Lake Michigan Biodiversity Recovery Support Document

LAKE MICHIGAN FEDERATION

Compiled from research, presentations, and discussions surrounding the Urban Aquatic Habitat Summit, November 3, 2000.

Citizen Action to
Protect a Great Lake

Lake Michigan Biodiversity
Recovery Support Document

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Foreword

Dr. Victor Shelford portentously wrote in his 1913 book, *Animal Communities in Temperate America*, one of the first studies in the world to examine animal ecology:

> Of the admirers . . . of nature I fancy that many, perhaps the majority, think of it as a series of lawn-like pastures, well-trimmed hedges, such as [those] in some of the older countries like England . . . The close observer of nature, even in such man-made conditions as in Bedfordshire or in the Chicago parks, sees all the struggle [of] the birds and mammals [in their] primeval conditions.

The area covered by the modern day Milwaukee-Chicago-Northwest Indiana corridor was a laboratory for the first modern ecologists—Shelford, Cowles, and others—for good reason. It was the junction where widely differing ecosystems, dunes, wetlands, prairies, and forests, come together. Today, this same junction contains 200,000 acres of protected natural lands, housing plant and animal communities that are more rare and threatened than those in the tropical rain forests.

These are the ecosystems that many of us think of here because we as people live on land. We have feet not fins. The ecosystem that makes up an entire border to today's Chicago Wilderness biodiversity reserve, however, is made up of water—Lake Michigan. In many respects Lake Michigan is the "last frontier." Because we don't live on the lake, its open waters have not been impacted by the same development that puts *terra firma* at risk.

The lake and its companion Great Lakes constitute nearly 20 percent of the Earth's fresh surface water supply. Lake Michigan once housed the largest self-sustaining lake trout

Executive Summary

The nearshore Lake Michigan zone is among the most biologically productive in the region. Nearly 30 percent of the globally significant species and communities within the Great Lakes basin are associated with coastal shore systems (TNC, 1994).

At the same time, the lakefront is under enormous pressure to produce a strong quality of life for the region. Chicago alone, for example, receives some 60 million visits per year to its lakefront.

If biodiversity is to thrive in Lake Michigan, and in return continue to provide us with a strong quality of life, it will only thrive as the result of proactive planning and implementation. Just as about 100 organizations and agencies produced the Chicago Wilderness *Biodiversity Recovery Plan* in 1999 for inland waters and terrestrial habitats, we need a biodiversity blueprint for Lake Michigan's shoreline and tributaries.

The purpose of this report is to gather relevant information for such a plan. It does this in three ways: first it gathers what we know about the geology and ecology of the lakeshore before settlement took place and today.

Second, it identifies what we still need to know to restore biodiversity. In other words, this report identifies the challenges to and opportunities for bringing habitat back to the lakefront.

parks. In so doing, the hope is to make the study area the showcase nationally for bringing back native aquatic communities in an urban center.

The study area is unique in that it is highly developed yet supports unique plant and animal life. Indiana's 45-mile Lake Michigan shoreline houses the world's 5th largest oil refinery, 25 percent of the nation's steel production, and the Port of Indiana as the busiest port in the Great Lakes. At the same time Indiana Dunes National Lakeshore ranks third of the country's national parks in plant diversity.

Illinois' 63-mile shoreline sees millions of visitors every year. One lakefront festival, the Taste of Chicago in Grant Par(e)c.9(or)5., (r)4.1tt(a)4.9(n)1.1(ag)11.1(yore (r)4.1lmos.9(e)4.9ou(a)4.9ions of)tors e (e)c

- Multiple options for continued large- and small-scale habitat restoration and creation exist in the Chicago area. Primary needs include funding and research from government and academic bodies

Indiana Dunes National Lakeshore ranks third in species diversity of all national parks. Vegetation along the first ridge of the backdunes at the Lakeshore includes jack pine, white pine, juniper and an understory of plants, including poison ivy. The second line of backdunes supports an oak community. Further inland exists a forest of beech and maple trees.

Conversely, the beaches found in Chicago contain little natural vegetative cover. They are artificial and must be continually replenished with sand and protected from erosion by revetments (Tetra Tech, 2000). One small exception to this standard has begun to surface. Two natural sand dunes, one 6-8 feet high and one about 2 feet high, have developed at Montrose Beach on the north side of the city. Rare vegetation has taken root, with lakeshore rush, sea rocket (threatened), and marram grass (endangered) all thriving on the dunes. The dunes have developed over the last several years due to lack of Chicago Park District activity and other human disturbances (Long, 2000).

Currently 8-13 percent of the nearshore area in Illinois' northern Lake County is wetland. The Calumet region has 1-7 percent wetland coverage (Chicago Wilderness, 1997). Small remnant and large interdunal wetlands remain in areas south of Chicago and around the southern end of Lake Michigan (Tetra Tech, 2000). Fringing wetlands, which can decrease erosion caused by changes in littoral drift (IDOT, 1980), account for only 1 percent of the shoreline in the study area. Urbanization and protection of Wisconsin's shoreline has decreased littoral drift of sand, resulting in a net erosion of the Illinois shoreline (Research Planning, Inc., 1994).

Presettlement northwest Indiana was continuous wetland. As of 1979, less than 5 percent of the original wetland cover remained. This exists primarily as narrow strips of intacsips of intaced. Ta pTc0.000ch
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Commercial fishing began in 1830 with whitefish providing the most abundant catch. Nearshore species have seen a precipitous drop in numbers as a result of overfishing, habitat destruction and poor water quality. The lake sturgeon was particularly hard hit because females do not reproduce until the age of 25 years and males until the age of 10. Young sturgeon were often removed from the ecosystem before they could reproduce. Open water

Exotic species composed the largest portion of the samples (more than 50 percent) in the Grand Calumet River area and Lake Michigan collections. The Little Calumet River and Trail Creek samples had 12-14 percent exotics (Simon, 1999, 2000). Recent Lake Michigan trawls performed by the USGS show that bloaters, the only species of the ciscoes that has not been impacted by overfishing or sea lamprey parasitism, dominate the prey base, making up 30 percent of the biomass collected. The exotic alewife made up 27 percent and sculpins 28 percent. Zebra mussels now comprise a substantial portion of the trawl biomass at most sites (USGS, 1999). The goby, which was first found in the Grand Calumet area, can now be found as far north as South Haven, Michigan (Simon, 1999, 2000).

Natural communities remain in the waters of the Millers Woods Ponds, Grand Calumet River and the Grand Calumet lagoons. However, the water quality in the Grand Calumet area is severely degraded, and some areas do not support any native fish populations (Simon, 1999, 2000). Restoration of the Grand Calumet River has resulted in the return of the Chinook salmon. An unsubstantiated report has surfaced about the presence of lake sturgeon in Wolf Lake as an adult sturgeon was caught there in 1999. Sturgeon used to travel through Wolf Lake to reach Lake George to spawn. Lake George is presently degraded, but it appears that restoration could encourage sturgeon to return.

It was recommended at the Summit that headwater streams be restored, the banks of northwest Indiana waterways be revegetated, and public lands be restored to a state more hospitable to sensitive species. Headwaters can be restored with a variety of engineering strategies, including riffle creation and stream channeling to adjust energy flows. As a first step, the

- Lake Michigan fisheries are strategically managed for game species, and exotic species invasions have resulted in drastic changes the lake's food web. Native predator populations have plummeted and several fish species have become extinct.

- Some natural communities still exist in the waterways that supply Lake Michigan. These areas should be targeted for restoration.

II. Challenges and Opportunities

Enhancement of the Lake Michigan shoreline in a highly urbanized area will not be an easy

Great Lakes sport fishing brings in an estimated $4 billion per year and currently 43 percent of all Great Lakes fishing is done in Lake Michigan (Tetra Tech, 2000). In 2000 Chicago hosted the 30th Annual BASS Masters Classic. This is the country's largest professional fishing event. The selection of Chicago as the host city is testimonial to the importance of sport fishing to the local economy. Competitors fished the waters of Lake Michigan, Chicago's harbors, Lake Calumet and the Chicago and Calumet Rivers for largemouth and smallmouth bass. Weigh-ins are open to the public and have attracted as many as 35,000 spectators at past events (Cabell, Charlos, Geib, 2000). The 2000 event drew 80,000 spectators, 5,000 of whom were tourists, suggesting a significant amount of spending from attendees, competitors and organizers. This demonstrates that sustainable fisheries can be economically beneficial.

The economic benefits of the Lake Michigan fisheries have been tempered by the problem of habitat loss, exotic species invasions, and water pollution. Strict fish consumption advisories apply to all Lake Michigan waters in the Chicago area. The consumption advisories' effects are apparent when considering that commercial fish production from Lake Michigan has an estimated value of only $11 million annually from a 14.6 million pound catch.

Policy Tools

A number of policy tools exist on the federal, state and local level that support Lake Michigan coastal habitat recovery. This section outlines some prominent examples.

Endangered Species Act

The federal Endangered Species Act (ESA) is intended to help restore healthy populations of imperiled fish, wildlife, plants, and insects. A recent effort by the US Fish and Wildlife Service (USFWS) - the agency charged with implementing the ESA - illustrates its usefulness around Lake Michigan. The piping plover (*Charadrius melodus*) is a small, pale-colored shorebird. It nests on sandy beaches with sparse vegetation and small stones. Nesting in the Great Lakes begins in mid-May, and plovers remain at the breeding grounds for three to four months. Because the nests are camouflaged with cobble ground cover, they are difficult to see and can be crushed by beach-goers. Historically, the Great Lakes breeding population contained 492 to 682 pairs in Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York, Wisconsin and Ontario. Today only thirty-two breeding pairs nest in the Great Lakes, thirty-one of which are found in northern Michigan (Barry, 2000).

In 1985 the piping plover was listed as an endangered species in the Great Lakes watershed by

benefits of protection to the species, designation can be prevented (McCloskey, 2000). Log on to http://plover.fws.gov/

federal financial assistance (Kuechenberg, 1990). Congress made $57 million available in fiscal year 1999 for coastal planning and protection (NOAA, 2000).

Currently, 33 states and territories participate in the program. The program manages 99.9 percent of the United States' oceanic and Great Lakes coastline miles, and only 108 miles have been left out of the program. Sixty-three of those miles lie in Illinois, which does not participate (NOAA, 2000) and has no current plans to do so. Illinois conducted a survey of its biological communities in 1976 as initial research for participation in the program (INHS, 1976). Little action was taken beyond that survey.

The other 45 miles are in Indiana, which is in the process of developing its program. Indiana received federal funds for several studies from the 1970s until 1981. In 1979 the Indiana Department of Natural Resources and the Natural Land Institute completed an inventory of natural areas. Indiana dropped out of the program in 1981 because it was unable to develop an organizational structure to implement the proposed program (Kuechenberg, 1990). Indiana rejoined the program in the fall of 1993 and its management plan is still under development. The state may require additional authorities for improving fish habitat, countering erosion and reducing pollution in order to receive federal approval (NOAA, 2000).

The remaining Lake Michigan states (Wisconsin and Michigan) manage their shoreline according to the Coastal Zone Management Program. Wisconsin's program is run by a 14-member, Governor-appointed Council representing state agencies, the state legislature, local governments, Indian tribes, the University of Wisconsin system and the public. An annual grant program is administered to award federal funds to local entities. Since 1985, the Wisconsin Coastal Management Program has awarded over $9 million in grants for coastal improvements (State of Wisconsin, 2000).

Michigan was among the first states to gain approval of its coastal program, which began in 1978. Michigan's Department of Environmental Quality (MDEQ) receives approximately $2.4 million yearly in federal funds, which are matched 1:1 by state and local funding. One-third of the grant is passed to Michigan's approximately three hundred shoreline communities, all of which are eligible to participate in the program. The remaining funds are used by MDEQ's Land and Water Management Division to support administration of several state programs including sand dune, wetland, and river protection, erosion control and shoreline management (MDEQ, 2000).

Municipal Ordinances

Local governments have a great deal of authority—often far greater power than federal and state government—to control local land use decisions that can affect biodiversity and habitat. One example of local zoning that is often held up as a model for preserving the lakefront is

(a) Promote and protect the health, safety, comfort, convenience and general welfare of the people, and to conserve our natural resources;

(b) Maintain and improve the purity and quality of the waters of Lake Michigan; and

(c) Insure that construction in the lake or modification of the existing shoreline shall not be permitted if such construction or modification would cause environmental or ecological damage to the lake or would diminish water quality; and to insure that the life patterns of fish, migratory birds and other fauna are recognized and supported.

Other local government ordinances exist to help protect watersheds from development and reduce erosion.

Media

In the fall of 1998 the Chicago Tribune ran the six-part series *Reinventing the Lakefront*. Its author, architecture critic Blair Kamin, won the Pulitzer Prize for criticism. The articles pointed out the lack of coordination and planning along Chicago's lakefront parks, the inequalities between the parks along the northern and southern lakefront and the overuse of popular parks while other lakefront areas lie vacant. His work sparked the interest of Chicago Mayor Richard M. Daley, who in turn prompted the Chicago Park District to plan for the reinvention of Chicago's Burnham Park, Jackson Park and the South Shore Cultural Center on the lakefront. These reinvention plans, created with input from the public, continue to be developed and include the modest creation of wildlife habitat. The *Lakefront* series reflects the immense popularity of the shoreline. It is also a reminder that efforts to rebuild habitat need to be continually communicated to the public and decision makers through the media.

Coalition Building

Effective habitat management for the regional and global benefit of native species must be part of a collaborative effort. Regional planning must incorporate citizens' concerns. One example of such a partnership is Chicago Wilderness. Another is the Lake Michigan Community Council (LMCC), coordinated by the Lake Michigan Federation. The LMCC is a coalition of more than 100 grassroots organizations dedicated to Lake Michigan watershed protection on a community-by-community basis. The LMCC shares information and coordinates efforts on a variety of environmental topics involving public health and the Lake Michigan ecosystem. Both types of collaboration can be extremely beneficial to habitat protection and restoration. Grassroots efforts can focus on specific community needs, while an organizing body can convey information about the successes of model efforts and ensure that migrating species and those with large ranges are being comprehensively managed.

Just as geographic diversity is essential to effective habitat management, partnerships among various interests are necessary. Collaborations among the private sector, government agencies, academia and the non-profit community will ensure that the needs of both the public and

wildlife are met. Likewise, collaborations among sportsmen, environmentalists, public interest advocates, recreationalists, scientists, planners, legislators and economists need to be created.

Competitive Uses

The Illinois and Indiana shoreline is a congested environment. Users with competing interests are constantly vying for a piece of the lakefront to call their own. Industry, homeowners, beach-goers, anglers, tourists and wildlife all have an impact of the shoreline ecosystem. Habitat protection would be much easier to achieve if the region were remote. But the high human population density of the region makes the presence of wildlife even more unique. It is essential to work through the challenge of determining how opposing needs can be met using the limited funding and workforce available. This section provides illustrations of potential competitive uses.

People versus Wildlife

Planning for the myriad uses of the Illinois-Indiana lakefront requires a skillful balancing act. Over 60 millions visitors flock to the Chicago lakefront every year to enjoy its sandy beaches and waterfront trails in close proximity to cultural activities, shopping, dining and entertainment. Indiana's shoreline supports the 5th largest oil refinery in the world, 25 percent of the nation's steel production and the busiest port in the Great Lakes (Port of Indiana) (NOAA, 2000). Tourists, students and academics marvel at nearby Indiana Dunes National Lakeshore, which ranks third in biodiversity amongst the nation's national parks (Tetra Tech, 2000) and is considered the birthplace of modern ecological study.

When considering how to accommodate these uses, planners must be aware that human activities in these areas often occur in close proximity to sensitive ecological processes. The dune systems in Illinois and Indiana are slowly created by movement of sand by wind and waves. Fragile dune vegetation systems are crucial to prevention of rapid erosion. If vegetation is not present, wind can cause a blowout in the dune structure, resulting in a saucer shaped depression that enlarges as wind forces scour out sand exposed by the destruction of vegetation. Ease of access to dune ecosystems should be of great concern in the Chicago area, as serious blowouts are almost always a result of human disturbances. The Chicago harbor

shoreline availability for birds and reduces impact to their habitats (Schilling and Williamson, 2000).

Water Quality Degradation

Another challenge to bringing native biodiversity back to the lakefront is water pollution. One example of a Lake Michigan fishery stressor is toxic pollution. Illinois and Indiana both issue fish consumption advisories based on fish tissue contamination with PCBs, chlordane and mercury. They are updated periodically and can be found posted online at: http://www.idph.state.il.us/public/press99/fish_advs_99.htm (Illinois) and http://www.state.in.us/isdh/dataandstats/fish/fish_adv_index.htm (Indiana). None of Illinois' sixty-three coastal miles are meeting their designated use due to fish consumption advisories. Indiana's general fish consumption advisory covers 241 square miles, including the southernmost waters of Lake Michigan. Several waterways, such as the Grand Calumet River and Indiana Harbor Ship Canal, have 100% "do not eat" advisories posted for their fish stocks (Tetra Tech, 2000).

Bacterial and other pathogenic pollution of the shoreline presents another vexing issue. In recent years, the southern Lake Michigan shoreline has experienced beach health problems indicated by high levels of *Escheria coli* (*E. coli*) bacteria. These bacteria serve as an indicator of the possible presence of more troubling pathogens. These pathogens pose significant risks to human health.

because the release happened before the start of the official beach season, the impact of the discharge could even be seen from aerial photographs.

While the human health risks from exposure to bacterial contamination at beaches are becoming increasingly clear, the effect of such contamination on aquatic life is less clear. Research on pathogenic contamination impacts on aquatic life must be pursued.

Exotic Species versus Native Species

As urban habitat renewal progresses, attention must be paid to the effects that exotic species have had on the Lake Michigan ecosystem. As discussed earlier, fish populations have changed dramatically since settlement of the lakefront as a result of non-native invasion and fish stocking. The wetland habitats upon which some native aquatic species are dependent have also been severely degraded. There is a concern that restoration may simply provide more habitat for exotics without increasing thriving populations of native species. It is also unclear if passive protection of ecosystems such as those found in Indiana Dunes National Park is actually maintaining healthy native populations.

An artificial reef was constructed in November of 1999 off of Jackson Harbor in Illinois in an attempt to enhance smallmouth bass fishing. Pure granite slabs of varying sizes were dumped into the water to form a 256 meter long, 15.5 meter wide, 2.1 meter tall structure covered by 7.5 meters of water. The Illinois Natural History Survey (INHS) was conducting a study on nearshore fish at the time and was asked to include the reef as a sampling site. In order to determine which types of species were colonizing the reef, fish, zooplankton and benthic invertebrate samples were taken from around the reef and from a reference site (as a measure of species makeup prior to reef installation). Adult fish were collected with gill nets and analyzed for abundance and diversity. The ages and stomach contents of smallmouth bass collected were noted. Visual surveys along transects and surface water collections of larval fish were also conducted. Zooplankton net tows, sediment cores, and rock baskets were used to gather plankton and benthic invertebrates (Charlebois, 2000).

Sampling indicated that exotic species dominate the reef. Rusty crayfish and round gobies were determined to be abundant by visual observations but could not be easily sampled because their preferred habitat is between large rocks. Fish are attracted to the reef, but it is not known if fish abundance is actually enhanced. Fish may opt to use the reef for nursery grounds more so than the protected harbors. This may actually cause a decline in fish numbers, as eggs deposited there may be more susceptible to storm events. The reef may also act as an attractor for anglers and predators that could decrease the populations of any native fish congregated at the reef (Charlebois, 2000).

Three of the eleven artificial Great Lakes reefs are in Lake Michigan. No basin wide policy on

Degraded wetland habitats are susceptible to invasions by exotic species. A prime example of a common invader is the ubiquitous purple loosestrife. Seeds were brought to the United States from Europe in ballast water and by settlers for ornamental use. Purple loosestrife currently exists in all Canadian provinces and all states except Florida. Loosestrife lowers the biodiversity of ecosystems by outcompeting native plants. Fauna diversity is consequently reduced by the loss of native plant cover (Charlebois, 2000).

Some progress has been made in the fight against loosetrife invasion. In 1992 the United States Department of Agriculture approved the use of 5 insects for the biological control of purple loosestrife. The *Galerucella* beetle was first released in Illinois in 1994 and by 1995 the INHS began rearing stocks of the beetles. In 1998, 450,000 beetles were released in Illinois. The adult beetle lays its eggs on purple loosestrife plants. After hatching, the larvae feed on the plants' growing stems and leaves. The beetles were released at the Weingart Road Sedge Meadow Nature Preserve in McHenry County, Illinois in 1994. By 1998 the numbers of loosestrife plants were visibly reduced, and by 2000 they were virtually gone. The beetles were also released in Savannah, Illinois in 1994. By 1999 the loosestrife was virtually gone. In 1994 native plants were rare at the site, but by 1999 16 different types of native plants were recorded. Unfortunately the loosestrife was seen flowering again in 2000, albeit in September instead of the usual flowering month of July. It seems that *Galerucella* introductions can allow native plants to return and can aid habitat restoration. However, the long-term efficacy of this biological control agent is unknown (Charlebois, 2000).

The Old Woman Creek, a freshwater estuary in East Huron, Ohio, provides a case study of the effectiveness of long-term passive preservation of a supposedly healthy ecosystem. In 1980 the creek and its surrounding habitats were designated a National Oceanic and Atmospheric Association (NOAA) Estuarine Research Reserve. It contains a variety of habitats, including marshes, a swamp forest, a stream channel and an island. It is a major way station for migratory birds and supports high plant diversity (Charlebois, 2000), indicative of a healthy ecosystem. Despite its purported health and protected status, this system is also impacted by exotic species. Carp are present, increasing water turbidity and reducing the abundance of native aquatic vegetation. Eurasian water milfoil, phragmites and purple loosestrife are emergent in the wetland areas and are outcompeting native flora.

Exotics can threaten protected habitats as well as degraded areas, making human control of exotics an absolutely critical component of habitat protection. Technologies do allow managers to combat some species, such as the purple loosestrife in wetlands and the sea lamprey in its spawning grounds. Open water species such as the alewife are more difficult to control. There is no effective eradication program for them (Charlebois, 2000). The best control is to prevent future introduction of additional exotic species.

Conclusions

- Lake Michigan's fisheries provide a strong economic benefit to the region. However, industrial contamination of game fish has reduced the use of fish for human consumption.

- Several regulatory pathways exist for protection and creation of habitat along the shoreline. These include the Endangered Species Act, the Conservation and Reinvestment Act, the Coastal Zone Management Program, the Public Trust Doctrine, and local ordinances.

- The media can be an effective means of motivating citizen and political interest in lakefront planning.

- Coalitions between private and public groups and across state lines are essential to redevelopment successes in the Chicago area.

- Contamination of southern Lake Michigan by toxics and pathogens has a marked impact on human uses of the Chicago area lakefront. More research is necessary on the effects of pathogenic pollution on aquatic life.

- Much of the Chicago area shoreline serves as wildlife habitat in addition to providing outlets for human use. Human impact on dune systems, harbors, and areas that serve as migratory bird pathways should be minimized to enhance habitat quality.

- Exotic species have had a deleterious effect on the quality and sustainability of the Lake Michigan ecosystem. Due to the difficulty of eradicating an established species, primary concern must be given to prevention of additional exotic species invasions.

III. Case Studies

Lessons learned from past and ongoing habitat preservation and restoration work serve as a valuable tool for guiding future efforts. The following three case studies are presented to

Unified restoration of the Calumet Area Wetlands is a daunting task that will require strong coalitions between government and private landowners. Most of the wetland preservation opportunities are on private property, limiting their long-term conservation potential. The City of Chicago is trying to convert many of these lands to public holdings. Thousands of acres owned by colleges, the Illinois Department of Transportation, and the City of Burnham are interspersed throughout the Calumet area, making development of continuous restored habitat

contact of protected areas with roadsides that encourage human disturbances and usher in exotic invaders (O'Leary, 2000).

Small fragments can be connected with corridors to supply wildlife with means to travel between communities. This can alleviate some of the stress a large population can present to a small habitat. However, corridors do not always have the desired effect. Some species cannot migrate through corridors either because they are stationary and cannot disperse seeds/young over great distances, or cannot survive in the riverine environment common to many corridors. Even seemingly related species may display differential ability to exploit corridors. Blanding's turtles can easily travel through corridors, but spotted turtles cannot. Species occupying small habitats that cannot relocate on a regular basis are highly susceptible to the perturbations common to fragmented systems. Corridors also provide avenues for exotic species to spread from one fragment to another.

Each conservation project in the NW Indiana region provides an opportunity to conserve a fragment of one of the many varieties of dune and swale communities. The differences between communities must be articulated in order ensure preservation of all essential species. Comparison of various preserve communities (Ivanhoe, Gibson Woods, Clark and Pine, Clark Junction) demonstrated marked divergences in soil composition and species diversity. Ivanhoe and Gibson Woods have greater species richness and older, more acidic soils. The Clark and Pine Preserve and Clark Junction are closer to Lake Michigan and thus have much younger soil profiles. These two preserves are the most similar of TNC's preserves. Even so, they have only 65 percent of species in common. Preservation of a single area simply will not protect all dune and swale species. Construction of efficient corridor systems depends on comprehension of the differences between communities within each preserve (O'Leary, 2000).

TNC has found that preservation of intact dune-swale systems is much more important and useful than attempting to create new dunes. Revitalization of an impacted dune is a more effective means of preservation than attempting to create new presettlement-type habitat. Dune systems that have been impacted but not completely degraded can be rejuvenated by the removal of stressors and exotic species. It is extremely difficult to create a similar viable ecosystem through landscape manipulation and seeding. A dune and swale landscape can be created by constructing ridges and valleys with a bulldozer. However, achieving the successful interaction of vegetation, wildlife, hydrology, soil chemistry and climate within a sustainable community presents a significant challenge (O'Leary, 2000).

Stakeholders in this area must determine what scale is important for protecting biological integrity and whether their priorities can be integrated with activities occurring on a larger scale. Many properties containing ecologically significant systems are privately owned.

Armored Shorelines and Incidental Habitat

The heart of the city provides a study of how wildlife coexists with extensive shoreline construction. The Chicago shoreline is predominantly artificial and lakefill along the coast averages 1500 feet in width. Since the existence of a stable shoreline in the Chicago area is unnatural, the land requires armored structures to protect it from erosion and storm damage. Chicago's existing shoreline armaments were built between 1910 and 1931. Four different types of structures were employed: offshore breakwaters, revetments, piers, and beaches anchored by groins. They were designed to last fifty years, but most are now over seventy-five years old.

Lake levels in the late 1980s were unusually high and caused a series of environmental incidents around the Great Lakes. Houses collapsed into the water due to significant bluff erosion, and shoreline roadways and cities flooded. The South Water Purification Plant in Chicago, which provides drinking water for 2.5 million people, was flooded during a 1988 storm despite being protected by an onshore revetment and an offshore breakwater. Wooden revetment supports had rotted away since being exposed to open air due to fluctuating lake levels (Jimenez, 2000).

The City of Chicago renewed its efforts at this time to obtain federal funding to protect its shoreline). In 1993 the United States Army Corps of Engineers (USACE) recommended to Congress that eight miles of Chicago's shoreline be reconstructed to protect the city from further land loss and flooding. This eight miles included four miles on the north side of the city from Montrose to Oak Street, a stretch on the south side of the city from McCormick Place to 57th Street, the eastern edge of Northerly Island and the breakwater that protects the South Water Purification Plant (Jimenez, 2000).

USACE conducted an environmental impact assessment on Chicago's proposed shoreline construction to evaluate the project's potential impacts on the quality of aquatic, terrestrial, archeological, historical and social resources. It was concluded that habitat would be disturbed during construction, but the net benefits of the project would provide for similar and even improved aquatic habitat. Fish would likely be driven away during construction, but would quickly return. Placing new stone would disrupt benthic organisms and change the substrate from sandy to rocky, but new surfaces would be colonized by algae and invertebrates (USACE, 1993). The term "incidental habitat" has been coined to describe such artificial structures, such as break walls, marinas, jetties, channels, navigations cells, confined disposal facilities and dredge spoil islands, that unintentionally provide habitat for and access to wildlife. These structures allow anglers to access deeper waters and serve as a shelter for Lake Michigan fish.

Several options exist for breakwater construction. The Chicago District of the USACE conducted fish sampling at southern Lake Michigan harbors from 1992 to 1998 (Appendix 3). They found a variety of fish species associated with rubble mound structures (Moy, 1994). Rubble mound structures are composed of layers of armor stone, core stone and the underlying bedding or mattress stone. The bedding, composed of the smallest stones in the three layers, extends out from the toe of the structure and can be manipulated to provide fish habitat. Another type of breakwater, called walled structure, is composed of a sheet pile or timber crib

habitat as natural shoreline and dune systems. An evaluation of the potential for rebuilding sustainable wildlife habitat while protecting such a highly developed shoreline is sorely needed. It has been demonstrated at Montrose Beach that, given the right conditions, stable shoreline communities can develop over time. Historically, aquatic construction designs have been aimed primarily at ensuring adequate shoreline protection. Habitat creation and natural area preservation has been a secondary concern following safety, erosion control and navigational needs. Coordination between engineers and aquatic biologists is essential throughout the design phase to assure that potentially habitat-enhancing features are integrated into shoreline protection projects. It is recognized that certain areas of the lakefront experience significant human activity. A balance needs to be achieved between these uses and the opportunity to enhance Chicago's historic natural character.

Conclusions

- The Calumet area wetlands provide extensive habitat recovery opportunities. Citizen groups have identified several large current and former industrial sites that are already serving as habitat for rare species. Cooperation among all levels of government and several local community organizations has provided the potential for development of a long-term plan to integrate wildlife habitat into an urban industrial zone.

- Viable habitat exists mostly in small fragments in northwest Indiana. Dune and swale fragments support a wide diversity of species, but are subject to high stress due to their size. Corridor construction can serve to mitigate some of this stress by allowing wildlife to exploit more than one habitat. It is essential to preserve existing habitats, as dune and swale ecosystems are difficult to create using restoration techniques.

- Most aquatic habitat in the city of Chicago exist as incidental habitat on breakwaters and shoreline revetments. These structures are deteriorating and are currently under repair by the USACE. While some of the new construction can be managed to serve as habitat, natural shoreline habitats employing shallow water and natural vegetation can support more stable and diverse fish populations.

IV. Site Specific Recovery Opportunities

Summit attendees congregated according to their primary geographic area of interest: northern Illinois, Chicago, or Indiana. They were asked to identify specific restoration opportunities within each area.

Northern Illinois

- The South Unit of Illinois Beach State Park is eroding. A sand recycling program in which sand from the south is moved north and allowed to move southward by way of lake currents has been proposed as an alternative to habitat-destroying revetment construction. The project will cost $1 million, but only $500,000 is available. Additional funds are needed to control erosion in a habitat friendly manner. The continuance of a preservation ethic is required in the State Park.

this. Corridors along these waterways need to be included in the Illinois Beach State Park. However, opposition from property owners is expected.

- The Hammond Migratory Bird Trap is underway to provide songbird habitat. Planners are looking into incorporating native plants into the area. Continuing support is needed for this effort.
- The wetlands around the Clark and Pine Preserve are in danger of being filled according to the City of Gary's redevelopment plans. The wetlands will probably be listed as valuable habitats in the plans. A USEPA report of an advanced identification of wetlands in Northwest Indiana is almost complete.

A lake bottom survey was identified as crucial to future restoration efforts in each break out group's assessment.

V. Findings and Recommendations

The southern end of the Lake Michigan shoreline today bears little resemblance to its natural state. The presettlement character of both terrestrial and aquatic habitats has been highly compromised by lakefill along the shoreline, invasion of exotic species, residential and commercial development, and management practices that favor human uses of Lake Michigan resources. Most wetland and shallow nearshore habitats that are essential to fish feeding and spawning have been eliminated or degraded, resulting in a reduction of healthy native fish populations.

Any attempts to develop wildlife habitat along the shoreline faces significant challenges. The economic value of the Lake Micturrshore he Man (, r)323 Trr rtt9()4.(Mbl)-12.brre4.(M)9.3(va)4.89.3ey8e

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Appendix 2: Presettlement Dune Plants and Animals

Association (in order from lake)	Common Plants
beach	sea rocket, bugseed, beach pea, cinquefoil, wormwood, sand thistle, cocklebur
fore-dune	sand reed grass, marram grass, rye grass, winged pigweed, green milkweed, seaside spurge, mullein, sand cherry, furry willow
cottonwood	cottonwood, sand cherry, smooth and glandular willows, bittersweet, horsetail
pine	jack pines, white pines, arbor vitae, red cedar, common juniper, prostrate juniper, bearberry, shinleaf, checkerberry, prince's pine, starflower, flase lily-of-the-valley, bluebells, puccoon, horsemint, hairy phlox, st john's wort, star grass, Solomon's seal, bellwort, wild rose, staghorn sumac, dwarf sumac, aromatic sumac, red-osier dogwood, bittersweet, woodbine, poison ivy, grape
black oak	black and chestnut oaks, sassafras, shadbush, pincherry, chokecherry, hop tree, dwarf blackberry, huckleberry, blueberry, bush honeysuckle, spiderwort, bastard toadflax, anemone, columbine, rock cress, lupine, hoary pea, bush clover, wild geranium, milkweed, flowering spurge, bird's foot, arrow-leaved violets, prickly pear cactus, butterfly weed, green milkweed, wild bergamot, lousewort, blazing star, goldenrods, sunflowers, yellow daisy
mixed oak	black, chestnut, white and red oaks, slippery and red elms, basswoods, beach, hop hornbeam, yellow lady's-slipper, hepatica, May apple, Canada violet, long-spurred violet, rattlesnake root

Association (in order from lake)	Common Animals
beach	crows, herring gulls, flies, predatory ground beetles, sandpiper, piping plover, knots, godwits, curlews, willets, white ants, termites, sand-colored spider
fore-dune	beetles, gnats, flies, dragon flies
cottonwood	tree swallow, locusts
pine	bronze tiger beetle, white ants, locusts, black ant, pitch moth, downy and hairy woodpeckers, golden-crowned and ruby-crowned kinglets, black-throated green warbler, pine warbler (during migration), chickadee, ruffed grouse, red squirrel,
black oak	ruffed grouse, ant lion, six lined lizard, blue racer, hog nose (puffer adder), locusts, grass hoppers, katydids, earthworms, woodchuck, snails, millipedes, centipedes, bees,
mixed oak	73.88 0.48 refT116 279 0.48 38.04 ref260.1012 0 0 12 T*7204 ref26 11012 0

Appendix 4: Web Resources

Agency	Address	Comments
Aquatic Plant Management Society	www.apms.org	exotic plant fact sheets
Army Corps of Engineers	www.wes.army.mil	Waterways Experiment Station, links to various publications
Calumet Environmental Resource Center	www.csu.edu/cerc	links to organizations, description of library services
Center for Aquatic and Invasive Plants	aquat1.ifas.ufl.edu	pictures of plants and birds
Illinois Natural History Survey	www.inhs.uiuc.edu/cwe/rra/rra.html	Inventory of Resource Rich

USFWS	http://www.nwi.fws.gov	National Wetlands Inventory
	http://www.fws.gov/cep/coastweb.html	Coastal Habitat Conservation Programs
	http://news.fws.gov/NewsRelease/SearchDisplay.cfm?ID=267 http://plover.fws.gov	Piping Plover Critical Habitat Designation

USGS

Great Lakes Science Center

Northern Prairie Wildlife Research

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Appendix 5: Funding Sources

Name	Funder	Description	For More Information
Great Lakes Aquatic Habitat Network and Fund	Tip of the Mitt Watershed Council	small organizations for advocacy and education in Great Lakes states/provinces	http://www.glhabitat.org
The Coastal Program	US Fish and Wildlife Service	coastal states, including Great Lakes, conserve fish and habitats, balance with ecologically sound levels of public use, economic benefits, and enjoyment of natural resources, $15 million available next year. Funds	

Appendix 6: Glossary

lacustrine--aquatic sites with sparse vegetation associated with a lake or pond.

littoral transport--movement of sand and sediment by lake currents.

palustrine--wetlands with a dense stand of cattails, trees, or other persistent vegetation.

riverine--aquatic sites with sparse vegetation associated with a stream or river.

Appendix 7: Participating Organizations

Aquatic Research Institute
Biology Department, Loyola University
Bird Conservation Network ^
Cass Conservation District
Charles Stewart Mott Foundation

Southwest Michigan Land Conservancy
The Field Museum
The Nature Conservancy Great Lakes Program # ^
The Nature Conservancy, Southern Lake Michigan Rim Project *
The Nature Museum, Chicago Academy of Sciences ^
Trout Unlimited
University of Illinois at Chicago, Great Cities Initiative ^
University of Notre Dame, Department of Biological Sciences
US Environmental Protection Agency, Great Lakes National Program Office ^
US Environmental Protection Agency, Water Office ^
US Fish and Wildlife Service * ^
US Geological Survey, Great Lakes Science Center

official collaborator * presenter ^ steering committee member

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