-agency publication to evaluate the success of lake trout stocking strategies to reestablish spawning stocks on offshore vs. onshore and stocked vs. non-stocked reefs and provided management recommendations

    - an analysis of the historical commercial lake trout fishery in Lake Superior to estimate the harvest and impact to siscowet lake trout and provide management recommendations for an expanded contemporary fishery
    - the morphological variation of siscowet lake trout among locations in Lake Superior and implications for an expanded fishery
- Co-authored the following publications
    - the "Genetic Evaluation of a Great Lakes Trout Hatchery Program"
    - the challenges to reestablishing deep water lake trout populations in Lake Michigan
    - correlations between PCB concentrations and habitat use in lake trout from North American lakes
    - a paper that established the genetic basis for the differences between siscowet and lean lake trout in Lake Superior
    - diets of Lake Superior lake trout

<u>Lake Sturgeon Restoration Activities in Lake Michigan and the Great lakes Basin</u>

- Coordinated activities of a team of researchers and biologists from 5 universities and 5 agencies to assess the status of lake sturgeon populations in Lake Michigan
- Collected, coordinated, and contributed genetic samples, and worked with geneticists, to evaluate distribution, origin, and genetic diversity of lake sturgeon basin-wide
- Worked with state and tribal commercial fishers and natural resource offices to collect data on incidentally caught lake sturgeon
- Completed studies to assess movement in Green Bay, historic abundance in Lake Michigan, juvenile habitat use in the Peshtigo River, stock structure in Green Bay, and habitat analysis of Green Bay tributaries
- Provided consultation and representation on fish passage and FERC relicensing issues related to lake sturgeon in Lake Michigan
- Participated on an implementation team of cooperating agencies and NGOs to develop and then implement a plan for installation and operation of fish passage facilities on the Menominee River capable of passing lake sturgeon
- Organized basin-wide workshops focused on 1) research and assessment needs (2000) and 2) passage needs at hydroelectric facilities (2010) focused on Great Lakes lake sturgeon rehabilitation for the Great lakes Fishery Trust
- Participated in the development of a basin-wide database for tagging and for describing assessment activities of lake sturgeon in the Great Lakes
- Organizing and hosting biennial Great Lakes basin Lake Sturgeon Coordination Meetings to foster communication and disseminate information (2002, 2004, 2006, 2008)
- Assisted in the drafting of guidelines for the genetic conservation, stocking, and propagation of lake sturgeon in Lake Michigan

- Produced two reports on the status of spawning populations in tributaries to Southern Green Bay 2001-2003 and 2004-2006
- Coordinated and co-authored biannual indicator reports on the status of lake sturgeon in the Great Lakes for the State Of The Lake Ecosystem Conferences, 2005, 2007, 2009
- Co-authored 4 scientific papers on the distribution and genetic composition of discrete populations of lake sturgeon in Green Bay and Lake Michigan
- Co-authored 5 scientific papers on the early life history characteristics and recruitment dynamics of lake sturgeon populations in Lake Michigan
- Co-authored 3 scientific papers on habitat characteristics and availability for lake sturgeon in multiple tributaries of Lake Michigan
- Coordinated funding distribution and implementation of basin-wide multi-agency streamside rearing, stocking and reintroduction project for Lake Michigan lake sturgeon

Maintenance of the Great Lakes Fish Stocking Database

- Coordinated with the 8 Great Lakes states, Indian tribes, and the Ontario Ministry of Natural Resources to compile stocking data into a single database that is served on the GLFC website

Provides Technical Assistance

- Served as members and chairs of the Technical Fisheries Committee and the Modeling Subcommittees that are responsible for implementing the terms of the 2000 Consent Decree. The Decree is a federal court order that allocates the fishery resources among five tribal governments and the state of Michigan within the 1836 treaty waters in lakes Michigan, Superior, and Huron
- Provided guidance and oversight to the PRC to implement the project proposal request selection process of the Great Lakes Fish and Wildlife Restoration Act. Served as point of contact for the Act and administered the program from request for proposals to final project selection.
- Served as the Department of Interior representative on the Scientific Advisory Team of the Great Lakes Fishery Trust that monitors the operation of the Ludington Pumped Storage Hydroelectric Facility, determined annual damage payments, and recommends projects for funding to the Trust board
- Served as the Service representative on the review board for the Great Lakes Fisheries and Ecosystem Restoration program of the U.S. Army Corp of Engineers.
- Invited by the Ontario Ministry of Natural Resources to consult on the design of new fishery surveys vessels for lakes Ontario and Huron
- Provided technical expertise to Ecological Services and Endangered Species Programs on the status review of shortjaw cisco in Lake Superior. Senior authored a paper on the decline of the shortjaw cisco and a new hypothesis for its demise in Lake Superior

- Served as member on the Sea Lamprey research Board and Board of Technical Experts for the Great Lakes Fishery Commission research program
- Assisted Tribal biologists with assessment study designs and activities
- Provided statistical catch at age modeling expertise for management agencies
- Provided expertise on fish habitat restoration projects
- Represented the FWS Fisheries program and the GLFC Technical Committees on the Sea Lamprey Barrier Task Force
- Invited participant in the Ontario Ministry of Natural Resources development of a lake sturgeon recovery strategy for Ontario populations of the Great Lakes
- Invited participant in the Department of Fisheries and Oceans – Canada Recovery Potential Assessment of lake sturgeon populations from the Great Lakes / St. Lawrence River watershed
- Invited participant in Lake Ontario Sea Lamprey Damage Analysis Workgroup
- Initiated data consolidation effort for sea lamprey wounding data across all Great Lakes, involving the compilation of all available historical data and standardization of data submissions, leading to more informative sea lamprey impact metrics
- Provided Great Lakes Fishery Commission sea lamprey control program with reliable and informative metrics measuring sea lamprey wounding and overall abundance of lake trout for evaluation of the sea lamprey control program
- Maintained and updated yearly contributions to the Lake Michigan Lake Trout Working Group databases pertaining to lake trout and creel data and produce yearly update graphs and summaries
- Developed SOP for hydroacoustic and trawling efforts performed from the M/V Spencer Baird

<u>Fish Habitat Restoration Activities</u>

- Led the Implementation Team (IT) for the removal/modification of the Boardman River dams near Traverse City, Michigan. Represented and coordinated with the East Lansing Field Office and Sea Lamprey Control Program on issues related to passage of Great Lakes fish and sea lamprey control in the Boardman River system
- Assisted with proposal development, coordination with the U.S. Army Corps of Engineers, review of reports, development of fact sheets and communication materials for the IT to remove/modify the four Boardman River dams.
- Assisted Conservation Resource Alliance with their annual work plan to use existing funds in the most cost effective and beneficial way to restore and maintain fish and wildlife resources in the Lake Michigan Watershed
- Provided technical assistance, project oversight and administration of Great Lakes Basin Fish Habitat Partnership funded projects in the Lake Michigan Watershed

- Continued to develop new partnerships and expand the National Fish Passage Program in the Lake Michigan Watershed, especially in the southwestern part of Michigan
- Participated in local watershed committee meetings and conduct barrier site visits in the Lake Michigan Watershed to develop proposals for the National Fish Passage Program
- Participated in Region 3's Habitat Team, the Lake Michigan Habitat Working Group and Michigan Stream Team to promote coordinate and implement habitat restoration projects in the Lake Michigan Watershed using the best science
- Coordinated with the Partners for Fish and Wildlife program to strategically leverage funds to benefit native fish and wildlife resources in the Lake Michigan Basin
- Removed more than 20 barriers to aquatic organism passage, which opened more than 360 stream miles of habitat
- Worked with partners to complete many design and feasibility studies for aquatic habitat restoration and inventoried barriers for prioritization in numerous watersheds in the Lake Michigan basin

Other activities

- Represented the Service on the Data/Science Team for the National Fish Habitat Action Plan Board
- Represented the Service on the Corp of Engineers/FWS team on Wind Power
- Provided assistance to collect fertilized bloater chub eggs from Lake Michigan for re-introduction effort into Lake Ontario for restoration of native forage base
- Assisted Wisconsin DNR with efforts to monitor growing spotted muskellunge population in Green Bay
- Assisted Wisconsin DNR with effort to track dispersal of newly reestablished river running stock of lake whitefish in Wisconsin waters.
- Co-authored paper describing Lake Michigan foodweb patterns based on fatty acid compositions of the forage base
- Collaborated on research using experimentally fed yellow perch and lake trout to determine whether neutral lipids, phospholipids, or the combined fractions provide the best indication of diet
- Co-authored paper on seasonal, spatial, ontogenic, and long-term trends in lipid concentrations in Lake Michigan fishes
- Co-authored paper on sexual difference in PCB concentrations of coho salmon (*Oncorhynchus kisutch*) in Lake Michigan
- Co-authored a paper on the trophic ecology of off shore reefs in Lake Michigan
- Co-authored a book chapter on the status of burbot populations in the Great Lakes
- Co-authored a statistical review of sample size requirements for morphometric studies on fish

Work of the Jordan River National Fish Hatchery, Elmira, Michigan, is geographically focused within the Lake Huron and Lake Michigan Basins. Jordan River National Fish

Hatchery is staffed by eight permanent employees. The hatchery services Lake Huron, Lake Michigan, and the State of Michigan. The hatchery rears lake trout as part of Great Lakes Restoration Program goals. The hatchery rears brook trout for Children in Nature, National Fishing Day, and other Partner supported educational programs, providing fishery education to the general public, school systems, and partner groups.

Below are examples of the Jordan River NFH accomplishments with funding provided through the Act:

- Propagated, marked, and stocked nearly 2 million lake trout yearlings annually into lakes Michigan and Huron
- Transferred nearly 1 million lake trout fingerlings annually to the Pendills Creek National Fish Hatchery to assist in meeting lake trout management goals for restoration in the Great Lakes
- Attended all the Upper Great Lakes Technical Committee meetings and participated on the Lake Trout Restoration subcommittee's task of updating stocking requests for state and federal fish
- Continued to evaluate expanding capabilities for additional species of fish cultured on the facility, including engaging congressional leaders, NGO's, and state cooperators on coregonid restoration options
- Participated in the Great Lakes Mass Marking development project with Fish and Wildlife Conservation Offices, other National Fish Hatcheries, tribal governments, and regional states
- Experimented with early life rearing systems, mass marking techniques and equipment, and development of improved effluent management
- Provided technical assistance to tribal partners

Work of the Pendills Creek/Sullivan Creek National Fish Hatchery Complex, Brimley, Michigan, is geographically focused within the Lake Huron and Lake Michigan Basins. Pendills Creek/Sullivan Creek National Fish Hatchery Complex is staffed with seven permanent employees. The hatchery services Lake Huron, Lake Michigan, and the State of Michigan The Hatchery rears lake trout as part of Great Lakes Restoration Program goals, and maintains lake trout brood stock, providing lake trout eggs to facilities throughout the Basin. The station conducts a wide array of outreach programs and works with its Friends group providing fishery education to the general public, school systems, and partner groups.

Below are examples of the Pendills Creek/Sullivan Creek NFH accomplishments with funding provided through the Act:

- Propagated, marked, and stocked 900,000 lake trout yearlings and 200,000 fall fingerlings annually for stocking under interagency rehabilitation programs in lakes Huron and Michigan
- Maintained various strains of lake trout brood stock as defined by rehabilitation plans, to provide over five million eggs for interagency rehabilitation programs in lakes Huron and Michigan
- Provided retired lake trout brood stock to state and tribal partners for recreational fishing opportunities
- Continued to utilize, maintain, enhance and monitor water filtration and liquid oxygen systems, bringing them into full operation
- Worked with partners through the Lake Michigan and Lake Huron Technical Committees to update and implement interagency lake trout rehabilitation
- Worked with partners and have established the Parry Sound strain of lake trout that originated in Lake Huron
- Provided eggs and technical assistance to local tribes
- Participated in the Great Lakes Mass Marking Program, providing support to fine tune the equipment for use with lake trout
- Continued to work with the U.S. Forest Service, Michigan Department of Environmental Quality, and Michigan DNR to monitor the status of the Videans Creek, Pendills Creek, and Sullivan Creek
- Participated at the Lake Huron Technical Committee meetings

Work of the Iron River National Fish Hatchery, Iron River, Wisconsin, is geographically focused within the Lake Superior, Lake Michigan, and Lake Huron Basins. The hatchery is staffed with seven permanent employees. The hatchery services Lake Superior, Lake Huron, Lake Michigan, and the states of Wisconsin, Minnesota, and Michigan. The station serves as the lead for maintaining Coaster brook trout brood stock. The station rears lake trout as part of Great Lakes Restoration Program goals, and maintains lake trout brood stock providing lake trout eggs to facilities throughout the Basin. The station conducts a wide array of outreach programs and works with its Friends group providing fishery education to the general public, school systems, and partner groups.

Below are examples of the Iron River NFH accomplishments with funding provided through the Act:

- Produced, marked, and stocked 1.2 million yearling lake trout, and up to 400,000

fingerling lake trout annually, for stocking under interagency rehabilitation programs in lakes Huron and Michigan
- Produced, marked, and stocked nearly 200,000 coaster brook trout annually for rehabilitation programs in Lake Superior
- Maintained various strains of lake trout brood stock as defined by rehabilitation plans, to provide over five million eggs for interagency rehabilitation programs in lakes Huron and Michigan
- Maintained Tobin Harbor and Siskiwit Bay strains of Coaster brook trout brood stock to provide over one million green eggs for interagency rehabilitation programs in Lake Superior
- Provided retired lake trout brood stock to state and tribal partners for recreational fishing opportunities
- Participated at the Lake Superior Technical Committee meetings
- Worked with the Keweenaw Bay Indian Community, Genoa NFH, Lacrosse FHC, Ashland FWCO, and other partners to collect Klondike Reef gametes from Lake Superior for future brood stock
- Worked with partners through lakes Huron, Michigan and Superior Technical Committees to update and implement interagency lake trout and coaster brook trout rehabilitation
- Provided eggs, technical assistance, and equipment to tribal partners
- Partnered with the Upper Mississippi River Science Center to develop a study and join the Investigational New Animal Drug (INAD) protocol to evaluate the use of hydrogen peroxide on fish
- Continued to utilize liquid oxygen to gain a 20% increase in yearling production

Work of the Genoa National Fish Hatchery, Genoa, Wisconsin, is geographically focused within the Mississippi River Basin however, the station serves as the lead for isolation and quarantine of future trout brood stock lines brought in as wild gametes as part of Great Lakes Restoration Program goals. The hatchery is staffed with eight permanent employees. The hatchery services Lake Superior, and six Midwestern states. The station conducts a wide array of outreach programs and works with its Friends group providing fishery education to the general public, school systems, and partner groups.

Below are examples of the Genoa NFH accomplishments with funding provided through the Act:

- Reared Coaster brook trout brood stock as backup brood lines for the Iron River NFH and transferred brook trout to maintain strain genetic integrity and support captive brood stock program objectives
- Cultured, marked, and stocked nearly 20,000 yearling brook trout annually

- Cultured, marked, and stocked 25,000 brook trout for the Grand Portage Tribe's Lake Superior restoration effort annually
- Assisted with the collection of gametes from numerous strains of lake trout throughout the Basin, and held the strains in the station's isolation facility until clearing a16 month quarantine
- Assisted with the collection of Coaster brook trout gametes from Isle Royale and held the strains in the station's isolation facility until clearing a16 month quarantine
- Provided technical assistance and equipment to tribal partners

Work of the Saratoga National Fish Hatchery, Saratoga, Wyoming, is part of the National brood stock program, providing brown trout and lake trout eggs to Federal, State and Tribal hatcheries across the country, as well as maintaining the Lewis Lake strain of lake trout for Great Lakes lake trout restoration efforts. The station is staffed with four permanent employees. The station provides back up for the Eagle lake strain of rainbow trout for the Ennis National Fish Hatchery, and maintains a Wyoming toad brood stock. The station conducts a wide array of outreach programs providing fishery education to the general public, school systems, and partner groups.

Below are examples of the Saratoga NFH accomplishments with funding provided through the Act:

- Maintained the Lewis Lake strain of lake trout brood stock, providing 2.5 million eyed eggs annually for interagency rehabilitation programs
- Provided 2.2 million eyed Lewis Lake strain eggs to Jordan River National Fish Hatchery annually
- Provided 150,000 eyed Lewis Lake strain eggs to Iron River National Fish Hatchery annually
- Provided retired and excess lake trout brood stock for stocking waters on the Ute Reservation near Vernal Utah, for recreational fishing opportunities

Work of the La Crosse Fish Health Center, Onalaska, Wisconsin, is geographically focused throughout the entire Great Lakes Basin. The station is staffed with nine permanent employees. The station provides fish health services to eight states: Minnesota, Wisconsin, Iowa, Missouri, Illinois, Michigan, Ohio, and Indiana, and conducts fish health inspections bi-annually to National and tribal fish hatcheries in the region. The station implements the National

Wildlife Fish Health Survey in the region and provides diagnostic services for disease outbreaks in hatcheries and wild populations. The station conducts research on drug effectiveness, disinfection techniques, pathogen pathology, parasite ecology and teaches a one week course, "Introduction to Fish Health Management" in cooperation with the USFWS National Conservation Training Center. The station conducts a wide array of outreach programs and works with its Friends group providing fishery education to the general public, school systems, and partner groups.

Below are examples of La Crosse Fish Health Center accomplishments with funding provided through the Act:

- In cooperation with state resource agencies, conducted surveillance in the Great Lakes for EEDv using the PCR developed by UC-Davis
- Used diagnostic PCR to identify *Nucleospora salmonis* in regional lake trout hatcheries
- Monitored the lake trout fish health quality assessment program in regional hatcheries
- Partnered with state and tribal agencies to conduct VHS surveillance in the Great Lakes region
- Implemented the National Wild Fish Health Survey in the Great Lakes region
- Partnered with the Service's Law Enforcement to conduct a baitfish pathogen study in Wisconsin